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INFLUENCE OF MOISTURE AND SUBSTRATE ON THE EMISSION OF VOLATILE ORGANIC COMPOUNDS FROM WALL STRUCTURES

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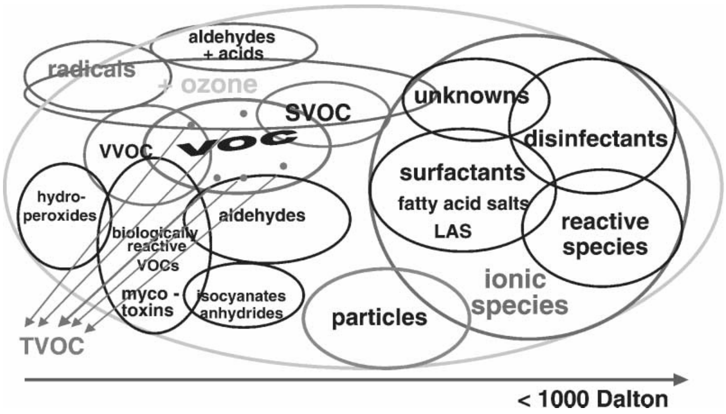

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Helsinki University of Technology
Department of Civil and Environmental Engineering
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ABSTRACT

Volatile organic compounds, VOCs, are released from a multitude of different polymer-based building materials. They can cause adverse health effects such as irritation of eyes, nose and throat, headache, fatigue, dizziness, sinus congestion, allergic reactions, and respiratory infections. This study concentrates on the influence of moisture and substrate on the emissions of VOCs from common wall structures. The structures are made up of primers and paints or adhesives applied onto either gypsum board or a combination of filler and plaster (or a single layer of plaster) which is applied onto calcium silicate bricks. An inert substrate, glass, is used as a reference substrate for single layers of paints, adhesives or plasters, and combinations of primer and paint and filler and plaster.

The experimental section of this study is preceded by a literature review where the different factors affecting the emission process is dealt with. The literature review also includes the elaboration of a mathematical model describing the emission process.

Small environmental chambers were developed for the experiments. The relative humidity of the air introduced into the chambers, the air exchange rate, and the air flow velocity over the sample surfaces could be easily controlled. Samples were exposed to different moisture conditions by adjusting the relative humidity of the air introduced into the chambers and by the use of different substrates. The emitted compounds were collected both from the chamber air and from the surface of the samples by using a Field and Laboratory Emission Cell into stainless steel tubes containing Tenax TA adsorbent.

Other tests performed in this study included infrared spectroscopy, mercury intrusion porosimetry, microscopy, and the determination of pH. These tests were mainly performed to derive additional information on the chemical and physical characteristics of the materials studied.

The experimental results demonstrated that the emission of VOCs from a surface layer is affected especially by the substrate, primer included, and by the drying process of both the substrate and the surface layer. The use of gypsum board as a substrate for either combinations of primer and paint or adhesives resulted in the lowest emission rates, while the use of a combination of filler and plaster or a single layer of plaster applied onto calcium silicate brick as a substrate resulted either in higher or lower emission rates compared with the glass (reference substrate) depending on the emission characteristics of the combination of filler and plaster. The experimental results indicated also that a high relative humidity prolongs the drying process, thus affecting the emissions because of interactions of water molecules with other emitting compounds. The consequence of this is that different compounds are emitted at different points of time.

There was a statistically significant difference after the samples had reached moisture equilibrium only in the emission rate of aldehydes at RH 20 % and RH 80 % target relative humidities for samples collected from the test chambers. The emission rate was higher for the higher humidity environment. This result applied only when different combinations of primer and paint were spread onto glass plates.

The experimental results additionally confirmed that TVOC, the total amount of VOCs being released, is not a good estimate of the behaviour of the emission of single compounds, since their behaviour, as regards relative humidity, can not always be determined based on TVOC-values. Nevertheless, it has been proven that it is possible to reach low emission rates, i.e. TVOC-values < 30 $\mu g/m^2 \cdot h$, in less than two weeks with an appropriate choice of materials and by ensuring good drying conditions.

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...to Heidi and Ebba, the loves of my life

Leif Wirtanen, Espoo, November 2005

APPENDICES

ABBREVIATIONS AND NOTATIONS

ASAFR	Area Specific Airflow Rate (m^3/m^2·h)
DRIFT	Diffuse Reflectance Unit
ESEM	Environmental Scanning Electron Microscope
FLEC	Field and Laboratory Emission Cell
FTIR	Fourier Transformed Infrared Spectroscopy
GC	Gas Chromatograph
MIP	Mercury Intrusion Porosimetre
MS	Mass Spectrometre
PLS	Partial Least Squares
$\mathrm{SER_a}$	Area specific air flow rate of a specific compound (µg/m^2·h)
SVOC	Semi-Volatile Organic Compound, boiling point range 240-260...380-400 °C
TVOC	Total Volatile Organic Compound, determined as toluene-equivalent
$\mathrm{TVOC_{SERa}}$	Area specific airflow rate of the total amount of VOCs (µg/m^2·h)
VOC	Volatile Organic Compound, boiling point range 50-100...240-260 °C

A	coefficient of relative humidity (-)
A, A_s	sample area (m^2)
ACH	air exchange rate (h^{-1})
B	constant (-)
c, C	concentration (kg/m^3)
c_a	gas-phase concentration (kg/m^3)
c_{a0}	initial gas-phase concentration (kg/m^3)
c_i	gas-phase concentration of a single compound (kg/m^3)
c_{pi}	partial vapour pressure of a single compound expressed as concentration (kg/m^3)
c_s	solid-phase concentration (kg/m^3)
c_v	equilibrium vapour pressure expressed as concentration (kg/m^3)
c_{vi}	equilibrium vapour pressure of a pure compound (kg/m^3)
c_w	concentration at a surface (kg/m^3)
c_∞	concentration in the bulk air (kg/m^3)
C_m	measured concentration
D	molecular diffusion coefficient (m^2/s)
D_a	average gas-phase diffusivity (m^2/s)
E	coefficient of temperature (-)
E_v	mass emission rate in diffusion (kg/m^{2}s)
E_w	emission rate in convection (kg/m^{2}s)
E_{wi}	emission rate of a single compound in convection (kg/m^{2}s)
H	test relative humidity (%)
$\mathrm{H_0}$	relative humidity under standardised conditions (%)
$\Delta_v H$	enthalpy of vaporisation (J)

$\Delta_v H_m$	molar enthalpy of vaporisation (J/mol)
J	species flux (kg/m²s)
k_c	convective mass transfer coefficient (m/s)
k_{ci}	convective mass transfer coefficient of a single compound (m/s)
k_l	linear partition coefficient (-)
k_s	surface/air partition coefficient (kg/s)
L, θ	thickness of a sample (m)
L_c	characteristic length (m)
ln	natural logarithm
m	mass (kg/m²)
m_i	mass of compound remaining (kg/m²)
m_0	initial mass (kg/m²)
M_a	molecular weight of air (g/mol)
$M_{i,}$ M_{VOC}	molecular weight of a compound (g/mol)
n	air change rate (h^{-1})
p	pressure (atm/bar)
p_A	partial vapour pressure of a component (atm)
p_L	vapour pressure of a liquid (atm)
P	amount of wet product applied (g)
q	adsorbed surface concentration
Q	volumetric flow of air (m³/s)
r	pore radius (m)
Re_L	Reynolds number (-)
RH	relative humidity (%)
R	gas constant (J/K mol)
S	recommended amount of paint usage (m²/l wet product)
Sc	Schmidt number (-)
Sh	Sherwood number (-)
t	time (s)
T, T	temperature (K/°C)
T_0	temperature at standardised conditions (K)
T_s	dry film thickness recommended by a paint producer (µm)
T_t	dry film thickness for testing (µm)
T_v	boiling temperature of a solvent (K/°C)
u	air velocity (m/s)
V	volume of chamber air (m³)
V_a	molar volume of air (cm³/mol)
V_s	solid content of a product (Vol.-%)
V_{VOC}	molar volume of a compound (cm³/mol)
x_A	mole fraction of a component
y	co-ordinate (m)
δ	density of a wet product (g/cm³)

δ_D	thickness of the diffusion boundary layer (m)
γ	surface tension (N/m²)
μ	viscosity (g/h m)
ρ	density (g/m³)
ν	kinematic viscosity (m²/s)
ω	contact angle (°)
Π_i	molar amount of a compound (mol)
Π	molar amount of TVOC (mol)

1 INTRODUCTION

Polymeric materials such as vinyl floorings, adhesives, wall-covering materials, plasters, sealants, thermal insulating materials, paints, and varnishes are important sources of volatile organic compound (VOC) emissions in buildings and they can emit a wide range of VOCs. VOCs have been defined by WHO as organic compounds having boiling points from 50-100 °C to 240-260 °C (WHO 1989). Some are solvent residues from the various polymerisation processes of polymer manufacturing; some are the excess unreacted monomers and co-monomers left trapped in the polymer structures; some are secondary products from the reactions of some monomers, solvents or plasticisers and some are the plasticisers used in the production of a material. (YU & CRUMP 1998)

VOCs can cause adverse health effects and initiate symptoms of the so-called sick building syndrome (WHO 1983). Common symptoms of sick building syndrome include irritation of the nose, eye and throat, headache, fatigue, dizziness, sinus congestion, allergic reactions, and respiratory infection. Most symptoms are short-term in nature and are relieved upon vacating the premises. Current research effort has, however, not been able to fully characterise the human health risk of a large number of VOCs found in the indoor environment, including the effects of synergism and secondary reactions. Therefore it must be assumed that not all compounds are in concentrations low enough to be considered harmless, particularly in the long term. (ELLACOTT & REED 1999) However, the health issues related to VOCs will not be dealt with in this work. This work concentrates on the joint effect of relative humidity and different material combinations on the VOC-emissions despite the fact that the “traditional” VOC-window, as defined by the WHO, comprises largely non-reactive species and has, thus, lost interest lately. Instead radicals, ozone, semi-volatile organic compounds, and NO_xs have gained increasing attention during the last few years as the primary targets reducing the indoor air quality. However, VOCs are the group of organic compounds that have gained most interest during the last decades, and for which there exists a relatively good international consensus as far as sample collection, analysis, and interpretation of test results are concerned. Furthermore, they are one parameter which national building material labelling schemes are based upon at least in Europe (WOLKOFF 2003).

A small environmental test chamber has been developed that meets the requirements set by the European standards (ENV 13491-1 1999) and by the author, i.e. that the operation and maintenance of the chamber should not be too cumbersome and that the relative humidity of the chamber air should be easily adjusted. The emissions of VOCs from common building materials and material combinations under controlled conditions are examined in order to clarify the joint influence of moisture conditions and substrate on the emission process. This information can undividedly be used by material manufacturers, building designers, contractors, officials and researchers dealing with issues related to indoor air quality, and the general public.

2 MATERIALS

The materials to be tested in this study are commercial products purchased from local hardware stores. Their main characteristics are presented in the following chapters very generally. Due to production secrets the author does not have detailed information on their composition, but rather has to rely on what is noted on the product information sheets provided by the producers for more specific information.

2.1 PAINTS

A pigmented coating material, in liquid, paste or powder form which, when applied to a substrate, forms an opaque film having protective, decorative or specific technical properties is a paint (EN 971-1 1996). All paints are based on the structure shown in Table 1. Major differences between paints occur between the polymers or resins that are formulated for different purposes. This is because of differences between the methods of application and cure, the nature of the substrate, and the conditions of use. The deterioration of paints that occurs in many situations is largely due to changes in the chemical nature of the film former with consequent changes in its mechanical properties.

Table 1. The structure of paints (BROCK ET AL. 2000).

Non-volatile matter	**Volatile matter**
pigments	solvents or dispersants
fillers	volatile additives
film formers	(any elimination products from stoving)
non-volatile additives	

2.1.1 Pigments and fillers

Pigments are generally finely dispersed particles that are practically insoluble in the application medium and which are used because of their optical, protective or decorative properties (EN 971-1 1996). Examples of pigments include titanium dioxide, carbon black, pearlescent pigments, and zinc phosphate (BROCK ET AL. 2000).

Aiming at improving the quality of paints, a great number of studies have been carried out to understand the role of pigments in paint formulation, fabrication, application, and durability. All the studies indicate that pigment characteristics, such as chemical nature, particle size, state of dispersion, morphology and level of pigmentation, determine the paint properties in its liquid and solid state. (PERERA 2004)

Fillers are granules or powders that are, like pigments, practically insoluble in the application medium. They are used as a constituent of paints to modify or influence certain physical properties. (EN 971-1 1996) Examples of fillers include chalk, talcum, and cellulose fibres (BROCK ET AL. 2000).

Fillers differ from white pigments primarily in their lower refractive index and also in their particle size, which is generally larger than that of pigments. The objective with fillers is to ensure that they build a compact skeleton structure with pigments in the coating material. They are used among others for: reinforcing, improving flexural, adhesive and tensile strength, controlling the degree of gloss of coatings and, since they are generally less expensive than pigments, reducing the price of a coating material. (BROCK ET AL. 2000).

2.1.2 Film formers

A film former forms a cohesive coating or paint film on a given substrate and, where relevant, holds together or embeds the other non-volatile components of the coating, particularly the pigments and fillers. Depending on their origin, film formers can be categorised into natural substances, modified natural substances, and synthetic substances. (BROCK ET AL. 2000) The following review is concentrated on alkyd resins and polymer dispersions, since these are the film formers used exclusively in this study.

2.1.2.1 Alkyd resins

Alkyd resins can be defined as polymers modified with fatty acids or fatty oils or with higher synthetic carboxylic acids. The molecules consist of a polyester backbone from which fatty acid groups project as side chains. Excess (free) hydroxyl and residual carboxyl groups are also present. The polyester component is responsible for physical drying and weather resistance, the oil component for the suppleness of the films and above all for the capacity of oxidative cross-linking. (BROCK ET AL. 2000).

With regard to the oil type or the fatty acid incorporated, alkyd resins can be categorised as drying or non-drying. Long oil alkyds, with an oil content of > 60 to 70 %, are principally used as sole film former for decorator’s paints and house paints. Thus, alkyd paints used in this study are most probably long oil alkyds. They are soluble in aliphatic hydrocarbons and they always dry by oxidation. The high oil content promotes good flow, high flexibility and easy manual processing, but also leads to relatively slow drying. If conjugate oil(s) or acid(s) are used in the resin synthesis, faster drying resins are produced. (BROCK ET AL. 2000).

2.1.2.2 Polymer dispersions

A polymer dispersion is formed by emulsion polymerisation. It is usually a relatively low-viscosity liquid. In microscopic terms it is a micro-heterogeneous system essentially consisting of roughly spherical polymer particles (“latex particles”) which are evenly distributed in a usually aqueous phase. Non-aqueous dispersions contain highly volatile, aliphatic hydrocarbons as dispersant. The latex particles used in paints are always copolymers. The main types are styrene-butadiene copolymers, vinyl acetate copolymers, pure acrylate copolymers, and styrene-acrylate copolymers. (BROCK ET AL. 2000).

As a minimum, the aqueous phase contains stabilisers such as surfactants and/or protective colloids together with decomposition products of the polymerisation initiator (BROCK ET AL. 2000). Surfactants are low-molecular substances with hydrophilic and hydrophobic molecule sections. They are used to prevent sedimentation and phase separation during polymerisation, film formation, and end-use conditions. (BUTLER ET AL. 2005). The aqueous phase may also contain plasticisers, buffer substances to regulate the pH, de-foaming agents, and preservatives (BROCK ET AL. 2000). Taken together, a water-borne paint formulation is extremely complex with a plethora of low and high molecular weight compounds (HELLGREN ET AL. 1999).

2.1.3 Solvents and dispersants

A solvent is defined as a single liquid or blend of liquids, volatile under specified drying conditions, in which the film former is completely soluble (EN 971-1 1996). Examples of solvents include butyl acetate, butyl glycol, white spirit, and water. Solvents serve primarily to adjust the viscosity of the coating material to the optimum level for a given application, and to control this level during application and film forming. However, solvents affect also e.g. the adhesion to the substrate (BROCK ET AL. 2000).

Dispersants are liquids that do not dissolve the film former(s), but instead hold them in a fine micro-heterogeneous dispersion or emulsion. Examples include water, and in non-aqueous dispersions, hydrocarbons (BROCK ET AL. 2000). Dispersions were dealt with in the preceding chapter.

A number of factors must be taken into account in choosing a solvent, including volatility, rheological behaviour, surface tension, combustibility, toxicity, odour, environmental compatibility, and cost. A solvent is, thus, generally required to be light and colourless, volatile with no residue, neutral, non-reactive or only slightly reactive, to have a slight or at least not unpleasant odour, and generally to be anhydrous, scarcely toxic, biodegradable, and moderately priced. (BROCK ET AL. 2000). Table 2 provides a summary of typical solvent contents in some coating materials.

Table 2. Typical solvent contents of paints and coating materials (BROCK ET AL. 2000).

Coating material	Solvent content (%)
Emulsion paints for interior use	0 – 2
Latex coatings (environment-friendly)	7 – 9
Alkyd resin coatings, polyester resin coatings, epoxy resin coatings, polyurethane coatings, polyester resin coatings, phenolic/urea/melamine resin coatings	40 - 50

During application and film forming, the volatile components of a paint are intended to evaporate. The speed at which this occurs influences not only the drying time but also the appearance of the final paint film. The rate of evaporation of a solvent is dependent on vapour pressure, surface tension, specific heat, molecular weight, enthalpy of vaporisation, and humidity. Both vapour pressure and boiling point of a solvent are dependent on the enthalpy of vaporisation, but there is no general correlation between these two quantities. For example, solvents forming hydrogen bridge bonds - like water, alcohols or amines - are less volatile than other solvents with the same boiling point. Since most of the factors that determine the rate of evaporation are in turn dependent on one another, it is almost impossible to make theoretical predictions about the precise extent of solvent release from a coating film. (BROCK ET AL. 2000)

For the optimum drying of a coating film, a blend of different solvents is generally required. In blends, deviations from an ideal behaviour occur which can be attributed to the interactions between the molecules of the blended components and are different for different solvents. Particularly in the case of blends containing water as one of the components, the strong interactions with this component can often lead to marked deviations from the ideal behaviour, which is expressed by Raoult's law, Equation 1.

$$p_A = x_A \cdot p_L \quad , \tag{1}$$

where p_A is the partial vapour pressure of a component, x_A is its mole fraction, and p_L is its vapour pressure as a pure liquid. The rate of evaporation of water is at the same time strongly influenced by the relative humidity. For example, if a blend of butyl glycol and water is evaporated, butyl glycol accumulates in the remaining mixture at low RH, whereas water accumulates in the mixture at high RH. At a given RH (the critical relative humidity, which is around 80 % in this case), both components evaporate approximately at the same rate and the composition of the liquid remains constant. (BROCK ET AL. 2000)

2.1.4 Paint additives

Additives are substances that are generally added in small quantities to a coating material to improve or modify one or more specific properties (EN 971-1 1996). Additives are generally subdivided into various groups, the most important of these being: de-foaming agents, surface-active additives, rheological additives, light stabilisers, dryers and catalysts or accelerators, and biocides. As some additives can influence several properties at the same time, the classification presented before is rather arbitrary. Moreover, the boundary between additives and other coating components is not always very clear, since some film formers, pigments, solvents, or even fillers are occasionally used like additives in terms of both function and of quantity added. (BROCK ET AL. 2000). The different additive groups and the main raw materials used in paints are presented in Table 3.

Table 3. Typical additives used in paints and their main raw materials (BROCK ET AL. 2000).

Coating material	**Solvent content (%)**
De-foaming and de-aerating agents	Mineral oil and silicone de-foaming agents Organic polymers, dimethyl polysiloxanes, organically modified polysiloxanes and fluorosilicone de-aerating agents
Surface-active additives (wetting and dispersion)	Surfactans which include countless substances such as ethoxylates and siloxanes
Rheological additives - thickeners - thixotropic agents	 Cellulose and polyurethane derivatives. Phyllosilicates, polyolefins, polyamides etc.
Light stabilisers	2-hydroxyphenyltriazoles, HALS¹⁾
Catalysts and driers	Salts
Biocides	Formaldehyde and its reaction products, sulphur and nitrogen containing organic compounds

1) Hindered Amine Light Stabiliser

2.2 ADHESIVES

An adhesive is defined as a non-metallic substance capable of joining materials by surface bonding (adhesion), and the bond possessing adequate internal strength (cohesion) (EN 923 1998). Thus, there are three requirements that must be met for successful adhesive application. These are: wetting of the substrate surface, solidification of the adhesive, and formation of a joint structure that is resistant to the operating stress and environment. (PETRIE 2000) Adhesives are usually comprised of a bulk polymer or polymer blend acting as a binder, a solvent, and a variety of additional components. In the following chapters is presented different bulk polymers and a short description of solvents and other material components generally used in adhesive formulations. However, the main emphasis is still on the type of adhesives used in this study.

2.2.1 Bulk polymers

Adhesives may be classified according to chemical composition, as presented in Table 4. This is not the only way to classify adhesives, but appropriate in this context. Other classifications are by function, mode of application or reaction, physical form, cost, or end-use (PETRIE 2000).

Table 4. Classification of adhesives according to origin (PETRIE 2000).

Classification	Bulk polymers	Most used forms
Thermoplastic	Cellulose derivatives, (poly)vinyl derivatives, acrylics	Liquid
Thermosetting	Urea and melamine formaldehyde, epoxies, acrylics	Liquid, but all forms common
Elastomeric	Natural and synthetic rubber, nitrile, styrene-butadiene, polyurethane	Liquid, some film
Alloys (hybrids)	Epoxy and phenolic alloys	Liquid, paste, film

Thermoplastic adhesives do not cure or set under heat like thermosetting adhesives, but they can rather be melted with application of heat and then applied to the substrate or they can be dissolved in solution and rehardened on evaporation of the solvent. Thermoplastics dissolved in water as latexes or emulsions harden on water evaporation or by water diffusion into a porous substrate (PETRIE 2000). This last group of thermoplastics belong to the common household adhesives and are also used in this study.

2.2.2 Polyvinyl acetate

Polyvinyl acetate, PVAc, is the binder of at least two of the adhesives used in this study. Polyvinyl acetate adhesives are dispersions of small droplets of PVAc in water. They set by loss of moisture, leaving the droplets to coalesce to form a continuous solid film. (TOUT 2000) PVAc dispersions have a reactive solid content of 40 - 70 %. The dispersions must be stabilised with protective colloids or emulsifying agents to prevent separation. When they are used with porous materials the majority of the water is absorbed by the substrates and the remainder, along with the small quantities of solvent which are used to keep the polymer dispersed, evaporate. (PARIS 2000) Thus, the setting times of PVAc adhesives depend on the moisture levels of the components being bonded, and the thickness of the adhesive film, but with optimum bonding conditions, i.e. low moisture content and thin gluelines, a modern PVAc adhesive will develop reasonable bond strength in about 15 minutes at normal ambient temperatures. Damp conditions and thick adhesive film will extend setting times. (TOUT 2000)

Even though PVAc- based adhesives are convenient to use, have low toxicity and a clear glueline, they have some detracting features which limit their application to non-structural uses only. The main detracting features are susceptibility to both moisture and heat, and also a tendency to creep under load. These deficiencies are primarily due to the inherent mechanical properties of the PVAc polymer and plasticisation of PVAc gluelines by moisture. (GRIGSBY ET AL. 2005) Cross-linking PVAc adhesives or the incorporation of copolymers has improved their moisture and temperature resistances compared with conventional PVAc adhesives (TOUT 2000 and GRIGSBY ET AL. 2005).

2.2.3 Adhesive additives

The properties of an adhesive resin emulsion are derived both from the polymer employed as well as the system used to emulsify the polymer in water. There are several additives necessary to stabilise and protect the emulsion and still other additives are used to adjust tack, drying time, viscosity, storage time etc. (PETRIE 2000). Adhesive additives and their main characteristics are presented in Table 5.

Table 5. Adhesive additives and their main characteristics (PETRIE 2000).

Components	**Characteristics**
Hardeners and curing agents	Combines chemically with the base resin
Catalysts	Causes the base resin to cross-link and solidify. Typically acids, bases, salts, sulphur compounds and peroxides
Accelerators, inhibitors, retarders	Controls curing rate, storage life, and working life
Solvents and water	Affects the consistency during adhesive manufacture and application. They must be completely evaporated prior to cure
Diluents	Diluents lowers the viscosity of an adhesive, but becomes part of the final product contrary to solvents
Thickeners and thixotropic agents	Maintains a reasonable thickness of the glueline through viscosity adjustment
Surfactants and wetting agents	Stabilises the adhesive emulsion
Extenders and fillers	Affects one or several adhesive properties and also reduces the concentration of other adhesive components. Common properties that can be modified e.g. by fillers are viscosity, shrinkage, strength, and electrical and thermal properties
Plasticisers and film formers	Plasticisers provide flexibility and/or elongation and may also reduce viscosity. They are, similar to diluents, non-volatile solvents for the base resin. Film formers lowers the glass transition temperature of an adhesive emulsion
Tackifiers	Besides increasing tack they also increase peel strength and decreases shear strength. Common tackifiers include aliphatic and aromatic hydrocarbons, terpenes, and esters
Antioxidants, antihydrolysis agents, stabilisers, biocides	Prolongs the service life of an adhesive

However, what was noted in the preceding chapter on paint additives applies also to adhesive additives, i.e. there are thousands of different additives that can be used in adhesive systems and many of them can influence several properties at the same time. Moreover, the boundary between additives and other adhesive components is not always very clear, which makes a classification rather arbitrary.

2.3 FILLERS, PLASTERS AND PLASTERBOARD

What is presented in the following two chapters on fillers, plasters and plasterboard is based on what is said on product information sheets and what the author knows from his own experience.

2.3.1 Fillers and plasters

Fillers and plasters are used e.g. to level interior surfaces of structures. They typically consist of 2-5 % binder that is either an organic substance, an inorganic substance, or a mixture of these, 60- 80 % inorganic filler, and 20-35 % water. The composition of fillers and plasters varies to a great extent according to their properties and purposes.

Fillers and plasters should have a strong adhesion to the substrate, small drying and curing shrinkage, no visible cracks or dents, durability against static and dynamic loading, and resistance against chemicals and water. They should also be grindable after curing.

Adhesion is very important to the performance of a plaster. Factors influencing its adhesion are filler and plaster composition and pre-treatment, smoothness, cleanliness, and strength of the substrate. The adhesion can be improved by using a primer. A primer contains usually a mixture of organic substances, which have good wetting and adhering properties.

A filler and plaster shrinks during curing. This causes two kinds of damage: cracking and denting. The tendency of a filler or plaster to shrink is dependent on temperature and humidity conditions during curing and of the water amount that is added to the powdery product. A surplus of water improves workability, but increases shrinkage leading to cracking. Cracks may damage the coating of a plastered surface.

2.3.2 Plasterboard

Plasterboard consists of a gypsum core (~93 % by weight) covered on both sides by a gypsum board liner (~6 % by weight). The additional one weight-percentage consists of moisture, starch, and other additives. The gypsum normally used originates from natural gypsum stone, recycled gypsum, and/or industrial gypsum gained from the purification of combustion gases. The gypsum that is gained from the purification of combustion gases is even purer than the one gained from the gypsum stone. Plasterboard is fabricated by mixing water, additives and calcined gypsum (flower of gypsum) and then pressing the mixture between two gypsum board liners. The liners overlap each other in a joint, which is glued together.

3 EMISSIONS FROM MATERIALS AND STRUCTURES

Research conducted for more than twenty years indicates that indoor air pollution in non-industrial buildings is affecting human comfort, health and productivity. (WHO 1983, NORBÄCK ET AL. 1990, SAMET 1990, BERGLUND ET AL. 1992, WARGOCKI ET AL. 1999, WARGOCKI ET AL. 2002) Of the different physical, chemical, and biological factors that occur in indoor air, volatile organic compounds, VOCs, have been shown to cause general discomfort, strong odour, irritation of eyes and throat, increased headache, and drowsiness. (MØLHAVE ET AL. 1986, OTTO ET AL. 1990, MØLHAVE 1991, KJÆRGAARD ET AL. 1991, JOHNSEN ET AL. 1991, HUDNELL ET AL. 1992, NIELSEN ET AL. 1997, WIESLANDER ET AL. 1997, KNUDSEN ET AL. 1999, VILLBERG ET AL. 2004)

There are a number of factors influencing the room air concentration of contaminants, which in turn are affected by long-term emission characteristics of materials. These factors include (ELLACOTT & REED 1999 taken from SPARKS 1992, SOWA 1994, WOLKOFF 1995):

A) Changes that occur during the course of the emission process due possibly to secondary chemical reactions between VOCs and other air pollutants (e.g. ozone) and adsorption/desorption effects.
B) Multiple emissions from the same material.
C) Delay in reaching equilibrium concentration gradients within the material.
D) Incomplete hardening/curing of a material applied to a surface.
E) Dilution and flushing of indoor air.
F) Pre-conditioning of a substrate or material. This may prove to be critical and is often overlooked.
G) Material inhomogeneity caused by varying thicknesses of a material.
H) Ambient temperature and humidity.
I) Possible vapour pressure effects during initial burst of VOC from wet and un-conditioned materials.
J) Human activity patterns, i.e. use of consumer products and location of occupants – occupants produce bio-effluents including aldehydes, ketones, and esters.

There are several factors that may have a significant impact on the emission rate of an organic vapour. These include the characteristic source strength of the product, product exposure to various temperatures and humidities, concentration of the organic vapour in the indoor environment, and product age. One aspect of organic sources that has a major impact on emission rates is the generation process of the organic vapour. Possible generation mechanisms influencing emission rates include chemical decomposition of the building material to produce the pollutant, off-gassing of a contaminant in the building material, and evaporation of the organic vapour due to less than equilibrium vapour pressure over the solid or liquid material. Examples of rate-limiting steps in the emission process include: (1) organic vapour production, (2) transport through the bulk phase, (3) transport through a physical barrier, or (4) diffusional transport from the building material into the room air.

Readily measured factors that might affect these steps include temperature, humidity, barrier thickness and permeation rates, face velocities, and room concentration of the organic pollutant. (HAWTHORNE & MATTHEWS 1987)

Thus, material emissions are the result of several processes, which are governed by material specific characteristics and ambient conditions. The interaction of the different processes commonly occurs, but the effects of these interactions on material emissions are somewhat complex. The emission processes and factors governing them will be dealt with in the following.

3.1 EVAPORATION AND DIFFUSION

Evidence from a variety of building investigations and systematic studies suggests that many of the materials used in buildings, either as structural components like floors and walls or as furnishings, are the main source of indoor air pollution. This is due to their large surface area and their permanent exposure to indoor air. The emission rates of indoor contaminants are effected not only by the vaporisable constituents and their concentration and distribution, but also by humidity, surface velocity, air exchange rate, temperature, substrate, and material loading factors. (BERGE ET AL. 1980, TICHENOR & MASON 1988, TICHENOR & GUO 1991, TUCKER 1991, ZHANG & HAGHIGHAT 1997)

3.1.1 Molecular migration

The lower the boiling point the greater is the vapour pressure of an agent and, thus, the higher is its volatility (emission rate). Since the vapour pressure difference between the evaporating molecule and the surrounding air is the driving force for evaporation, the emission rate of a compound increases with decreasing concentration (increased vapour pressure difference) due to dilution and flushing. A decrease in the concentration is caused e.g. by a rise in the air exchange rate. Thus, higher air exchange rates cause higher emission rates. (SOLLINGER ET AL. 1993, GUNNARSEN 1997) Material loading has the opposite effect. As the loading (area of material/volume of room, m^2/m^3) is increased the concentration increases, and the vapour pressure difference decreases decreasing the emission rate. (TICHENOR & GUO 1991, SOLLINGER ET AL. 1993, JAYJOCK 1994)

The effect of sinks in the indoor environment can also affect the emission rate. As compounds are emitted, they may adsorb to other materials, i.e. sinks. Such adsorption causes a decrease in concentration analogous to an increase in the air exchange rate and occurs as long as the concentration of a specific compound in the air is higher than the gas phase concentration within a material. Re-emission from the sink can also occur when the concentration in the air decreases reversing the concentration difference between the initially adsorbing material and the surrounding air. (TICHENOR & GUO 1991, NERETNIEKS ET AL. 1993) For similar compounds, the less volatile the compound, the more severe the sink effect (CHANG & GUO 1992, COLOMBO ET AL. 1993, CHANG & GUO 1994, POPA & HAGHIGHAT 2003). For instance, semi-volatile organic compounds, SVOCs, which are defined as compounds with vapour pressures from approximately 10^{-2} to 10^{-8} kPa and a boiling-point range of 240-260 to 380-400 °C at normal ambient temperatures (WHO 1989), have strong sink effects because of their ability to adsorb to surfaces. They exist to a high degree in the condensed phase. The sink strength of materials also increases with increasing polar forces of the sink or the adsorbed species (COLOMBO ET AL. 1993, CHANG ET AL. 1998). COX ET AL. (2001) further noted that sorbed water molecules, water being a strongly polar compound, increase the total uptake of VOC. This may be attributed to at least two causes according to the authors. Firstly, water can exist in substrates in bound or bulk form causing VOCs to dissolve into it. Secondly, water could, in case of a polymer substrate such as vinyl flooring, disrupt the dipole-dipole interactions between relatively polar polymer chains further plasticising the polymer. Additional plastification would increase the void volume within the polymer matrix possibly increasing its sorptive capacity. Thirdly, from a thermodynamic viewpoint, the system free energy of the substrate/solute system could lower the chemical potential of each sorbed species, since the free energy of a mixture of solutes is lower than for a single solute. The overall system equilibrium would then shift to minimise the total substrate/gas-system free energy. The equilibrium shift due to solute interactions would result in more molecules sorbing to the substrate.

The comments presented above regarding adsorption apply also to the desorption process from a sink. TICHENOR ET AL. (1991) noted that different sinks desorb adsorbed compounds at a different rate depending on the characteristics of the sink. There was no significant difference in the desorption rates between the two compounds studied, ethylbenzene and tetrachloroethylene, even though their adsorption rates differed depending on the sink material. JØRGENSEN & BJØRSETH (1999) also studied the sorption of organic compounds using two different VOCs, α-pinene and toluene, and two different sinks, wool and nylon carpet. The authors concentrated on the desorption phase only, because according to earlier experiments (JØRGENSEN ET AL. 1999) the uncertainty of desorption phase experiments is lower than the uncertainty of adsorption phase experiments. This is due to the dosing system used. They noted that the presence of two emitting compounds at the same time gives higher sorption compared to one compound at a time. This indicates that the desorbed masses of individual compounds are additive. Also the combination of two materials at the same time leads to higher sorption than one single material.

3.1.2 Rate of emission

The rate of emission from liquid materials is usually rapid in the beginning and reaches a peak after a short period of time (typically 0.5 – 3 h), which indicates that the emission is mainly evaporative. The emission rate also declines rapidly and some organic solvent-borne materials decline to a very low emission rate within hours of testing, whereas others, e.g. some water-borne types of paint, decline to a "steady" but still significant level in 1 – 5 days. (TICHENOR & GUO 1991, CHANG & GUO 1992, YU & CRUMP 1998, HUANG & HAGHIGHAT 2002, LEE ET AL. 2003)

In cases where the emission of a compound is not purely evaporative, diffusion of the compound within the source becomes important and starts to control the emission rate. This is the case for e.g. dry solid materials. When the diffusion of a compound to the surface of the source is slower than the evaporation rate, the rate of emission will be reduced. (TICHENOR & GUO 1991, GUNNARSEN 1997) The physical properties, i.e. size and structure (e.g. polar charges) of the migrating molecule, the structure of the material, and temperature and relative humidity, influence molecular migration within a material. The rate of diffusion of a specific compound can be expressed as a function of the diffusion coefficient, or diffusivity. The diffusivity of an individual compound in a mixture is also affected by the composition of the mixture and by any inhomogeneity in the material itself (YU & CRUMP 1998).

3.1.3 Factors affecting the emission process

CLAUSEN (1993) studied the influence of film thickness on the emission of volatile and semi-volatile organic compounds from a waterborne paint in a climate chamber. He used three different film thicknesses and the paint he used was applied to tin-plated steel sheets. The results showed that the emission rates decay slower with increasing film thickness. The emission of semi-volatile and volatile organic compounds from a waterborne paint film prior to film formation may be regarded as being controlled by evaporation, i.e. limited by diffusion through a boundary layer above the paint film. The emission after dry film formation might be controlled by either evaporation or by internal diffusion within the paint film. This depends on the emitted compounds and the interactions that occur between them. A thick film of a given paint has a larger VOC and semi-VOC mass than a thin film, but they have the same surface concentration and, thus, also the same characteristic equilibrium vapour pressure (TICHENOR ET AL. 1993). Assuming no influence of the chamber VOC and semi-VOC concentration they will have identical initial emission rates, but the thick film emission decays slower because of the larger VOC and semi-VOC mass. An uneven paint film surface can have very different film thicknesses locally, but the evaporation controlled emission rate decay is the same all over the surface because of the homogenous concentration at the surface of the paint film. This is not the case for the diffusion-controlled emission where the areas with thin film have a faster decrease of VOCs and SVOCs content than areas with thick film. The emission can not be considered as the sum of several independent sources because compounds may diffuse from the thick film to the thin film areas.

LEE ET AL. (2003) studied the influence of film thickness on the VOC emissions from a finishing varnish in a test chamber. Three different film thicknesses were examined. The results showed that the maximum concentration of VOCs in the chamber air increased with increasing film thickness. An increase in the film thickness also caused a decrease in the emission decay; a finding similar to that of Clausen presented above. The authors also noted that different compounds have different peak concentrations and are depleted at different, compound specific, emission rates.

WOLKOFF (1995) also stated that the emission process is generally controlled by either evaporation from the building material surface or by internal diffusion within the material itself or a combination thereof. The distinction between the two mechanisms should be reflected to some extent in their dependence on the air velocity and possibly the concentration in the surroundings. Individual VOCs are released, usually, in quite different amounts and with different time dependencies, i.e. different emission rates and different emission mechanisms, the latter may even change during the decay period. STROMBERG & WIND (1968) reached the same conclusion in their study on the evaporation patterns of mixed solvents in water thinnable resins. Thus, the concentration/time profiles may change drastically in particular during the early stage of the emission process (WOLKOFF 1998).

GUO & MURRAY (2000) compared the time dependence of TVOC concentration of a solvent-soluble paint and a water-soluble paint and concluded that the concentration of the solvent-soluble paint decreased with an increase in the air exchange rate. The TVOC concentration of the water-soluble paint was initially higher for the high air exchange rate (4.42 h^{-1}), but after about six hours, the TVOC concentration was higher for the low air exchange rate (0.885 h^{-1}). This result is similar to the results of the study by TICHENOR & MASON (1988), in which VOC emissions from wet materials under different air exchange rates were evaluated. Tichenor and Mason also noted that within the mixture of organic compounds emitted from a given source, the difference in emission factors for different compounds might be quite large. HANSEN (1974) further stated that different compounds evaporate largely independently from each other.

ZHANG & HAGHIGHAT (1997) studied the impact of surface air movement (air velocity and turbulent fluctuations) on the emissions from a polyurethane plastic finish varnish and a common water-based acrylic paint using a small velocity-controlled test chamber. The emission rates for the varnish decreased rapidly with time during the first few hours. The emission rates were initially higher for a high surface air velocity (v = 0.113 m/s); after 10-15 hours, the rates were higher for the low surface air velocity (v = 0.054 m/s). Thus, the higher surface air velocity caused the material emission to deplete faster. This result is consistent with the findings by KORNUM (1980) who studied the drying of coating films. The result is also consistent with both the flow boundary layer theory and the mass conservation theory. The effects of turbulent fluctuation levels on emission rates from the varnish were smaller compared to that of the surface air velocity; and unlike surface air velocity, the turbulent fluctuation levels and material emission rates have an inversely proportional relationship. The emission rates and their decay rates of the paint during the initial stage were much smaller than that of varnish; and the emission rates remained higher for the high surface air velocity during the 50-hour experimental period. The effects of turbulent fluctuation on the paint emissions were not obvious due to its weaker effect on boundary layer shear stress. The different behaviour of the VOC emissions from the paint and varnish may be due to the high water content and the relatively low content of VOCs in the paint according to the authors. The release of water vapour from the paint sample impedes the early release of VOCs because water prevents the VOCs in the paint sample from being released due to hydrogen bonding.

VAN NETTEN ET AL. (1989) came to a similar conclusion as Zhang and Haghighat in their studies on temperature and humidity dependence of formaldehyde release from building materials. They stated that the rate of release of formaldehyde from a material is a combination of various actions. These include physical and chemical actions on formaldehyde sources including the formaldehyde that is physically absorbed onto the surface of the material, absorbed by the moisture held by the material, and chemically bound either in a free form or in a polymerised form. The release from different sources is further influenced by, among others, concentration gradient, porosity, humidity, differential geometric configurations, and the bulk of the material under investigation. In order to obtain an index that compares the relative emissions from a material an average release rate can be calculated. Release rate coefficients based on surface area were noted to be a better measure of potential release than release rate coefficients based on weight (PICKRELL ET AL. 1983).

KIRCHNER ET AL. (1995) measured the specific surface of some of the materials they used in a chamber study on the adsorption/desorption of 2-butoxyethanol on indoor surface materials. The measured specific surface (surface readily available for adsorption) of the acoustic tile studied was about 10 times higher than that of a carpet backing (2.3 and 0.28 m^2g^{-1}). This was also confirmed by the visual inspection of these two materials by electronic microscopy where the compacted rock-wool fibre structure of the acoustic tile appeared much more favourable for adsorption than the alveolar structure of the carpet latex backing. Therefore, the microstructural characterisation of the acoustic tile and of the carpet was in good agreement with the adsorption experiments. JØRGENSEN ET AL. (1999) discussed the influence of specific surface area on the adsorption capacity of different materials, and speculated that the adsorption capacity of a material increases with increasing surface area.

TOPP ET AL. (2001) studied the emission from building materials in ventilated rooms. They used numerical calculations by computational fluid dynamics (CFD) and full-scale laboratory experiments and found that material emissions are a strong function of air-change rate, local air velocity, and local turbulence, since the mass transfer coefficient increases in proportion to these parameters. They also stated that the mass transfer coefficient increases in proportion to the velocity when the emission is controlled by evaporation and is unaffected by the velocity when the emission is controlled by diffusion. On the other hand, the emission always involves mass transfer across the boundary layer along the surface, which is affected by the surface air velocity and turbulence. This was noted also by Lundgren and colleagues who stated that for the majority of solid materials the rate of diffusion within the material determines the rate of emission when a reasonable air circulation above the material surface is maintained (LUNDGREN ET AL. 1999).

3.1.4 Substrate effects

GUO & MURRAY (2000) analysed and characterised emissions from both organic solvent-soluble and water-soluble paints. They noted that when comparing emissions rates obtained in chamber studies to real indoor environments the possibility of changed emission characteristics from typical substrates has to be considered.

CHANG ET AL. (1997) studied the effect of two different substrates, a stainless steel plate and a gypsum board, on VOC emissions from a latex paint in a test chamber. The test results showed significant differences in emission rates between the VOCs released from the two substrates. After the first two weeks, over 90 % of the VOCs were emitted from the stainless steel plate, but less than 20 % had left the gypsum board. Similar results were obtained by SPARKS ET AL. (1999) who used the same substrate materials as Chang and his colleagues had used. The dominant species also changed when stainless steel was replaced with gypsum board (CHANG ET AL. 1997). WOLKOFF (1998) reached a similar conclusion in his study on the influence of air velocity, temperature, relative humidity and type of gas (air vs. nitrogen) on the chemical emission from different building products. ROSÉN & ANDERSSON (1990), on the other hand, noticed only a minor influence of the substrate on solvent emission from a newly applied paint. The substrates they studied included glass and untreated and previously treated beech-veneer plywood. FORTMANN ET AL. (1998) reached a similar conclusion as Rosén and Andersson. Both studies, however, concentrated on the emissions from alkyd paints.

The development of low emitting products relies on a better understanding of the pollutant transfer at the air/material interface. This transfer will be highly dependent on the type of pollutants and materials (gas/material affinity), but also on other parameters such as the microphysical shape of the materials (porosity, roughness) and the environmental conditions (temperature, humidity) (KIRCHNER ET AL. 1995).

3.2 COMPUTATIONAL MODELLING

The emission of VOCs from building materials can be generally considered to stem from two major processes: evaporation (surface emission) and diffusion, as was described in the preceding chapters. The emission process involves diffusion through the bulk material followed by surface evaporation. Depending on which of the two is the limiting process emission is often considered as either evaporative or diffusion-controlled. Emission of VOCs from freshly applied liquid films is typically evaporative although, after an initial period of evaporation, it becomes diffusion-controlled while the emission from carpets and other dry materials is mainly controlled by internal diffusion. These two transport processes will be dealt with mathematically in the following chapters.

The emission model to be presented is based on physical phenomena, because a model that has a physical basis also provides insight into the controlling mechanisms. The applicability of a model to the results achieved in this study will be discussed in Chapter 8.

3.2.1 Surface emission

For freshly applied liquid films, e.g. paint and lacquer, the emission is generally controlled by evaporation from the surface as the drying process progresses. Resistance in the gas phase limits the mass transfer. Thus, the emission process can be described in terms of a convective mass transfer coefficient and the difference between the concentration at the surface of the material and the bulk air

$$E_w = k_c\,(c_w - c_\infty) \quad , \qquad (2)$$

where E_w is the emission rate (kg/m²s), k_c is the convective mass transfer coefficient (m/s), c_w is the concentration at the surface (kg/m³) and c_∞ is the concentration in the bulk air (kg/m³). (TOPP ET AL. 2001)

In liquids the evaporation of a compound is the dominating drying process. Analogously, the vapour pressure of the compounds in a liquid film, such as a freshly applied paint, and of the overlying air, is proportional to their concentrations. The mass transfer coefficient is, on the other hand, dependent upon the environment in which the process is taking place, including the surface air velocity and turbulence, surface characteristics, and the properties of the overlying air, i.e. its temperature and relative humidity. (HAGHIGHAT & DE BELLIS 1998)

Turbulence decreases towards a surface, which has led to the concept of a laminar (or diffusion) boundary layer, Figure 1. No definite thickness can be assigned to such a layer because turbulence changes gradually. Nevertheless, in a very thin layer close to the surface, the air is moving slowly and can be considered stagnant. Throughout this layer, flow normal to the surface corresponds to mass transfer by molecular diffusion, and the velocity gradient is constant. Further away from the surface where the flow becomes turbulent, the velocity gradient is practically zeroed, and the emission is a combined process of both molecular and turbulent diffusion. The thickness of the diffusion boundary layer, δ_D, is defined so that the layer offers the same resistance to diffusion as encountered in the combined process of molecular and turbulent diffusion. (BEEK ET AL. 1999, TOPP ET AL. 2001) There is a retardation of the fluid particle velocity in the vicinity of a surface. Thus, adjoining fluid particle layers act to retard the motion of the next layer until at a distance $y = \delta_D$ from the surface, the effect becomes negligible. The retardation of fluid motion is associated with shear stresses acting in planes that are parallel to the fluid velocity. Turbulent fluctuations do have an effect on emission rates by affecting the surface shear stress, but the relationship between them is weak. In most cases shear stress is far more affected by surface air velocity and surface roughness than turbulent fluctuation. Thus, increasing air velocities reduce the laminar boundary layer thickness, thereby increasing the mass transfer rate. (BEEK ET AL. 1999, ZHANG & HAGHIGHAT 1997)

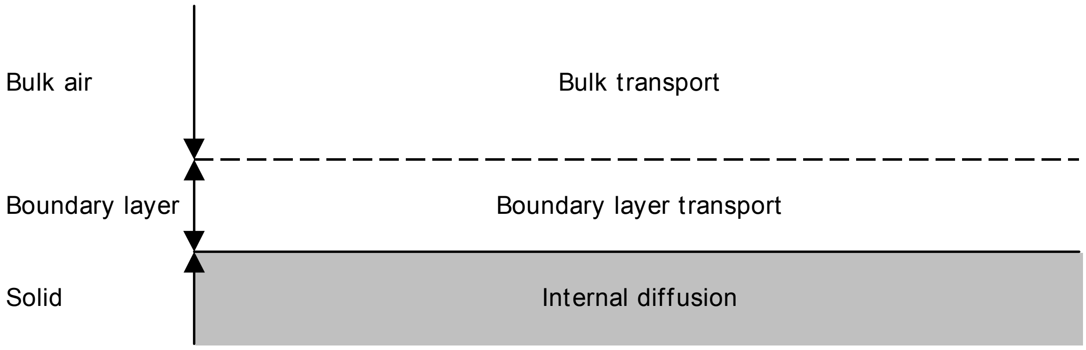

Figure 1. Processes involved in the emission of pollutants from building materials and furnishings. (TOPP ET AL. 2001)

Evaluating Fick's first law at $y = \delta_D$ yields

$$J = - D \frac{\partial c}{\partial y} \quad , \qquad (3)$$

$$E_w = \frac{D}{\delta_D}(c_w - c_\infty) \quad , \qquad (4)$$

where J is the species flux (kg/m²s), D is the molecular diffusion coefficient (m²/s), c is the concentration (kg/m³), y is the co-ordinate (m), and δ_D is the thickness of the diffusion boundary layer (m). (TOPP ET AL. 2001)

Consequently, the mass transfer coefficient can be written in terms of the diffusion coefficient and the diffusion boundary layer thickness

$$k_c = \frac{D}{\delta_D} \quad . \qquad (5)$$

Thus, the mass transfer coefficient is dependent on both the local airflow parameters and the source. (TOPP ET AL. 2001)

3.2.2 Internal diffusion

Most emission processes become diffusion controlled after an initial period of evaporative emission. Different compound phases have to be taken into account, as a compound undergoes a change in phase after crossing the physical barrier at the surface-air interface by adsorption or desorption. In the solid material, a compound assumes a solid or adsorbed phase and, in the air, a compound assumes a vapour or gas phase. (TOPP ET AL. 2001)

The fundamental equations in mass transfer within a material are Fick's laws of diffusion. Assuming diffusion in only one direction, Fick's first law, expressing direct proportionality between the concentration gradient and the species flux, is given by Equation 3.

Fick's second law expresses conservation of species

$$\frac{\partial c}{\partial t} = D\frac{\partial^2 c}{\partial y^2} \quad , \qquad (6)$$

where t is the time (s).

Since the VOC concentration in dry materials is usually low, the diffusion coefficient can be assumed to be independent of concentration. Nevertheless, it is a function of pressure and temperature. Each compound has its own diffusion coefficient, which is dependent upon its molecular weight, molecular volume, the characteristics of the material within which the diffusion is occurring, and ambient conditions. (BIRD ET AL. 2002)

At steady state, the rate of internal diffusion balances the emission from the surface and there is, thus, a relation between the compound concentration in the solid phase and the gas-phase. Under isothermal conditions this relation is referred to as an adsorption isotherm. The simplest relation is the linear model

$$c_s = k_l c_a \quad , \qquad (7)$$

where c_s is the solid-phase concentration (kg/m^3), k_l is the linear partition coefficient (-) and c_a is the gas-phase concentration (kg/m^3). (TOPP ET AL. 2001)

3.2.3 Model development

What has been discussed in the foregoing will be converted into mathematical expressions in the following. Since most of the tests in this study consist of an initial rapid, evaporation controlled emission followed by a slower diffusion controlled emission, this sequence will be maintained also in the discussion and model development presented in the following.

3.2.3.1 Surface evaporation

TICHENOR ET AL. (1993) developed a mass transfer model for surface coatings, i.e. so called wet materials, whose emissions are controlled by evaporation from the surface. This model, called the VB-model, is based on Equation 4. The model can be applied to both individual compounds or mixed solvents with the following characteristics:

1) All freshly applied liquid surfaces have the same equilibrium vapour pressure (expressed as concentration), c_v which is characteristic of that product. c_v is independent of the amount of coating applied.

2) As the coated surface ages, the vapour pressures of the remaining VOC gradually decrease. The vapour pressure during the ageing period, c_w is assumed to be proportional to the mass of VOC left, m. $c_w = c_v(m/m_0)$, where m_0 is the initial mass of VOC applied (mg/m²).

3) The average gas-phase diffusivity, D_a, of solvent molecules can be represented by the diffusivity of the most abundant component in the solvent mixture and can be obtained e.g. through theoretical calculations.

The emission rate E_w in the VB-model is thus expressed as:

$$E_w = k_c\,(c_v\,(m/m_0) - c_\infty) \quad . \qquad (8)$$

GUO ET AL. (1999) estimated the rate of emissions from solvent-based indoor coating materials based on the knowledge of product formulation. They noted that the decay rate of individual VOC-compounds is related to their vapour pressure. This result was consistent with earlier findings by STROMBERG & WIND (1968), SULLIVAN (1975), and CHANG & GUO (1994).

GUO ET AL. (1998) developed a new model based on the VB-model. They estimated the emission of individual compounds. The result from their work is called the VBX-model, and it is presented in the following paragraphs.

The basic mass transfer process for an individual compound is the same as that for TVOC presented in the VB-model. Thus the mass transfer equation for a single component is:

$$E_{wi} = k_{ci}\,(c_{pi} - c_i) \quad , \qquad (9)$$

where subscript i represents component i and c_{pi} the partial pressure for i. According to Raoult's law, the partial pressure for an individual component in a solvent mixture is determined by:

$$c_{pi} = c_{vi}\, x_i \quad , \qquad (10)$$

where c_{vi} is the vapour pressure for the pure compound i (kg/m³) and x_i is the dimensionless molar fraction of i in the solvent mixture. By definition,

$$x_i = \left(\frac{\Pi_i}{\Pi}\right) \quad , \qquad (11)$$

where Π_i and Π are the molar amounts in the source for component i and TVOC, respectively, i.e.

$$\Pi_i = m_i/M_i \quad , \qquad (12)$$

$$\Pi = \Sigma\Pi_i \quad , \qquad (13)$$

where m_i is the amount of i remaining in the (kg/m²) and M_i is the molecular weight of i (g/mol). As the source emits, both Π_i and Π change. Substituting Equations (10) and (11) into (9) gives:

$$E_{wi} = k_{ci}\,(c_{vi}\left(\frac{\Pi_i}{\Pi}\right) - c_i) \quad . \qquad (14)$$

Determining Π by summing Π_i for all the individual components is a challenge in analytical chemistry and makes the model very complicated. The authors propose to use the molecular weight of the most dominant species in the solvent mixture to approximate the average molecular weight of the total mixture as was also proposed for the VB-model. (GUO ET AL. 1998)

3.2.3.2 *Internal diffusion*

The mathematical expression for internal diffusion presented in the following has been elaborated by LITTLE ET AL. (1994) and COX ET AL. (2002). Fick's second law, Equation 6, is the governing equation describing one-dimensional transient diffusion. The initial assumption is that the VOCs are evenly distributed throughout the sample. An additional assumption is that the flux out of the sample occurs only through one plane, i.e. the bottom and the edges of the sample are sealed. A second flux condition is imposed through a mass balance of VOCs in the chamber air. This can be expressed by three terms: the accumulation of VOC in the chamber air, the mass flux diffusing out of the sample, and the VOC leaving the chamber in the out-flowing air steam. This can be expressed as

$$\frac{\partial c_a}{\partial t} V = - D A \left. \frac{\partial c_s}{\partial y} \right|_{y=L} - Q c_a \qquad , \qquad (15)$$

where c_a is the concentration of VOC in the chamber air, Q is the volymetric flow rate of air through the chamber, V is the volume of air in the chamber, and A is the sample area. Equilibrium is assumed to exist between the bulk and surface concentration of the sample and also between the surface concentration of the sample and the chamber air. This results in Equation 16, the assumption of a linear relation between the surface and the gas phase concentration of a specific VOC. Combining Equations 15 and 16 yields the appropriate boundary condition, Equation 17.

$$c_w = k_l c_a \qquad (16)$$

$$\left(\frac{V}{A \cdot k_c} \right) \left. \frac{\partial c}{\partial t} \right|_{y=L} + \mathrm{D} \left. \frac{\partial c}{\partial t} \right|_{y=L} + \left(\frac{Q}{A \cdot k_c} \right) c \Big|_{y=L} = 0 \qquad . \qquad (17)$$

A solution to Equation 17 considering the initial and boundary conditions given is

$$c(y,t) = 2\, c_0 \sum_{n=1}^{\infty} \left\{ \frac{\exp(-D q_n{}^2 t)(h - k q_n{}^2)\cos(q_n y)}{\left[L(h - k q_n{}^2)^2 + q_n{}^2 (L + k) + h \right] \cos(q_n L)} \right\} \qquad , \qquad (18)$$

where

$$h = \frac{Q}{A D k_c} \qquad , \qquad (19)$$

$$k = \frac{V}{A k_c} \qquad , \qquad (20)$$

and the q_n values are the roots of

$$q_n \tan(q_n L) = h - k q_n^2 \quad . \qquad (21)$$

Equation 18 gives the VOC concentration in a sample as a function of distance from the base of the sample and time. An expression for the mass emission rate, E_v, may be derived from that equation according to (COX ET AL. 2002)

$$E_v = AJ(y,t)\Big|_{y=L} = -AD \frac{\partial c(y,t)}{\partial y}\bigg|_{y=L} \quad . \qquad (22)$$

The VOC concentration in the air is obtained from the experimental results and the partition coefficient achieved according to Equation 34, which will be presented in chapter 3.2.3.5 on model parameters. Thus, the VOC concentration at the sample surface may be estimated using Equation 16.

3.2.3.3 Sinks

The models presented above do not take into account the sink effect of the test chamber walls. DUNN & TICHENOR (1988) were among the first to include a sink term in their VOC emission model. Later, TICHENOR ET AL. (1991) modelled indoor sink behaviour assuming mono-molecular adsorption for which the Langmuir isotherm can be applied. Assuming that the occupied adsorption sites are a small fraction of the total available sites, linear adsorption behaviour can be presumed. Their test results (TICHENOR ET AL. 1991) showed that the Langmuir equilibrium was applicable for adsorption at low concentrations while the desorption process showed different behaviour. Nevertheless, COX ET AL. (2002) evaluated the chamber sink effect assuming a linear and instantaneously reversible equilibrium relationship to exist between a stainless steel surface and the chamber air. This can be expressed as

$$k_s = \frac{q}{c_a} \quad , \qquad (23)$$

where q is the adsorbed surface concentration and k_s is the surface/air partition coefficient. k_s has units of mass per surface area (A_s)/gram per volume (V). A_s is the exposed area of stainless steel within the chamber. The mass balance for VOC in the empty chamber yields

$$\frac{dq}{dt} A_s + \frac{dc_a}{dt} V = - Q c_a \quad . \qquad (24)$$

If the gas-phase concentration in the chamber air at time zero is c_{a0}, then combining Equations 23 and 24, and integrating, results in (COX ET AL. 2002)

$$\ln\left(\frac{c}{c_{a0}}\right) = -\left(\frac{Q}{V + k_s A_s}\right)t \quad . \tag{25}$$

Equation 25 can be used to determine the value of k_s from experimental data. A similar analysis may also be applied when a sample is present in the chamber. The incorporation of the adsorbed phase may be expressed simply as an increase in the chamber volume equal in magnitude to k_sA_s. This solution may be applied with Equation 20 as follows (COX ET AL. 2002):

$$k = \frac{V + k_s A_s}{Ak_c} \quad . \tag{26}$$

3.2.3.4 *Relative humidity*

A model that takes into account the relative humidity of the surrounding air was developed by BERGE ET AL. (1980). It was developed for modelling formaldehyde emissions in a closed system, i.e. a space without ventilation or concentration gradients in the surrounding air. The influence of temperature and relative humidity on the steady state formaldehyde concentration, C, is described as:

$$\mathrm{C} = \frac{\mathrm{C_m}}{[1 + \mathrm{A}(\mathrm{H} - \mathrm{H_0})]\mathrm{e}^{-\mathrm{E}\left(\frac{1}{\mathrm{T}} - \frac{1}{\mathrm{T_0}}\right)}} \quad , \tag{27}$$

where, $\mathrm{C_m}$ is the measured formaldehyde concentration, A is a coefficient of relative humidity whose optimum value is 0.0175, H is the test relative humidity (%), $\mathrm{H_0}$ is the relative humidity under standardised conditions (%), E is a coefficient of temperature whose optimum value is 9799, T is the test temperature (K) and $\mathrm{T_0}$ is the temperature at standardised conditions (K). (BERGE ET AL. 1980) The standardised relative humidity is 50 % and the standardised temperature is 23° C according to ENV 13419. The temperature used in this study was 21° C during sample collection for all samples, which gives a temperature correction factor of 0.798. GODISH & ROUCH (1985) found good agreement between experimentally measured formaldehyde concentrations and the level determined using the Berge equation.

Another, empirical, function was presented by DUNN & TICHENOR (1988) to apply for VOCs. It has the following expression:

$$E = -12.28 + 0.6155\,T + 32.28\,ACH/RH \quad , \qquad (28)$$

where E is the emission rate factor (mg/h g), T is the temperature (° C), ACH is the air change rate (h^{-1}), and RH is the relative humidity (%).

3.2.3.5 Model parameters

The variables that are most difficult to specify in the models presented in the foregoing sections are the initial mass of the VOC applied, the thickness of the diffusion boundary layer or alternatively the material/air partition coefficient, and the diffusion coefficient. However, the initial mass of VOC can be approximated from product formulation. Values for the partition and diffusion coefficients can be found in the literature, but the information is rather scarce. They can also be approximated according to the following equations.

In all viscous flows, the controlling parameter is the Reynolds number, which links the inertial force to the viscous force:

$$Re_L = \frac{uL}{\nu} \quad , \qquad (29)$$

where Re_L is the Reynolds number (-), u is velocity (m/s), L is a characteristic length (m) and ν is the kinematic viscosity (m^2/s).

SPARKS ET AL. (1996) derived the correlation between the Sherwood number (Sh) and the Reynolds number (Re) from experimental data:

$$Sh = 0.33\,Re^{2/3} \qquad (30)$$

This result is very close to the expression for mass transfer during laminar flow with a stationary interface and an air-velocity, $\nu_x = \nu_\infty$ sufficiently far from the interface for which the following applies:

$$Sh = 0.332\,Re^{1/2}Sc^{1/3} \quad , \qquad (31)$$

where Sc is the Schmidt number, which is the measure for the ratio between the thicknesses of the hydrodynamic and concentration boundary layers, i.e. the ratio of viscous diffusion to the diffusion of mass. (BEEK ET AL. 1999) The Schmidt number is expressed as

$$Sc = \frac{\nu}{D} \quad , \qquad (32)$$

where ν is the kinematic viscosity (m²/s) and *D* is the mass diffusivity.

The boundary layer theory for mass transfer defines the Sherwood number as

$$Sh = \frac{k_c L}{D} \qquad (33)$$

where *L* is the characteristic length of the source, i.e. the square-root of the source area (m) and *D* is the diffusivity of the pollutant. Combining Equation 33 with the expression for the Reynolds number, Equation 29, and the relation between the Reynolds number and the Sherwood number, Equation 30, gives an expression for the partition coefficient:

$$k_c = 0.33\, D_a L_c^{-(1/3)} \left(\frac{u\rho}{\mu} \right)^{2/3} \quad , \qquad (34)$$

where D_a is the diffusivity of VOC in the air (m²/h), L_c is the characteristic length of the source, i.e. the square-root of the source area (m), *u* is the air-velocity over the source (m/h), ρ is the air density (g/m³), and μ is the viscosity of the air (g/h m). L_c and *u* can be obtained from the experimental set-up, ρ and μ can be found in the literature, and D_a can be calculated according to the FSG method (FULLER ET AL. 1966):

$$D_a = \frac{10^{-3} T^{1.75} \sqrt{M_r}}{p \left[V_a^{1/3} + V_{VOC}^{1/3} \right]^2} \quad , \qquad (35)$$

where *T* is the temperature (K), $M_r = (M_a + M_{VOC})/M_a M_{VOC}$, i.e. the molecular weight of air and the specific VOC (g/mol) respectively, *p* is the pressure (atm), V_a is the molar volume of air (cm³/mol) and V_{VOC} is the molar volume of the specific VOC (cm³/mol).

MEININGHAUS ET AL. (2000b) estimated the partition coefficient for combinations of *m*-xylene and *n*-octane with several indoor materials using both a micro-balance set-up and a CLIMPAQ-method. The micro-balance set-up gave a linear or almost linear relationship between gas phase concentration and adsorbed mass at steady state. This relationship gave the partition coefficient, K_p, which is dimensionless. There were some discrepancies between the results from the two test set-ups, but these were related to limitations in the micro-balance method and different experimental conditions. The limitations comprised limited sensitivity of the micro-balance, fluctuations in water levels present in the samples that may hide or vary VOC adsorption effects, and errors caused by the analytical process.

In another study, MEININGHAUS ET AL. (2000a) used two CLIMPAQs to determine the effective diffusion coefficient, sorption capacities, partition coefficients, and $t_{0.25}$-values for several different building materials using ethyl acetate and *n*-octane. The $t_{0.25}$-value indicates the time until the concentration of a compound had dropped to one-fourth of its initial value. The partition coefficients determined from the two studies presented above are shown in Table 6.

Table 6. Partition coefficients for different VOCs and building materials according to MEININGHAUS ET AL. (2000a) and MEININGHAUS ET AL. (2000b).

Material	**Partition coefficient, k_c**		
	***m*-xylene**	***n*-octane**	**ethyl acetate**
wallpaper	1.21	0.211	-
acrylic paint on wallpaper	0.720	0.140	-
carpet (not specified)	1.028	0.226	-
carpet with SBR backing	-	0.381	0.170
PVC	0.360	0.010	-
aerated concrete	0.144	0.043/0.120	>2.614
solid concrete	-	0.031	>0.590
brick wall	-	0.016	0.129
gypsum board	0.010	0.010/0.105	0.133

COX ET AL. (2001) also measured the partition and diffusion coefficients for VOCs ranging from n-butanol to n-pentadecane and water vapour in vinyl flooring using a micro-balance. Their studies showed that both the material/air partition coefficients and diffusion coefficients are independent of concentration. For the four alkanes (n-decane, n-dodecane, n-tetradecane, and n-pentadecane) studied, the partition coefficient increased with increasing vapour pressure while the diffusion coefficient decreased with increasing molecular weight. This result was similar to the findings by LITTLE ET AL. (1994) and BODALAL ET AL. (2000). The simultaneous sorption of a binary mixture showed to be non-competitive, which is consistent with the linear partitioning mechanism emphasised also by Meininghaus and his colleagues mentioned before. On the other hand, HE AT AL. (2004) concluded that the diffusion coefficient decreases with increasing molecular weight, but that the partition coefficient decreases with the increase of vapour pressure. They obtained their values for the diffusion and partition coefficients by fitting existing emission data from small-scale chamber measurements through regression.

LITTLE ET AL. (1994) and BODALAL ET AL. (2000) also measured the partition and diffusion coefficients for different materials and VOCs tested based on emission results. Even though the experimental set-ups for these three studies differed, their results were similar and are presented in Table 7. The partition coefficients achieved by Meininghaus and his colleagues differ from that of the three other studies because of the different mathematical expressions used. This also makes it impossible to compare the values in Tables 6 and 7 with each other.

Table 7. Partition and diffusion coefficients for different building materials according to LITTLE ET AL. (1994), BODALAL ET AL. (2000), COX ET AL. (2001), and HE ET AL. (2004).

Experimenter / material	**Partition coefficient (-)**	**Diffusion coefficient (m²/s)**
Little et al. / carpets	1 – 450,000	$6.0\times10^{-14} - 10.2\times10^{-12}$
Cox et al. / vinyl flooring	78 – 420,000	$6.7\times10^{-14} - 3.6\times10^{-12}$
Bodalal et al. / carpet, vinyl floor tile, and plywood	348 – 27,000	$8.6\times10^{-13} - 1.6\times10^{-10}$
He et al. / acoustic ceiling tile, carpet, gypsum board, orient stranded board, particle board, plywood, sub floor tile, and under pad	86 - 276,000	$1.5\times10^{-13} - 10.5\times10^{-10}$

CLAUSEN ET AL. (1993) found that, for a given product, the partition coefficient is related to the film thickness according to:

$$k_c = k_{ce}/\theta \quad , \tag{36}$$

$$k_c = k_{cd}/\theta^2 \quad , \tag{37}$$

where k_{ce} denotes evaporation-controlled emission, k_{cd} denotes diffusion-controlled emission, and θ is the film thickness (m). Equations 36 and 37 provide a way to adjust k_c when the film thickness changes. CHANG & GUO (1994) noted that, for an individual VOC in a given product, the partition coefficient can be related to its vapour pressure.

$$\frac{k_{c1}}{k_{c2}} = \frac{p_1}{p_2} \tag{38}$$

Based on what has been presented in the preceding chapters, the applicability of a deterministic model based on the mass balance in the climate chamber will be evaluated in this work.

4 INFLUENCE OF MOISTURE ON EMISSIONS

4.1 POLARITY, HYDROPHILICITY AND LIPOPHILICITY

GEHRIG ET AL. (1993) and CHANG ET AL. (1997) noted that compounds with more polar oxygen containing functional groups show lower emissions from a liner-covered gypsum plate and from a wood chip wallpaper than from a glass or stainless steel plate.

WOLKOFF ET AL. (1993) modelled the emission process from different building products using a Field and Laboratory Emission Cell (FLEC) in their tests. They observed that maximum chamber concentrations were generally reached within two hours at an air exchange rate of 342 h^{-1} for non-polar volatile organic compounds or volatile organic compounds having a low boiling point. Polar and high boiling volatile organic compounds required 25-75 hours at the lowest air exchange rate, 171 h^{-1} to reach maximum chamber concentration. According to the authors, one rationale for this result could be that the non-polar, low boiling compound establishes a concentration gradient within the material relatively faster than the more polar, high boiling volatile organic compounds.

COLOMBO ET AL. (1993) studied the adsorption of vapours of different polarity on a carpet made of nylon fibre with a SBR backing, a gypsum board, and a blown vinyl wall coating. Their experiments showed that adsorption seems to occur to at least two different sinks, i.e. adsorption sites with different rate constants in the same material. They also concluded that generally adsorption increases with the boiling point of the compounds, but that it also depends on other physicochemical properties, such as the chemical functionality of the compounds, as well as on the sorbent material. One of the main criteria for the selection of a compound for adsorption testing was the lipophilic or hydrophilic character of the compound, a feature that is more important than polarity according to their experience.

In their study on the retention capacities (RC values), i.e. how strongly a VOC is held back by a building material, for different materials MEININGHAUS ET AL. (1999) showed two evident features of the RC values, which were partly overlapping. These were: an increase of RC values, i.e. the compound is held back by the material more strongly, with increasing boiling point of the compounds, and higher RC values for hydrophilic compared to lipophilic compounds.

The highest RC values were found for the carpet and gypsum board studied, for which the differences between lipophilic and hydrophilic compounds were more pronounced. In this case, presumably the capacity of the compounds to form hydrogen bonds was the discriminating factor. An interesting difference could be noticed between the RC values of linalool and menthol. Although menthol has a higher boiling point, linalool has significantly higher RC values with the exception of gypsum board and a carpet with polyamide tuft and polypropylene backing where the values were similar. This points to an influence of the molecular structure (linear vs. ring) or the degree of unsaturation as influencing factors according to the authors. (MEININGHAUS ET AL. 1999)

In another study MEININGHAUS ET AL. (2000b) observed different adsorption behaviours of *m*-xylene and *n*-octane on typical indoor materials under controlled relative humidity (45 %) and temperature at ambient pressure. The materials included wallpaper, carpet, acrylic paint on wallpaper, PVC, aerated concrete, gypsum board, marble, and wooden parquet. They stated that since *m*-xylene, in contrast to *n*-octane, has a weak permanent dipole, and due to the π-electrons of the aromatic structure, it can be easily polarised. Interactions between *m*-xylene and a material surface will therefore be based on combinations of dispersion, dipole-dipole and dipole-induced dipole interactions, whereas for *n*-octane only (weak) dispersion interactions will contribute.

KIRCHNER ET AL. (1995) studied the adsorption and desorption behaviour of 2-butoxyethanol on six different building materials in a chamber. They noticed that since 2-butoxyethanol is miscible in water, increasing the liquid water content in the chamber would tend to lower its gas-phase concentration and/or its retention efficiency on the Tenax tubes. Therefore they would rather privilege a kind of "liquid water content effect" (in the chamber and/or the adsorbent sampling tubes) than an "adsorption on the walls effect" to explain their observed chamber sink, i.e. adsorption of volatile compounds on the chamber walls.

4.2 THE INFLUENCE OF MOISTURE ON THE SORPTION OF ORGANIC COMPOUNDS

DUNN & TICHENOR (1988) observed in their study where they modelled chamber sink-effects mathematically that the air change rate of the chamber must be adjusted to compensate for the increasing relative humidity in order to maintain a constant emission rate factor. Increasing the air change rate will increase the emission rate factor more rapidly at a low relative humidity than at a high relative humidity. Increasing relative humidity will, on the other hand, offset the effect of increasing the air change rate, particularly at high air change values. The authors speculated that the reason for the noted effect was that the increasing humidity might have conditioned the adsorptive sites in their test chamber.

GOSS & EISENREICH (1996) studied the influence of relative humidity on the adsorption equilibrium of VOCs from the gas phase onto different minerals and a mineral mixture. They found an exponential decrease of the adsorption coefficients (weaker adsorption) of all tested compounds which included alkanes, aromatic and chloroaromatic compounds, alcohols, ketones, and ethers, between 30 % and 90 % RH. Below 30 %, the influence of the relative humidity was even stronger. They hypothesised, based on this and also their earlier studies (GOSS 1992 and 1993), that this result is valid for all minerals in general. They also stated that the extrapolated adsorption coefficients at 100% RH agrees with those reported for a bulk water surface. At close to 100% RH, the adsorbed water film apparently was thick enough to prevent influence of the mineral surface on adsorption. They also noticed that the adsorption of organic vapours to a mixture of minerals was equal to the sum of the contributions of the single minerals.

The sorption of organic vapours to mineral surfaces may generally occur by three different mechanisms according to PENNELL ET AL. (1992). These are: adsorption from the vapour phase to the pure mineral surface, adsorption on the surface of a water film that is adsorbed on the mineral, or dissolution into an adsorbed water film. The relative importance of these different sorption mechanisms varies with varying humidity. Adsorption at the interface between the mineral and an adsorbed water film as another sorption mechanism can be ruled out since non-polar and most polar organic compounds cannot effectively compete with water for adsorption sites on a pure mineral surface. However, organic matter usually dominates the sorption of organic compounds from the aqueous phase.

The sorbent can affect the adsorption equilibrium in two ways: by the number of available adsorption sites, which is proportional to the specific surface area and linearly related to the adsorption coefficient, and by the affinity that an adsorption site has for the adsorbate. (GOSS & EISENREICH 1996, RUIZ ET AL. 1998) Thus, the actual surface area available for adsorption of any given compound depends on whether the adsorbate molecule can reach the adsorbing sites. The larger the adsorbate molecule relative to the pore size of the adsorbate, the less adsorption is expected to occur at any given relative vapour pressure. (AMALI ET AL. 1994)

GOSS & EISENREICH (1996) also concluded that the adsorption of alkanes is dominated by dispersion interactions (induced dipole interactions with the surface are neglected) and can thus be used to characterise the dispersive component of the surface free energy of the adsorbents. The adsorption interactions of the aromatic compounds are also dominated by dispersion forces, with hydrogen bonds and dipole interactions (where it applies) being of less importance. The oxygen-containing carbohydrates show a stronger deviation from this order. Their adsorption is dominated by the formation of hydrogen bonds with the hydrated surface. RUIZ ET AL. (1998) reached a similar conclusion and stated further that whilst organic compounds compete with water molecules for adsorption sites, due to the strong dipole interactions of the polar water molecules, they displace the non-polar organic molecules such as aliphatic and aromatic hydrocarbons. In the case of polar compounds, the interactions with the adsorption sites are of the same intensity as of water, and the reduction in adsorption is significant only at low VOC concentrations.

MEININGHAUS ET AL. (2000a) studied the sorption and diffusion of volatile organic compounds in different building materials. They observed large differences in the sorption capacities for *n*-octane and ethyl acetate especially for different concrete samples. They hypothesised that this was attributed to the ability to form hydrogen bonds, because ethyl acetate, in contrast to octane, can act as a hydrogen bond base via the oxygen of its ester group. Additionally, the presence of pores and capillaries could be an important parameter according to the authors. At 45% RH, water condensation may take place in the pores. Henry's law constants are a measure for the solubility of a species in water. For *n*-octane and ethyl acetate they differ over several orders of magnitude being 3×10^{-4} M/atm and 5.9-7.4 M/atm, respectively. The solubility of a compound in capillary-condensed water in materials could therefore explain different sorption behaviours. (They also studied whether hydrolysis would explain the differences in the sorption behaviour of *n*-octane and ethyl acetate, and concluded that the hydrolysis reaction does not contribute to the sink effect.)

COX ET AL. (2001) found in their study on the partition and diffusion coefficients for a selection of VOCs and water vapour in a vinyl flooring that water vapour is rapidly absorbed in the flooring compared with the other compounds. It reached equilibrium after about one hour while n-dodecane required about 25 hours and phenol required about 60 hours to reach equilibrium. When the authors compared the individual uptake curves for water vapour and phenol to the curve for their binary system, there was no observable difference in the overall uptake until about three hours. After this, the vinyl flooring specimen exposed to the two-component gas stream took up more mass than would be expected if the sorption processes were completely independent. Similar results were obtained for the n-dodecane and water vapour system. The test results for both systems suggested that sorbed water molecules increase the total uptake of VOCs.

The apparent increase in sorption capacity of VOCs in vinyl flooring in the presence of water may be attributed to several causes according to the authors. Firstly, water can exist in polymers in bound or bulk form (SAMMON ET AL. 1998). Consequently, VOCs could dissolve into bulk water that may be present in the pores of the vinyl flooring. However, the relatively small vinyl flooring/water vapour partition coefficient suggests that little bulk water is present in the vinyl flooring. Even if all the water in the vinyl flooring at equilibrium was in bulk form, calculations using Henry's law constants for phenol and n-dodecane show that the VOC mass absorbed into the bulk water would be small compared to the apparent increase in sorption capacity of the vinyl flooring in the presence of water vapour. Therefore, dissolution in water alone can not account for the observed increase in sorption capacity.

Another possible mechanism is that bound water molecules could disrupt the dipole-dipole interactions between the relatively polar PVC chains effectively further plasticising the PVC in the vinyl flooring (TSUKRUK ET AL. 2000). Additional plastification would increase the void volume within the PVC matrix, possibly increasing its sorptive capacity.

From a thermodynamic viewpoint, the free energy of the vinyl flooring/solute system is lower for the mixture of solutes than for a single solute. System free energy is the sum of the chemical potential of each species present in the system. Molecular interactions between solute species sorbed to the vinyl flooring could lower the chemical potential of each sorbed species. Overall system equilibrium would then shift to total gas/solid system free energy. The equilibrium shift due to solute interactions would result in more molecules sorbed to the vinyl flooring. The higher apparent sorptive capacity of the vinyl flooring/phenol/water system compared to the vinyl flooring/n-dodecane/water system could result from greater affinity between phenol and water. Phenol and water have similar polarities, which may create a lower free energy state compared to the vinyl flooring/water/dodecane system. (TSUKRUK ET AL. 2000)

4.3 THE INFLUENCE OF MOISTURE ON EMISSIONS

Moisture can enable, promote, or change chemical reactions in building materials. Moisture also enables the growth of moulds and other micro-organisms in building materials, and the formation of volatile compounds generated by them. The adverse effects caused by moisture usually require a high and long-standing moisture load. Problems caused by a long-standing and severe moisture load together with an estimate of moisture contents that may cause damage of building materials are presented in Table 8.

Table 8. Examples of structures exposed to moisture or alkaline moisture, estimated threshold values leading to damage, and generated emissions (SAARELA 1992 and 1999).

Material	RH of the material (%)	Damage and emission
PVC mats and covers in damp structures	>95	Staining, decomposition reactions, 2-ethyl-1-hexanol
Water-soluble paints	>95	Saponification, material specific products of hydrolysis
Water-based glues in damp structures	>85-95	Saponification, material specific products of hydrolysis
Urea-formaldehyde based resins in lacquers and binding agents in insulations	>60-70	Degradation, formaldehyde
Two component paints, injection resins, plastic fillers	Material specific	Inhibition of curing reactions, monomer emissions
Micro-organisms	>85	Bio-aerosols, volatile organic compounds generated by micro-organisms (MVOC)

The influence of moisture on materials may consist of hydrolytic degradation reactions and thereby induced emissions. For instance resins used as binding agents may degrade in unfavourable conditions, i.e. when the moisture load is high. This may result in emissions of formaldehyde and higher aliphatic and aromatic aldehydes, such as benzaldehydes and its derivatives, and ketones. (SAARELA 1992)

Moisture that evaporates from wet cement based-materials is alkaline and causes alkalihydrolytic reactions in many polymeric materials. Some phtalic plasticisers included in PVC carpets and also other materials may degrade in damp, alkaline conditions. This kind of degradation results in e.g. 2-ethyl-1-hexanol that gives damaged PVC materials their characteristic, strong smell. Alkaline moisture, especially when it includes ammonia caused by a degradation reaction, also causes staining of materials such as the discoloration of oak, and it may also generate stains observed on PVC carpets. (SAARELA 1992)

Besides the hydrolytic degradation reactions of polymers presented above, moisture also hinders the curing reactions of in situ cured resins. This results in a change in the proportions of the components taking part in the curing reactions and thus leads to incomplete curing and, as a consequence, emission of non-reacted monomers from the resin. (SAARELA 1992)

Water and moisture are often factors of decisive importance in connection with many substances' release from or binding to the surface of a material. The properties of the individual material are often of course important, but under practical circumstances water of some sort is always present, which often is of greater importance to the release of the substances to the surroundings than the material components themselves. Through interaction between the potential decontamination product and water, micro-atmospheres are created where contamination can take place. (NIELSEN 1987)

Acidity of the water, its pH-value, is of importance to the potential pollutants, which can be ionised. If the potential pollutant is an amine, it is bound in a water phase whereas it can be released on an alkaline surface, e.g. concrete. Conversely, the acids will be bound on alkaline surfaces and be released if these are, or become, acid. In addition to the fact that water is of importance to substances, which can be ionised, it might influence other non-ionisable matters too, i.e. those forming azeotropic (a mixture of liquids that has a constant boiling point) mixtures together or with water. These could be water-soluble as well as insoluble. (NIELSEN 1987)

In connection with indoor climate many different substances are often present and it can be difficult to calculate the mechanisms behind the decomposition of a material. The presence of water consequently may have the effect that adsorbent substances from a surface of a material can be "lifted" into a ventilating gas phase. (NIELSEN 1987)

There are two distinct features characterising the studies about the influence of water on the emission of organic compounds from different building materials. One concerns studies conducted mainly in the 1980s, which concentrate on the emission of formaldehyde. The other concerns the correlation between emissions and relative humidity. These are conducted during the 1990s and onwards.

ANDERSEN ET AL. (1975) studied the influence of different climatic parameters on the emission of formaldehyde from a chipboard fabricated using a urea-formaldehyde glue in a climate chamber. They noticed that an increase in the relative humidity from 30 % RH to 70 % RH doubled the formaldehyde concentration in the chamber.

In his study on the importance of potential pollutants to the sick building syndrome, NIELSEN (1987) also observed the release mechanisms of the pollutants. He emphasised the importance of water on the emission of formaldehyde, which has a great affinity to water. The reaction between water and formaldehyde is an equilibrium reaction and is presented in Equation 39:

$$CH_2O + H_2O \rightleftharpoons CH_2(OH)_2 \quad , \qquad (39)$$

This balance will be strongly shifted in favour of glycol, i.e. formaldehyde will be bound when water is present, for instant on moist walls. (MEYER 1979) As the moisture content of many materials varies according to the moisture content of the air, different materials will form an effective buffer for moisture as well as for formaldehyde and probably for many other substances.

HAWTHORNE & MATTHEWS (1987) also stated that one mechanism that might affect the emission process is water vapour that can decompose a building material and release pollutants. They modelled formaldehyde emission and included product age, the influence of temperature and relative humidity on the generation of emissions, and the influence of temperature and relative humidity on the transport coefficient. The characteristic product concentration was derived from experimental data. According to their model thus developed, the likely seasonal variation in temperature and relative humidity results in a substantial change in the emission rate.

VAN NETTEN ET AL. (1989) found in their studies on the release of formaldehyde from different building materials that based on the response of the various materials to high and low humidity, over the time span used in their study, there appear to be two general categories. One increases formaldehyde release with increasing humidity, i.e. the wood-based products including ceiling tile, shiplap, plywood, and particleboard. The other class includes gypsum board, lath and plaster, terra cotta brick, and cement block. The materials belonging to the latter category decrease formaldehyde release with increasing humidity for the first hours, but this trend reverses after approximately 4 hours. The materials belonging to the latter group had been in contact with urea formaldehyde insulation before testing.

TUCKER (1991) reviewed studies on emissions from indoor surface materials conducted by that time. He concluded that early studies of formaldehyde emissions from pressed-wood products showed that relative humidity was an important factor influencing the emission rate.

He further stated that research studies of other pollutants have, however, shown that their emission rates from various materials are not particularly sensitive to relative humidity, at least for the normal range found indoors. Therefore, only materials that are known to emit highly polar compounds need to be tested at different relative humidities.

Studies on the emissions of compounds other than formaldehyde have concentrated either on the relative humidity of the indoor air or on the moisture content of the material. It seems that the moisture content of the material is affecting the emissions more pronouncedly than the relative humidity of the indoor air.

SOLLINGER ET AL. (1993) studied the organic emissions from textile floor coverings in a climate chamber under static conditions, i.e. with no air exchange. They determined the dependence of concentration of 15 compounds emitted from the same textile floor covering at 0 and 45 % relative humidity. Their results demonstrated that the equilibrium concentrations did not depend on humidity with the possible exception of aniline, the emission of which increased slightly with increasing humidity.

WOLKOFF (1998) studied the influence of two different relative humidities, 0% and 50% RH, on the emission of two volatile organic compounds of concern from five building products: PVC flooring, tufted carpet, water-borne acrylic floor varnish on pre-treated beech-wood parquet, water-borne acrylic wall paint applied onto gypsum board, and an acrylic sealant. He noticed that some of the volatile organic compound emissions were markedly influenced by the relative humidity, and that the dependency was related to building product and the type of volatile organic compound emitted. For example, the results for the wall paint studied showed that while the Texanol time/concentration profile was unchanged by the different relative humidities, the concentration/time profile of propandiol approached zero concentration at 0% RH in less than one day. The low humidity may have resulted in a different film structure due to a faster dry-out process or otherwise, the water vapour itself carries polar substances from the surface. 2-ethylhexanol and dimethyloctanols emitted from the studied carpet and the sealant, respectively showed increased concentration/time profiles at 50% RH. This infers that the plasticisers present may decompose to their corresponding free alcohols already at 50% RH. Thus, he recommended including the relative humidity as an element in the emission testing of building products.

FANG ET AL. (1999) studied the chemical and sensory emissions from the same building materials as used by Wolkoff (see the preceding paragraph). They noticed that the effect of the humidity of the ambient air was significant for the primary emission of total volatile organic compounds (TVOC) emitted from waterborne materials – floor varnish and wall paint. The increased emissions from the materials with increasing relative humidity were also clearly perceivable. The authors proposed that increasing moisture in the air leads to extraction of more hydrophilic VOCs out of the material surface and therefore increases the emission rate of those compounds. This would imply that the moisture level of the material might influence the rate of emissions. LUNDGREN ET AL. (1999) also stated that high concentrations of volatile organic compounds in indoor air studies may indicate moisture damage of building materials.

HAGHIGHAT & DE BELLIS (1998) studied the impact of temperature and relative humidity on material emission rates. Their experimental set-up was analogous to the one used in this study, which is presented in chapter 6. Haghighat's and de Bellis' emission test chamber design was somewhat different from the one used in this study, but they also mixed humidified and dry air to reach a desired level of relative humidity. The relative humidities used were 3 %, 32 %, and 62 %. A water-based gloss acrylic paint and a polyurethane plastic finish varnish were used in their experiments. It was noted that as the humidity increased, the TVOC emission rates increased for both the paint and varnish, but that it is truly impossible to generalise the behaviour of individual compounds based on the TVOC time-emission rate curve. They further noticed that though the concentration of the varnish was near depletion at the end of the test period, when the test chamber door was opened, a strong odour was still detected.

Though feeding very dry air, 3 % relative humidity, into the test chamber with the paint sample, it was noticed that the release of water vapour from the sample must impede the release of VOCs. As the recorded exit humidity dropped to levels below 30 % relative humidity, which occurred after 12-24 hours, the time-emission rate curve began to behave exponentially as expected. As far as the water-based paint and the relative humidity in the test chamber were concerned, the time-emission rate curves could not be described as exponential decays. The curves reached steady state after approximately 160 hours, but the emission rates were not yet depleted. The emission rates were higher at 32 % relative humidity than at 62 % relative humidity. The relationship between emission rate and relative humidity could not be generalised as either directly or inversely proportional. At 32 % relative humidity the humidity may be such that the vapour pressure of the overlying air encourages, rather than inhibits, the release of VOCs. This is not as evident at the other two levels tested. The emission rates recorded for the 3 % relative humidity test yielded the lowest emission rates and depletion values. The impact of the relative humidity on the different compounds studied was quite extraordinary. Toluene and m,p-xylene were greatly affected by the humidity but at different levels, for instance. As they also have very abundant emission rates, their reaction to the relative humidity must impact the TVOC emission rate profile. The behaviour of the TVOC emission rate was also noticed to be different for the two materials tested. The higher water content of VOCs in the paint may cause this difference. The explanation may be due to the release of water vapour from the paint sample impeding the release of VOCs due to hydrogen bonding. The effects of relative humidity thus can not be summarised into a general trend for the emissions from different materials. (HAGHIGHAT & DE BELLIS 1998)

The varnish had the highest emission rates recorded for the highest humidity level. Though following smoother trends than the paint, the varnish still showed varied effects under the influence of different relative humidities. Its TVOC increased with increasing humidity, but some of its individual compounds showed higher emission rates at RH 32 % than at RH 62 %. (HAGHIGHAT & DE BELLIS 1998)

KORNUM (1980) reached similar conclusions to the ones by Haghighat and de Bellis in his studies on the influence of relative humidity on the evaporation of water and solvents from different water/organic solvent mixtures.

THØGERSEN ET AL. (1993) studied the effect of water-damaged chipboards on the indoor air quality. They stated that during the material decay phase caused by water damage, chemical substances are diffused to the material surface and evaporate. After emissions have stabilised, subsequent decomposition will determine the emission rate. Thus, during water damage the high emission rate is caused by the high water content, which increases the diffusion speed inside the material. The emission rate is also increased by organic compounds being transported into the air along with water during evaporation. A high water content also promotes the dissolution of the glue used in the fabrication of the chipboard. Water damage to chipboards resulted in increased emission of organic compounds even when the chipboards had dried. WOLKOFF ET AL. (1993) showed in their study that wetting linoleum had a marked influence on the qualitative emission of fatty acids, glycol ethers, and 2-decenal.

WIRTANEN ET AL. (2002) studied the influence of moisture damage on the emissions from common floor structures. The results showed that an external moisture load increases the emission of α-pinene from a wood-based parquet composite. An external moisture load increased also the emission of 1,2-propanediol and 2-butoxyethanol originating from a water-borne lacquer applied onto a wooden mosaic parquet (WIRTANEN 2001)

5 OBJECTIVES OF THE EXPERIMENTAL STUDY

The main objective of the experimental part of this study is to clarify the influence of moisture and substrate on the emission of volatile organic compounds (VOC) from paints and adhesives as a part of a wall structure using environmental test chambers and the Field and Laboratory Emission Cell (FLEC). Earlier studies have, as been shown, concentrated either on a substrate effect, the emissions from a coating spread onto an inert substrate has been compared with the emissions from a coating spread onto gypsum board, or a humidity effect using only a single material layer applied onto an inert substrate. In this study the combined effect of relative humidity and different substrates, i.e. an inert substrate (glass), gypsum board, and plasters applied onto calcium silicate brick, on the emissions from combinations of primer and paint and adhesives will be clarified. This is done by introducing the materials to be tested into environmental chambers into which humidified air having specified relative humidities will be introduced. The emitted compounds, which are analysed using gas chromatography and mass spectrometry, are collected into Tenax TA-tubes both directly from the chamber air and from the surface of the samples by using FLEC, and the results are compared with each other to verify whether the test chambers' inner surfaces have acted as sinks. FLEC samples will be collected only at the end of each testing period. The relative humidity of the chamber air, the olfaction, and the weight change of the samples are also recorded. The information of the composition of different materials provided by their manufacturers is usually rather scarce, thus the physical and chemical characteristics of the different materials will be studied using mercury intrusion porosimetry, infrared spectroscopy, pH-indicator liquid, light microscopy, and environmental scanning electron microscopy (ESEM) equipped with an energy-dispersive spectrometer. The ESEM is, thus, used both for studying the surface of the materials and for performing element analysis.

Another, more practical, objective of the study is to verify if it is possible to achieve a low emission rate using different material combinations. A target value of 30 $\mu g/m^2 \cdot h$ was set based on the study by MØLHAVE ET AL. (1996). This area specific emission rate would result in a target concentration of 200 $\mu g/m^3$ attained in a small bedroom 1 year after construction. This value is also the target value for the best indoor climate category according to the Finnish classification of indoor climate (CIC 2000).

Matters that are not dealt with in this study include deterioration of the samples, i.e. hydrolysis and other failure mechanisms, and aging phenomena. Aging is defined in this context as sample ages over 28 days, which is the highest testing age according to the standard ENV 13419 (1999). These exclusions are made since one of the main objectives of this study is to achieve a low emission rate in a short period of time. Another relevant issue, as far as the indoor environment is concerned that is left untreated is the health implications of the VOCs emitted.

6 MATERIALS AND EXPERIMENTAL SETUP

Three products of each material group: primers and paints, adhesives, and fillers and plasters, were chosen according to their popularity among domestic consumers (according to ironmongers' sales personnel's estimate), classification (CIC 2001), and chemical composition as given by the product manufacturer. The substrates were glass (used as reference), gypsum board, and calcium silicate brick together with a combination of filler and plaster B or a single layer of plaster C. The materials used and their main characteristics are presented in Table 9.

Table 9. The materials used in this study and their main characteristics.

Material	Main characteristics	Classification[1)]
Primer A	Water-borne acrylic emulsion primer	M1
Paint A	Water-borne acrylic emulsion paint	M1
Primer B	Water-borne acrylic emulsion primer	M1
Paint B	Water-borne acrylic emulsion paint	M1
Primer C	Alkyd resin primer	-
Paint C	Alkyd resin paint	-
Adhesive A	Water-borne PVAc-dispersion glue	-
Adhesive B	Water-borne PVAc-dispersion glue	-
Adhesive C	Water-borne PVC-dispersion glue	-
Filler A	Polymer binder, water mixable	M1
Plaster A	Polymer binder, water mixable	M1
Filler B	Polymer binder, ready-mixed	M1
Plaster B	Polymer binder, ready-mixed	M1
Plaster C[2)]	Gypsum binder, water mixable	M1
Gypsum board	-	M1
Calcium-silicate brick (CSB)	-	M1

[1)] The limit for the emission rate of total volatile organic compounds (TVOC) for M1 products is 200 µg/m²·h at 28 days. The products should also be odourless. (CIC 2001)

[2)] Plaster C is not used together with a filler.

A primer is a coating product generally used as a substrate for a paint. One of the main differences between primers and paints is a lower gloss and higher filler content of the former. A filler is a plastering product used for filling holes and levelling a rough substrate such as a brick wall. It forms the substrate for a plaster, which itself forms the substrate for e.g. a paint or wallpaper. Primers and paints as well as adhesives A and B have different manufacturers.

The study was divided into three successive parts and the results from a previous part were used in the following ones. The main objective of Part I was to study the influence of ambient relative humidity on the emission of VOCs from single material layers on an inert substrate (glass). The objective of Part II was to study the VOC-emissions from combinations of primer and paint or filler and plaster prepared according to the manufacturer's recommendations, on an inert substrate. The least and most emitting materials (adhesives) and material combinations (primer and paint and filler and plaster) according to the results in Part I and Part II were used in Part III, where they were spread onto real substrates, i.e. on gypsum board or CSB. Thus, the objective of Part III of this study was to examine the emissions from real structural components at different ambient relative humidities. Factorial experimental design was used in the set-up regarding the CSB as a substrate in Part III of this study. The materials studied in the different Parts are presented in Figure 2. The relative humidity of the air introduced into the test chambers (measurement of empty chamber) and the time of testing are presented in Table 10.

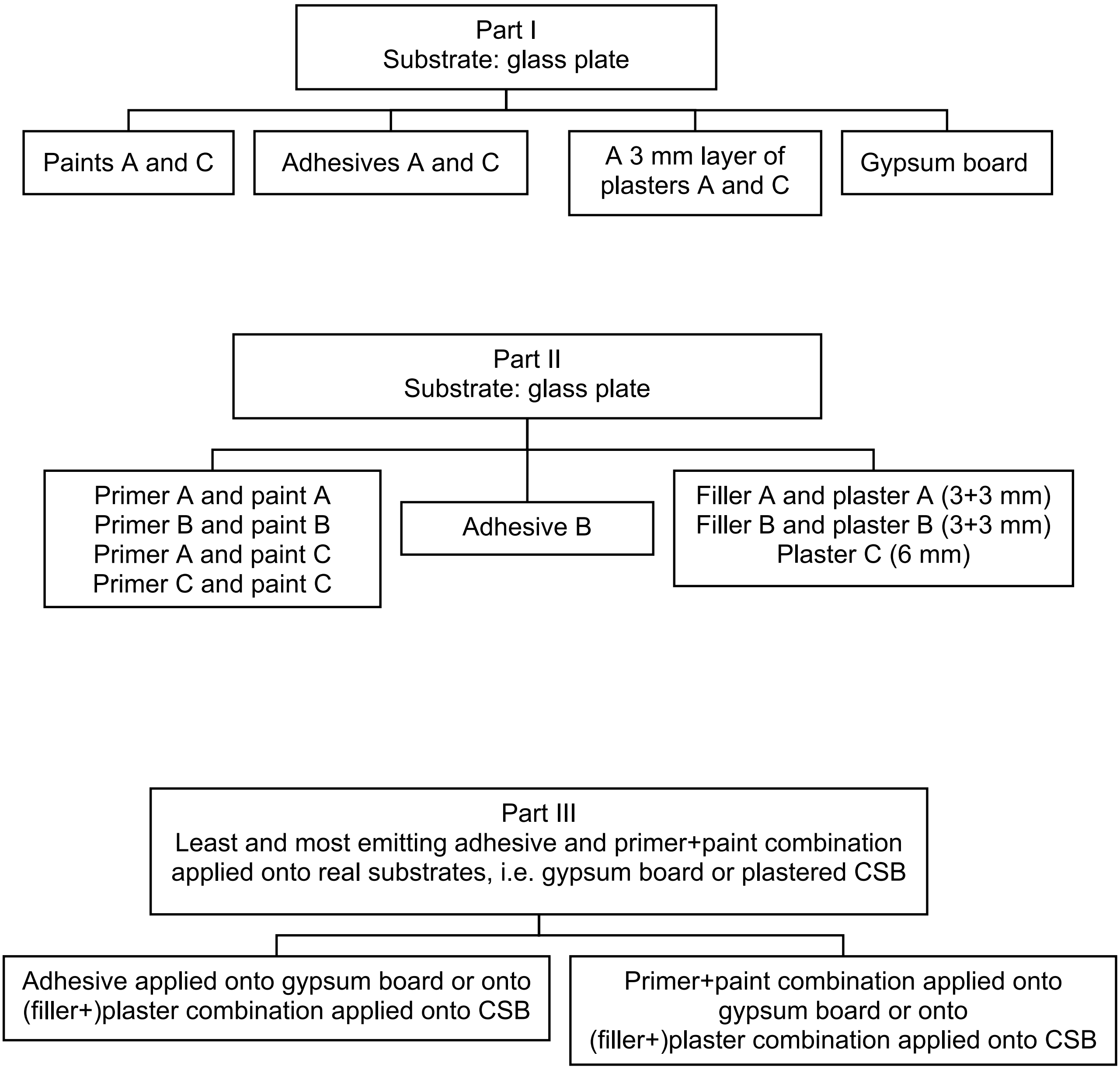

Figure 2. Materials and material combinations studied in the different Parts of this study.

Table 10. The target relative humidity of the inflowing air and the testing age at the different stages of this study.

Part	RH (%)	Testing age (d)
I	20, 50, 80	1, 14, 28
II	20, 50, 80	1, 7, 14
III	20, 50, 80	1, 7, 14

The testing age of 28 days was included in Part I, since this is the testing age used in the requirements for building materials in the Finnish classification of indoor climate (CIC 2001).

6.1 FOURIER TRANSFORMED INFRARED SPECTROMETRY (FTIR)

Infrared spectroscopy was used to get a rough estimate of the constituents of the different materials studied. The FTIR-apparatus used by the author consists of a Bomem MB 102 spectrometer with a DTGS detector. The resolution was set to 4 cm^{-1} and the number of scans depended on the material to be studied ranging from 100 to 400 scans. The method detects substances making up more than 3 weight-% of the sample. However, this is only a rough estimation and may be too low a value for some substances.

6.1.1 Primers, paints and adhesives

All samples in Part I were analysed by FTIR. Paint and adhesive samples were spread onto stainless steel plates, 20×80 mm^2, and kept in climate chambers on top of the glass plates. Duplicate samples were analysed at the age of 28 days using a grazing angle unit.

However, the spectra had very low absorption intensities and suffered from severe specular reflectance, and the results were later discarded as non-usable. Additional samples, ~30×50 mm^2, including primers, paints and adhesives, were spread onto a glass plate, peeled with a scraper and put into airtight plastic vials at the age of one day, and analysed at the crime laboratory of the National Bureau of Investigation at the age of 5-7 days. Before analysis the samples were pressed against a KBr tablet. The FTIR-apparatus used, an AutoIMAGE FTIR microscope system, consists of a Perkin Elmer Spectrum 2000 IR unit and an adjoining Perkin Elmer AutoIMAGE microscope. The samples were collected using 50 scans with a resolution of 4 cm^{-1}.

6.1.2 Fillers, plasters and gypsum board

Samples of the fillers, plasters, and the core of the gypsum board were analysed by the author with the apparatus referred to earlier using a Diffuse Reflectance Unit (DRIFT). The samples were prepared by crushing them in a mortar and mixing them with KBr. The weight of the material studied was 10 % of the total weight of the sample. Duplicate samples were analysed at the age of 14 or 28±1 days.

6.1.3 FTIR-sample analysis

FTIR-samples are analysed based on data in the following references: AHOLA (1993), WILLIAMS ET AL. (1989), SOCRATES (1980), and NYQUIST ET AL. (1971). The regions in which functional groups absorb are presented in Table 11 to aid in the interpretation of the bands in the different infrared spectra. Furthermore, by examining a spectrum for the absence of bands in a given region, it is possible to exclude particular functional groups and, hence, compounds containing these groups. Table 12 can be used for this purpose.

Table 11. Regions for different functional groups. (WILLIAMS ET AL. 1989 and SOCRATES, 1980)

Wavenumber (cm^{-1})	Functional groups
~3700 - 2250	O–H, N–H, C–H stretching
~2250 - 1900	C≡C, C≡N, X=Y=Z stretching
~1900 - 1400	C=C, C=O, C=N, N=O stretching and N–H bending
~1400 - 650	Other stretching, bending and combination bands. The fingerprint region.
650>	Skeletal vibrations, difficult to interpret and left out in this review

Table 12. Negative spectral interpretation table. (SOCRATES 1980)

Absorption band absent in region (cm^{-1})	Type of vibration responsible for bands in this region	Type of group or compound absent
4000-3200	O–H and N–H stretch	Primary and secondary alcohols, amides, organic acids and phenols
3310-3100	C–H stretch (unsaturated)	Alkynes
3100-3000	C–H stretch (unsaturated)	Aromatic and olefinic compounds
3000-2800	C–H stretch (aliphatic)	Methyl, methylene, methyne groups
2500-2000	X≡Y, X≡Y≡Z stretch1)	Alkynes2), allenes, cyanate, isocyanate etc.
1879-1550	C=O stretch	Esters, ketones, carboxylic acids etc.
1690-1620	C=C stretch	Olefinic compounds
1680-1610	N=O stretch	Organic nitrite compounds
1655-1610	$-O-NO_2$ asymmetric stretch	Organic nitrate compounds
1600-1510	$-NO_2$ asymmetric stretch	Organic nitro- compounds
1600-1450	C=C stretch	Aromatic ring system
1490-1150	H–C–H bend	Methyl, methylene
1420-990	S=O stretch	Sulphoxides, sulphates, sulphites etc.
1310-1020	C–O–C stretch	Ethers (aromatic, olefinic, or aliphatic)
1225-1045	C=S stretch	Thiosters, thioureas, thioamides etc.
1000-780	C=C–H deformation	Aliphatic unsaturation
900-670	C–H deformation	Substituted aromatics
850-500	C–X stretch3)	Organohalogenes
730-720	$(CH_2)_{n>3}$	Four or more consecutive methylene groups

1) X,Y, and Z may represent any of the atoms C, N, O, and S.

2) Band may be absent due to symmetry of functional groups.

3) X may be Cl, Br, or I.

6.2 MICROSCOPY

6.2.1 Light microscopy

The paint and adhesive samples that were spread onto 20×80 mm² stainless steel plates were also studied by light microscopy at the end of each testing period in Part I in order to check if the different storing conditions caused any visual changes in the samples. The microscope used was a stereo microscope manufactured by Wild Heerbrugg with a 50× magnification power.

6.2.2 Environmental Scanning Electron Microscopy (ESEM)

The ESEM used was a Model E-3 microscope manufactured by Electroscan equipped with an EDX X-ray analyser. The images were made using a secondary electron detector, which is very suitable for imaging the topography and elements of a sample. The accelerating voltage was 15 keV and the chamber pressure was 5 Torr. The element analysis by EDX was done at a working distance of 13.3 mm, a count rate of approximately 1500 counts per second (cps), and 60-second count time. The ESEM was not calibrated separately for the samples used in this study, since the purpose of the element analysis was not for quantification, only for identification.

The samples, primers, paints and adhesives, analysed by ESEM were one day old. They were spread onto sample stubs, ~10 mm diameter, by using a paintbrush.

6.3 MERCURY INTRUSION POROSIMETRY (MIP)

Mercury intrusion porosimetry was used to determine the porosity characteristics of the plasters and the core of the gypsum board. The mercury porosimeter manufactured by Carlo Erba Strumentazione used in this study consists of two units. The low-pressure unit, Macropores Unit 120, has a pressure range from 0.15 to 1 bar and it measures pores with a radius from 2,500 to 30,000 nm. The high-pressure unit, Porosimeter 2000 WS, has a pressure range from 1 to 1,990 bar and it measures pores with a radius between 3.7 and 7,500 nm.

The relationship between pressure and pore radius is described by the Washburn equation as

$$pr = 2\gamma\cos\omega \quad , \qquad (40)$$

where p is pressure (bar), r is pore radius (nm), γ is surface tension of mercury (mN/m^2), and ω is the contact angle (°) between mercury and the material studied. The value of surface tension is 480 mN/m^2 and the contact angle is 141.3°. Mercury has to be forced into the sample studied by using pressure since its contact is > 90°. The pore size distribution is determined from the volume of mercury intruded at each pressure increment and the total porosity from the total volume intruded. The pores are assumed to be of cylindrical shape and fully accessible for mercury penetration. This is only a rough approximation and may, thus, give rise to erroneous results as regards the true pore size distribution, since instead of the true pore diameter the method detects only the diameters of the entrance throats of the pores.

The pore size distribution and the total porosity of the plasters and the core of the gypsum board were analysed. The MIP-samples were chiselled so that they represented the whole cross-section of the original sample. Chiselling resulted in arbitrary, generally flaky, sample shapes. The samples were put into a desiccator at the end of each test series, i.e. at the age of 28±1 days. Drying the samples in a desiccator can alter their microstructure, but is a necessary modus operandi as regards sample preparation. Duplicate samples were vacuum-stored at room temperature for four weeks before testing.

Nitrogen adsorption was also initially considered as a test means, but it was rejected during the course of the study. The idea of including nitrogen adsorption stemmed from the test results by Pennell and his colleagues (PENNELL ET AL. 1992) who observed that nitrogen adsorbs much in the same way as organic vapours on mineral surfaces. Nitrogen can, moreover, not replace adsorbed water molecules, i.e. the surface area determination with nitrogen is expected to yield the same surface area that is available for adsorption of organic vapours (GOSS & EISENREICH 1996). Nevertheless, the use of nitrogen adsorption for the determination of the pore size distribution and specific surface area of the samples was rejected for several reasons. The main reason was that the moisture content of the samples would alter during sample preparation. Thus, it would not be possible to clarify the influence of the different storing conditions on the pore structure characteristics of the samples. Moisture absorbed in the pores of the samples might also alter the test result if the samples would not be dried before testing, since the samples come into contact with very low temperatures, -67° C or lower, during analysis. Furthermore, the main interest in the analysis of the samples used in this study would be on composite materials such as painted gypsum board. Separating the contribution of a single material on the surface area of a multi-layered sample would require a study of its own. Finally, the analysis of the pore structure was aimed at separating the porosity characteristics of the different substrates and this was achieved quite satisfactory by mercury intrusion porosimetry.

6.4 pH-MEASUREMENTS

The pH of the samples used for emission testing was tested at the end of each testing period in Part III of the study by using a full range pH-indicator solution. A few droplets of the solution were spread onto a sample after the finish of the VOC-sample collection by using the Field and Laboratory Emission Cell (FLEC). The pH of the samples and its change with time was recorded by visual inspection.

6.5 EMISSION TESTING

6.5.1 Sample preparation

The surface area of the samples was 220×280 mm² in all measurements. The thickness of the samples and the amount of product applied to a substrate varied according to the specifications presented in SAARELA ET AL. (2002) and what was judged to be convenient.

6.5.1.1 Primers and paints

The recommended usage amount of paint is given by the manufacturer in square metres per litre wet product. The resulting dry film thickness is then calculated according to:

$$T_s = (V_s / S) \times 10 \qquad , \qquad (41)$$

where T_s is the dry film thickness recommended by the manufacturer, (µm), V_s is the solid content of the paint given by the manufacturer, and S is the recommended amount of paint usage (m²/l wet product). The classes for the different dry film thicknesses are presented in Table 13.

Table 13. Classes for dry film thickness (EN 927-1 1996).

Class	Supplier's mean thickness, T_s	Dry film thickness for testing, T_t
Minimal	< 5 µm	5 µm
Low	5 – 20 µm	15 µm
Medium	20 – 60 µm	40 µm
High	> 60 µm	> 60 µm

The amount of wet product applied to a certain area to receive a specified dry film thickness is calculated according to:

$$P = (T_t \times A \times \delta) / (V_s \times 100) \qquad , \qquad (42)$$

where P is the amount of wet product applied, (g), T_t is the dry film thickness for testing (µm), according to Table 11, A is the painted area (cm²), δ is the density of the wet product (g/cm³) given by the manufacturer, and V_s is the solid content of the product (Vol.-%) given by the manufacturer.

The paint film thickness has been shown to influence the emission rate of single (S)VOCs from water-borne paints (CLAUSEN 1993). The dry film thickness in this study was medium, i.e. T_t was 40 µm, for all paints tested and it was kept as constant as possible irrespective of the substrate. CLAUSEN (1993) used a short haired (synthetic) paint roller and noticed that its use resulted in very uneven surfaces. In this study the paint was therefore applied with a foamed plastic paint roller. The roller method gave reproducible results in experiments performed by SPARKS ET AL. (1999) and represents a common method for applying paints on wall and ceiling materials. The test specimens were weighed before and after application.

6.5.1.2 Adhesives

The recommended adhesive weight is 300±15 g/m² according to SAARELA ET AL. (2002). The adhesive to be tested was transferred in an excess of minimum 20 % by weight onto the substrate and spread with a notched spatula completely and uniformly. The adhesive weight was adjusted by adding more or by removing parts of it. All this handling took less than three minutes to perform. The test specimens were weighed before and after the application.

6.5.1.3 Fillers and plasters

The water mixable plasters were prepared by using a mixer attached to a power drill according to the manufacturer's recommendations. A uniform layer of the sample was placed on the substrate with a spatula. A stainless steel border was used to adjust the sample thickness of 3 or 6 mm. The test specimens were weighed before and after the application.

6.5.2 Emission testing methods

6.5.2.1 Emission test chamber

The author developed the test chamber used in this study. The chambers were kept in an air-conditioned room having a constant temperature of +21±1 °C. The chamber was designed so that it would meet the requirements set in the European Standard for emission test chambers (ENV 13419-1 1999) and that a Field and Laboratory Emission Cell (FLEC) could also be used for collecting VOC-samples. The chamber consists of a 27-litre stainless steel container made for institutional kitchens. On the bottom of the container is a stainless steel wire net. The size of the net is 220×280 mm² and its mesh size is 1.0×1.0 mm². The thickness of the steel threads is 0.46 mm. It was noticed during the design stage, that both the mesh size and the thickness of the steel thread influence the air velocity over the test sample. A fan was placed on the steel net at the middle of the chamber 15 mm above the net to regulate the air velocity over the test sample and to ensure proper mixing of the chamber air. The air velocity could be adjusted by regulating the voltage of the fan. The samples were placed on four adjustable stainless steel mounts. The height of the surface of the samples was 95 mm measured from the surface of the steel net in all measurements regardless of the thickness of the sample to ensure that the air velocity over the sample was the same irrespective of the height of the sample. The lid of the chamber was made of 8-mm thick glass and there were three holes in it. One hole was for a humidity and temperature measuring probe, one for VOC-sample collection, and one was originally intended for olfactory analysis, but was not taken into use since it would have required an extra fan to achieve proper results. The holes were covered with glass plates when not in use. The lid was made tight by a Viton-tube and the joint of the tube was made tight using laboratory film. Six chambers were in use simultaneously. Each chamber was cleaned according to the regulations presented in ENV 13419-1 (1999), prior to testing with de-ionised water and methanol. All loose metal parts were cleaned with de-ionised water and methanol before heating them to 400 °C and additionally rinsed with methanol before introducing them into the chamber.

The air used was normal compressed air that is used by the whole Department of Civil and Environmental Engineering at Helsinki University of Technology. It was cleaned of impurities by a water-separator, an oil filter, an active-charcoal filter, and a Zero Air generator connected in series. The air was introduced into the chambers by Teflon-tubes. The length of the tubes was the same for all chambers to ensure pressure balance. The relative humidity of the chamber air could be adjusted by mixing dry and humidified air. Leading it through a water-filled gas washing bottle humidified the air. The ventilation rate was 1 h^{-1}, i.e. an air flow rate of 450±5 ml/min was used. A Field-Cal 650 Flow Calibrator manufactured by Humonics Inc. was used to measure the airflow rate. Its accuracy is ±2 ml/min according to the manufacturer. The measurements were carried out regularly. Pictures of a test chamber and of the experimental setup are shown in Figures 3-5.

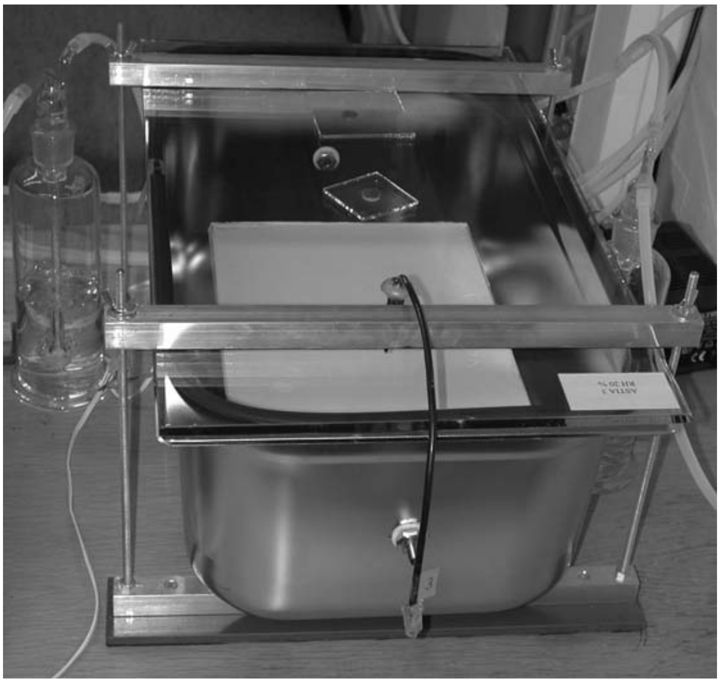

Figure 3. An environmental test chamber.

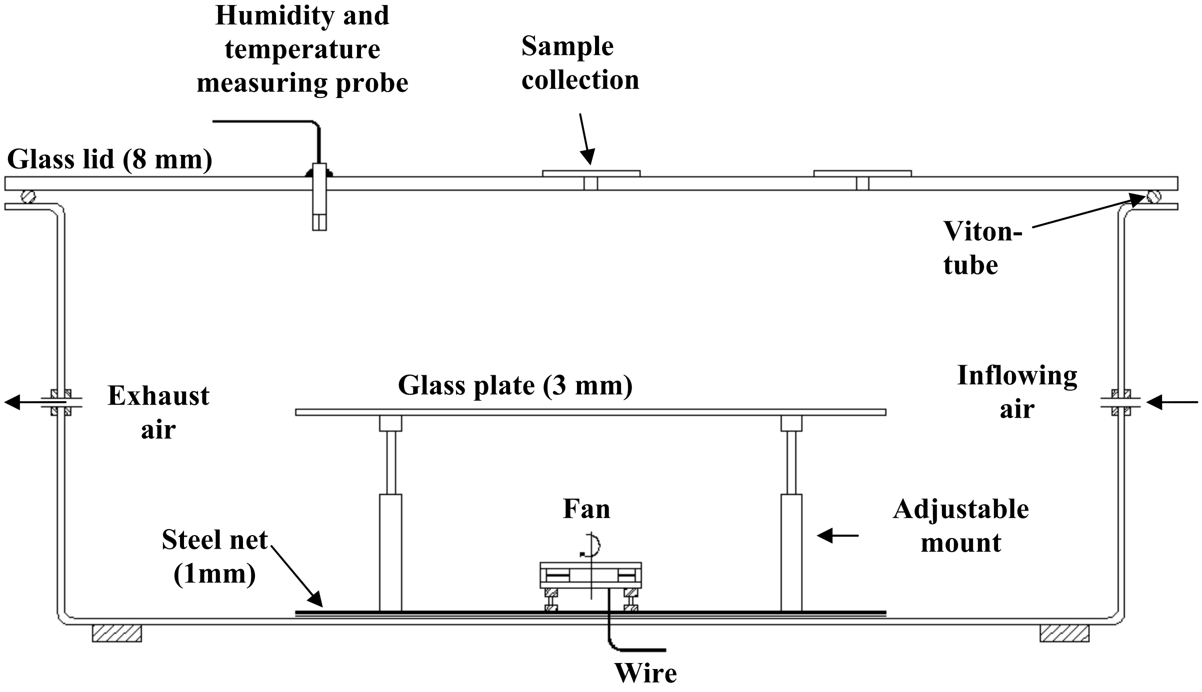

Figure 4. A sketch of an environmental test chamber.

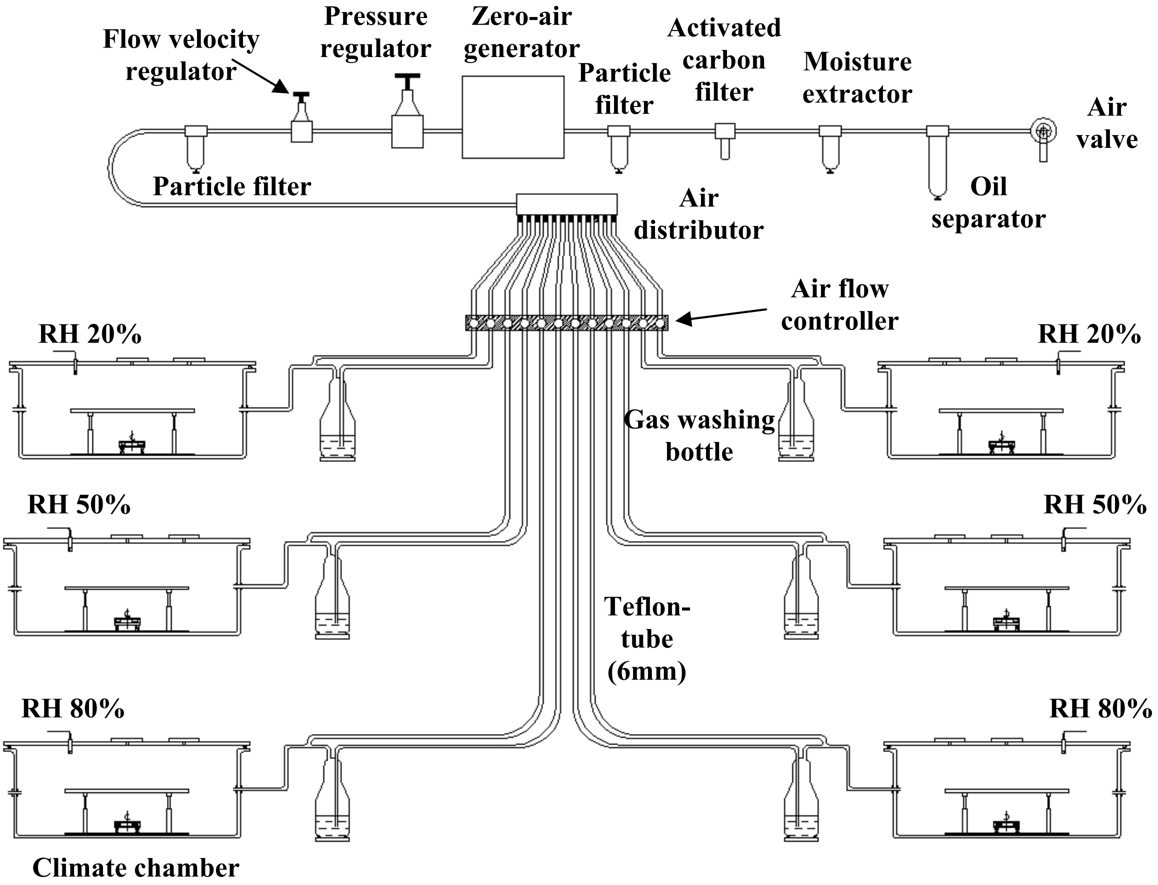

Figure 5. A sketch of the experimental setup.

6.5.2.2 Testing conditions

The air-velocity 1 cm above the surface of the samples is shown in Figure 6. It was measured from nine points, i.e. from each corner, from the centre of each side and from the centre of the sample area, respectively.

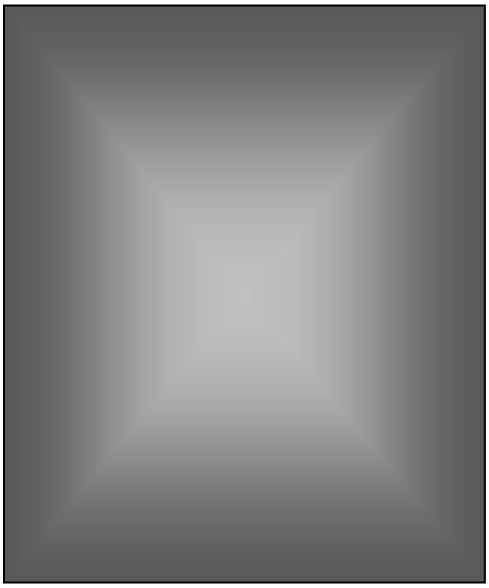

Figure 6. Air-velocity profiles measured 1 cm above the sample surface. A darker shade indicates a higher air-velocity.

The air velocity was measured using an air velocity transducer model 8475, manufactured by TSI Incorporated. The air velocity was 0.15±0.03 m/s at the centre of the sample increasing somewhat (0.01-0.02 m/s) closer to the edges. In Part I of the tests, 20×80×3 mm^3 stainless steel plates used for FTIR-measurements were placed at the narrow ends on top of the paint and glue samples. This caused a minor distortion of the velocity field. The velocity of the narrow ends was 0.03-0.05 m/s and at the right-hand side 0.02-0.04 m/s higher than at the centre of the sample. The distortion of the air-velocity profile was caused by the fact that the fans used did not create an independently-oriented flow of air.

The relative humidity of the chambers was measured using one temperature and humidity measuring probe, HMP 233 manufactured by Vaisala, per chamber. The accuracy of the probes is ±2 RH-% at RH 0-90 % and ±3 RH-% at RH 90-98 % according to the manufacturer. The probes were calibrated periodically by using saturated salt solutions in a HMK 13 B Humidity Calibrator manufactured by Vaisala. The accuracy of the measured relative humidity compared with the target values were ±5 % RH for empty chambers.

6.5.2.3 Field and Laboratory Emission Cell (FLEC)

The FLEC was supplied with 5.0-synthetic air with a mixture of 80 % nitrogen and 20 % oxygen. The air was led into the chamber via a FLEC Air Control unit in which it was humidified to RH 50±5 %. The chamber was cleaned according to (ENV 13419-2 1999) with de-ionised water and methanol before heating it up to 105 °C for one hour and additionally rinsing it with methanol prior to testing. The FLEC was used for trying to neglect the sink effect of the climate chamber.

6.5.3 VOC-sample collection

The area specific airflow rate (ASAFR), which is expressed as n/(A/V), was equal for both the test chamber and the FLEC. This was achieved by adjusting the airflow rate of the FLEC to 130±2 ml/min. The relevant parameters are presented in Table 14.

Table 14. The area specific airflow rates (ASAFR).

Parameter	**Test chamber**	**FLEC**
Area, A	0.22×0.28 m^2	0.0177 m^2
Volume, V	0.027 m^3	3.5×10^{-5} m^3
Air changes, n	1 h^{-1}	222 h^{-1}
ASAFR	0.438 m^3/m^2·h	0.439 m^3/m^2·h
Airflow rate	450 ml/min	130 ml/min
Air velocity	0.15±0.03 m/s	0.0047 m/s

The air velocity inside the FLEC-cell is calculated based on the FLEC chamber volume and airflow rate, which are shown in Table 14. It is to be noted that the air velocity inside the FLEC-chamber is not evenly distributed, even though this effect will average out with homogenous surfaces (UHDE ET AL. 1998)

VOC-samples were collected into Tenax TA-filled stainless steel tubes using a FLEC Air Pump 1001. The air flow rate during sample collection was controlled using the Field-Cal 650 Flow Calibrator and it was measured both from the exhaust air leaving the pump and the air leaving the environmental chamber or FLEC. The sample volumes varied according to the amount of VOC emitted being different for different materials, relative humidity, and sample age. The volumes ranged thus from 0.5 to 10 litres. Two parallel samples were collected from each sample at the respective testing age, except for background measurements, whereas only one sample was collected per climate chamber before each testing period started. This same routine was applied for the FLEC. The FLEC-samples were collected at the end of each testing period, i.e. at 14 or 28 days depending on the length of the testing period. The collected samples were stored in sealed glass jars at room temperature for a maximum of 7 days prior to delivery for sample analysis.

6.5.4 VOC-sample analysis

The VOC-samples were analysed by the Laboratory of Chemistry and Microbiology at the Uusimaa Regional Institute of Occupational Health. The sealed glass jars containing the collected VOC-samples were stored in a refrigerator at the Uusimaa Regional Institute of Occupational Health for a maximum of 8 days prior to sample analysis. The analysis was performed by the GC/MS-method according to (ISO 16000-6 2004). The inaccuracy of the analysis is 15-41 % depending on the compound, being 25 % in average. The uncertainty of measurement of compounds identified as toluene-equivalents is even higher and the quantification is semi-quantitative. The limit of detection is also compound dependent. An average value is 10 ng/sample, i.e. 1 µg/m³ for a 10 l sample. The analysis results were given as concentration of VOCs in sampled air expressed as µg/m³. The background concentrations, i.e. the VOC-concentrations of the empty environmental chambers or the FLEC applied onto a stainless steel plate, were first subtracted from the actual concentrations, i.e the emissions generated by the material samples. Then the results were converted to area specific emission rates, SER_a, expressed as $\mu g/m^2 \cdot h$ according to the equations presented in (ENV 13419-1 and 13419-2 1999), respectively.

6.5.5 Data handling

The VOC-emission data is presented as area specific emission rates for each single material and material combination tested separately. The emission data is also analysed statistically using STATGRAPHICS and MODDE software programs. A Kruskal-Wallis test using the STATGRAPHICS program is applied to clarify the influence of the relative humidity of the surrounding air on the emission rates of single compounds. The compounds are separated according to which chemical group they belong to, i.e. all aromatic hydrocarbons emitted from the samples stored at the three target relative humidities in Part I are compared with each other, and so forth. The same procedure is done when the area specific emission rates of the total volatile organic compound emissions, $TVOC_{SERa}$, from the two different sample collection methods are compared with each other. The Kruskal-Wallis test was chosen since the test data is not, at least in most cases in this study, normally distributed as a consequence of the fact that the emission rates are very material dependent.

Factorial design was used in order to optimise the number of tests in Part III of this study where primer and paint combinations or adhesives were applied onto filler and plaster combinations which were applied onto calcium silicate brick. The factorial design was performed using a D-optimal design tool in MODDE. The $TVOC_{SERa}$-values were analysed with the same program using PLS (Partial Least Squares) regression, interaction models, and response prediction plots.

6.5.6 Olfactory evaluation

The olfaction of the samples stored in the environmental chambers was recorded according to SAARELA ET AL. (2002) with three exceptions. First, the olfaction was evaluated by the author only and no evaluation panel was used. Second, no diffuser was used, thus, the airflow rate was 0.0075 l/s instead of the recommended 0.9 l/s. Third, the evaluation was started the day following the introduction of a sample into a climate chamber and it was recorded once a day throughout a testing period. SAARELA ET AL. (2002) recommend that a test specimen should be conditioned for two days prior to testing. And last, no acceptability scale was used, rather the perception was ranked on a scale from 0 to 5, where 0 denoted no perceptible smell and 5 denoted a strong perception.

The evaluation was performed by placing a glass funnel over the nose, waiting approximately 10 seconds, and then breathing in air through the nose three times in sequence. The funnel was attached to the outlet of the chamber by a teflon-tube. The last recording was made when the lid to the climate chamber was opened. This proved to be a beneficial modus operandi, since you could then quite often sense a rather strong smell even though earlier evaluations had proved a sample to be odourless.

7 EXPERIMENTAL RESULTS

The aim of the following four chapters is to get a rough estimate of the chemical and physical characteristics of the materials studied.

7.1 FOURIER TRANSFORMED INFRARED SPECTROSCOPY (FTIR)

The analysis of the FTIR-spectra gives a rough estimate of the chemical composition of the different samples. Thus, no attempts to estimate the amounts of the different constituents are made, since this would be very laborious and, also, a task outside the scope of this work.

7.1.1 Primers and paints

The FTIR-spectra of primers and paints A and B are shown in Figures 7 and 8 and their main spectral bands are presented in Table 15.

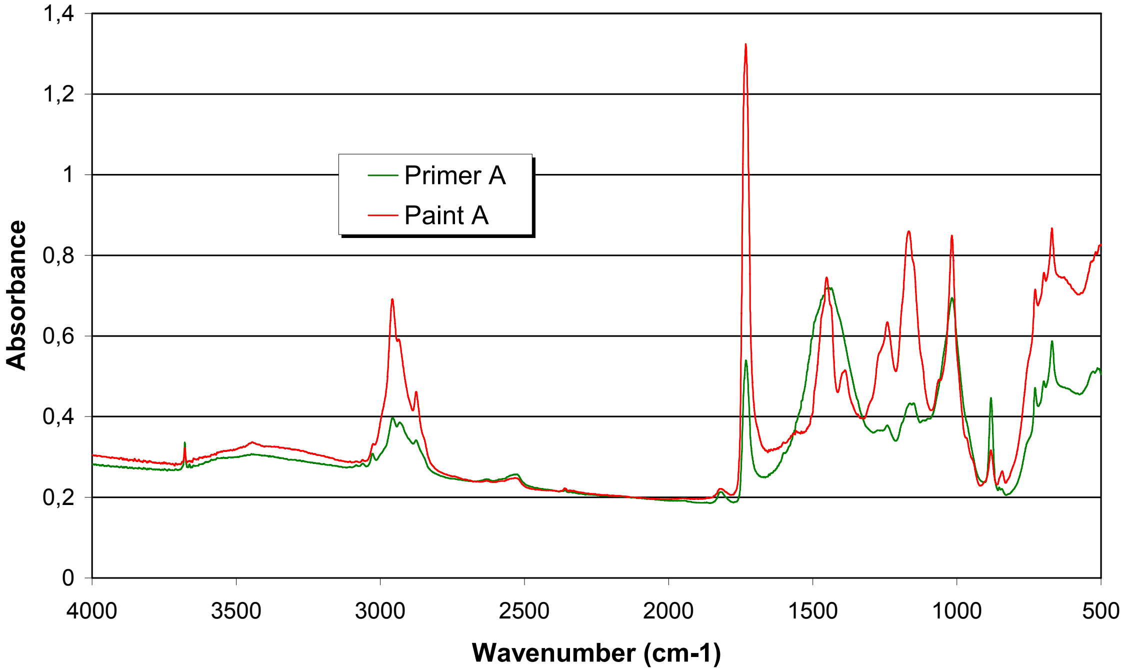

Figure 7. FTIR-spectra of primer A and paint A.

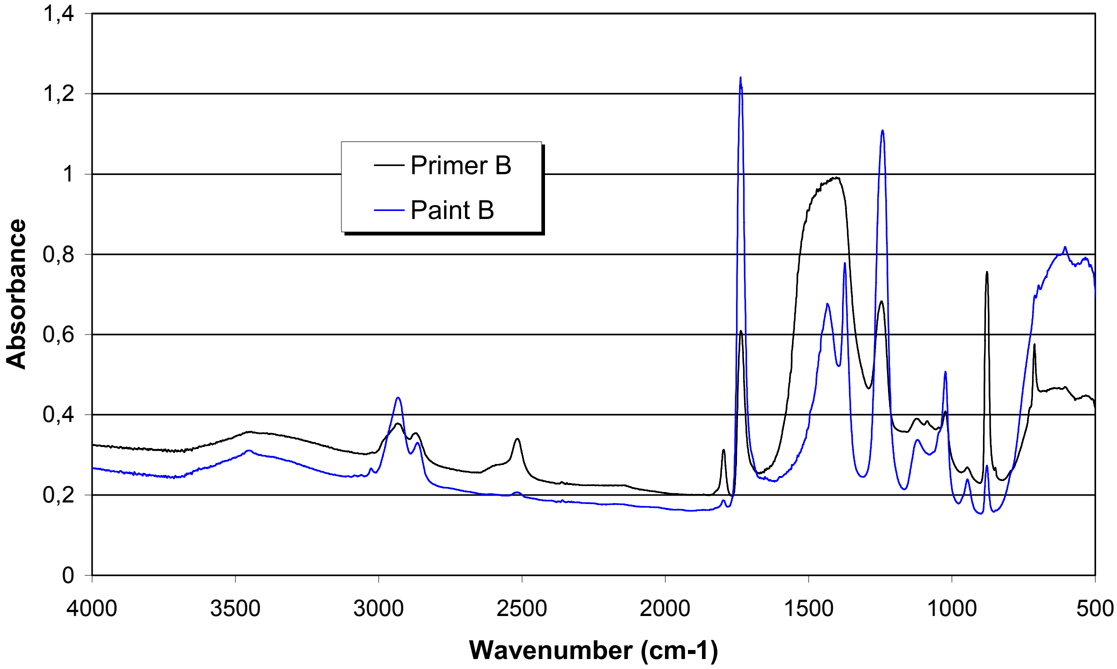

Figure 8. FTIR-spectra of primer B and paint B.

Table 15. The spectral bands of primers and paints A and B and the compounds they assign.

Wavenumber (cm^{-1})	Compound
3677, 2524, 1805, 879	$CaCO_3$
~3600 - 3100	O–H stretching in water or alcohol
3050 - 3020	could assign aromatics
2950 - 2850	asymmetric C–H stretching in $–CH_2$ and $–CH_3$, symmetric stretching in $–CH_3$
1731	C=O stretching in ester
1545	could assign aromatics
1450	asymmetric bending in $–CH_3$ and/or scissoring in $–CH_2$
1385	symmetric bending in $–CH_3$
1240, 1160, 1110, 1015	asymmetric and symmetric C–O–C stretching characteristic of ethers and carboxylic esters. The band at 1015 cm^{-1} could also assign C–O stretching vibration of alcohol
1050	shoulder assign skeletal vibration of acrylate
963	shoulder assign skeletal wagging of acrylate
940	$=CH_2$ wagging of methacrylate
900 - 800	could assign aromatics

The primers' absorption spectrum differs from that of the paints most distinctly at 1600 cm^{-1} - 1300 cm^{-1}. This assigns $CaCO_3$, a common filler in paint products. The amount of solids in a primer is usually higher than that in a paint.

The absorption spectra of paints A and B are very similar. There are, however, some differences, which will be dealt with in the following. Paint B lacks the medium intensity band at 3677 cm^{-1}. Moreover it has a rather strong band at 940 cm^{-1} assigning $=CH_2$ wagging of methacrylate. The third main difference is that paint B lacks a band at 1160 cm^{-1} and has, instead, a medium intensity band at 1110 cm^{-1}. The differences that were observed between the two different paints apply also to the two different primers. The structure of an acrylate monomer is shown in Figure 9.

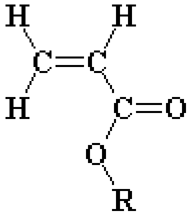

Figure 9. The structure of an acrylate monomer. R stands for any atom or molecule.

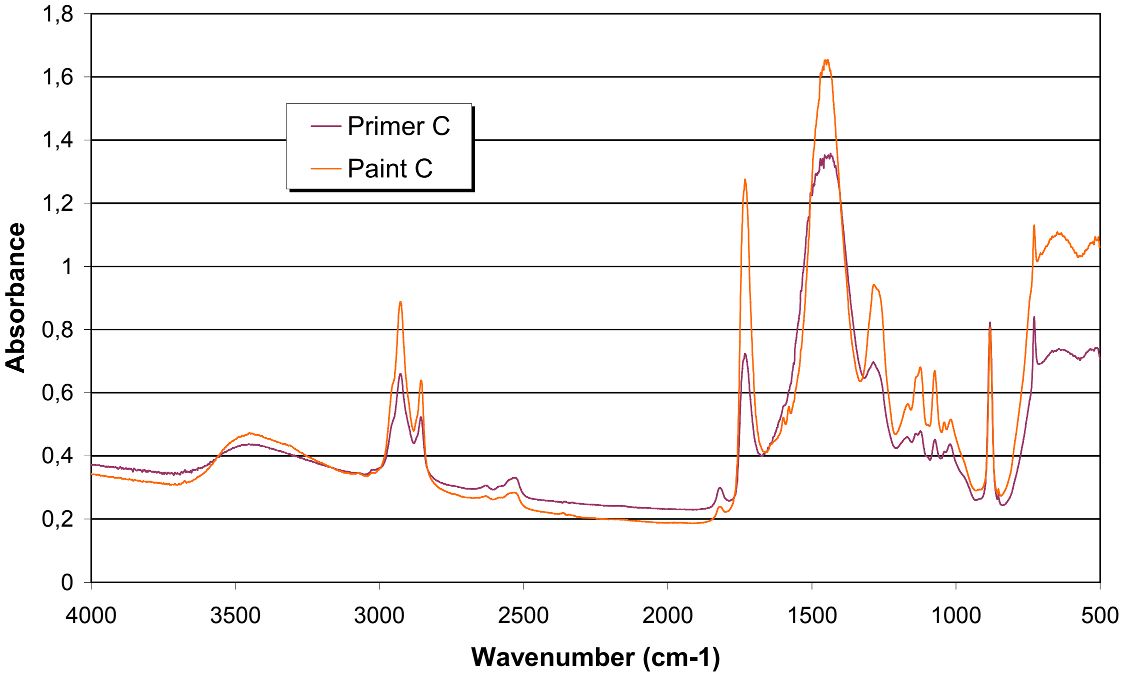

Figure 10. FTIR-spectra of primer C and paint C.

The primer and paint C, which are alkyd-based products, have very similar spectra, as can be seen in Figure 10. The main spectral bands are presented in Table 16.

Table 16. The spectral bands of primer C and paint C and the compounds they assign.

Wavenumber (cm^{-1})	Compound
~3600 - 3100	O–H stretching in alcohol
2950 - 2850	asymmetric and symmetric C–H stretching in $–CH_2$
2650 - 2500	could assign O–H stretching in carboxylic acid
1731	C=O stretching in ester
1440	C–H bending in $–CH_3$ and/or scissoring in $–CH_2$ or $CaCO_3$
1270, 1160	asymmetric and symmetric C–O–C stretching characteristic of ethers and carboxylic esters
1120, 1070	could assign C–O asymmetric stretching in phthalate. The band at 1070 cm^{-1} could also assign $CaCO_3$
1040, 1010	C–O stretching vibration (in alcohol, ether, carboxylic acid, or ester)
880	$CaCO_3$
963	shoulder assign skeletal wagging of acrylate
940	$=CH_2$ wagging of methacrylate
900 - 800	could assign aromatics

$CaCO_3$ has a strong band at 1500 to 1400 cm^{-1}. Thus, the band at 1440 cm^{-1} that assigns C–H bending can also assign $CaCO_3$, and most probably these bands overlap each other at that wavenumber region.

7.1.2 Adhesives

The FTIR-spectra of the adhesives studied are shown in Figure 11 and their main spectral bands are presented in Table 17. Adhesives A and B are water-borne PVAc-dispersion adhesives, while adhesive C is a water-borne PVC-dispersion adhesive, according to the manufacturers' information.

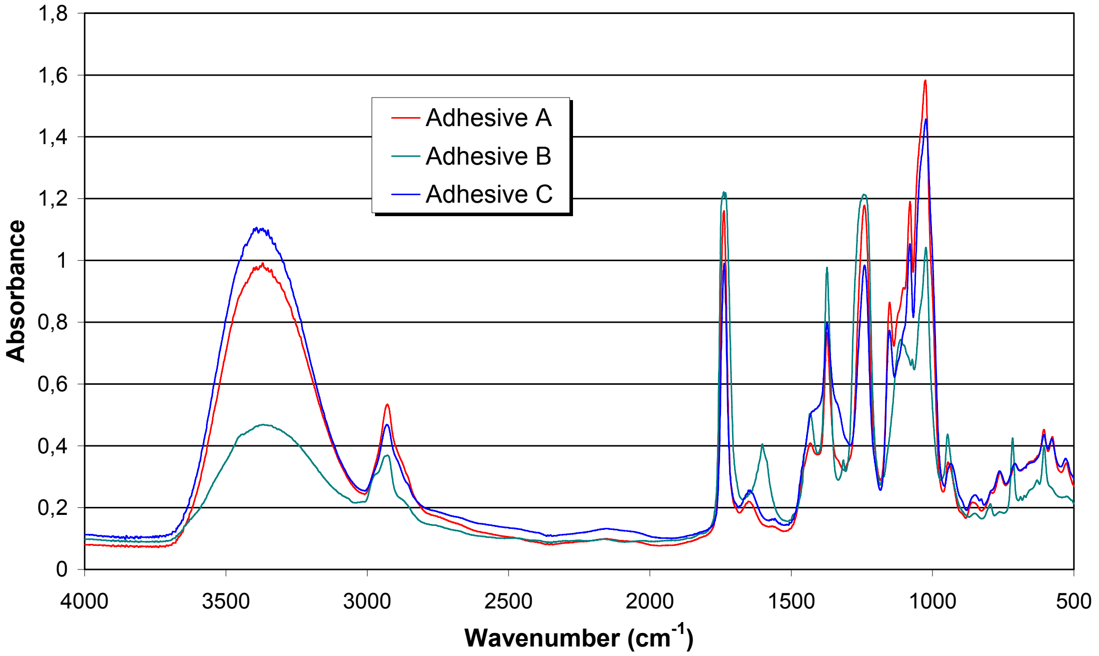

Figure 11. FTIR-spectra of the different adhesives studied.

Table 17. The spectral bands of adhesives A, B, and C and the compounds they assign.

Wavenumber (cm^{-1})	**Compound**
~3700 - 3100	O–H stretching in water or alcohol
2920	asymmetric C–H stretching in $–CH_2$
1730	C=O stretching in ester
1640	C=C stretching in vinyl ether
1600	C=C stretching in C=C conjugated with C=C
1430	symmetric bending in $–CH_3$
1370	asymmetric bending in $–CH_3$
1240, 1160, 1110	asymmetric and symmetric C–O–C stretching characteristic of ethers and carboxylic esters
1080, 1020	C–O stretching in alcohol or ester
940	C–H out-of-plane deformation of $=CH_2$ in vinyl hydrocarbon
880 - 700	could assign aromatics

There are some differences between the spectral bands of the different adhesives, which will be treated in the following. First, adhesives A and C have a medium strong band at 1640 cm^{-1}, while adhesive B has a medium strong band at 1600 cm^{-1}. These assign C=C stretching in vinyl ether and C=C stretching in C=C conjugated with C=C, respectively. Second, adhesives A and B have a medium strong band at 1430 cm^{-1}, while adhesive C has a shoulder at the same wavelength. Third, adhesives A and C have bands at 1160 cm^{-1} and 1080 cm^{-1}, while adhesive B has a band at 1110 cm^{-1}. The structure of vinyl monomer and vinyl chloride are shown in Figure 12.

Figure 12. Vinyl monomer (to the left) and vinyl chloride (to the right).

7.1.3 Fillers, plasters and gypsum board

The FTIR-spectra of the two plasters with polymer binder and their respective fillers are shown in Figures 13 and 14 and their main spectral bands are presented in Table 18.

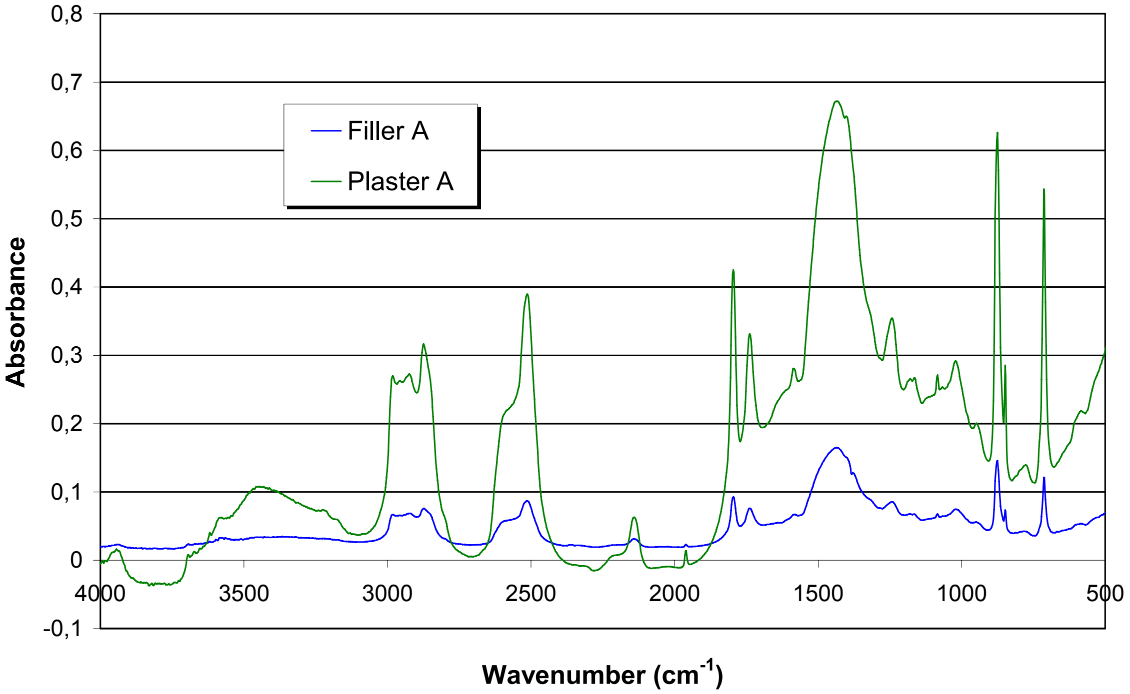

Figure 13. FTIR-spectra of filler A and plaster A. The filler (age 14 days) was stored in a climate room (21° C, RH 30 %) and the plaster (age 28 days) was stored in a climate chamber (21° C, RH 50 % target relative humidity).

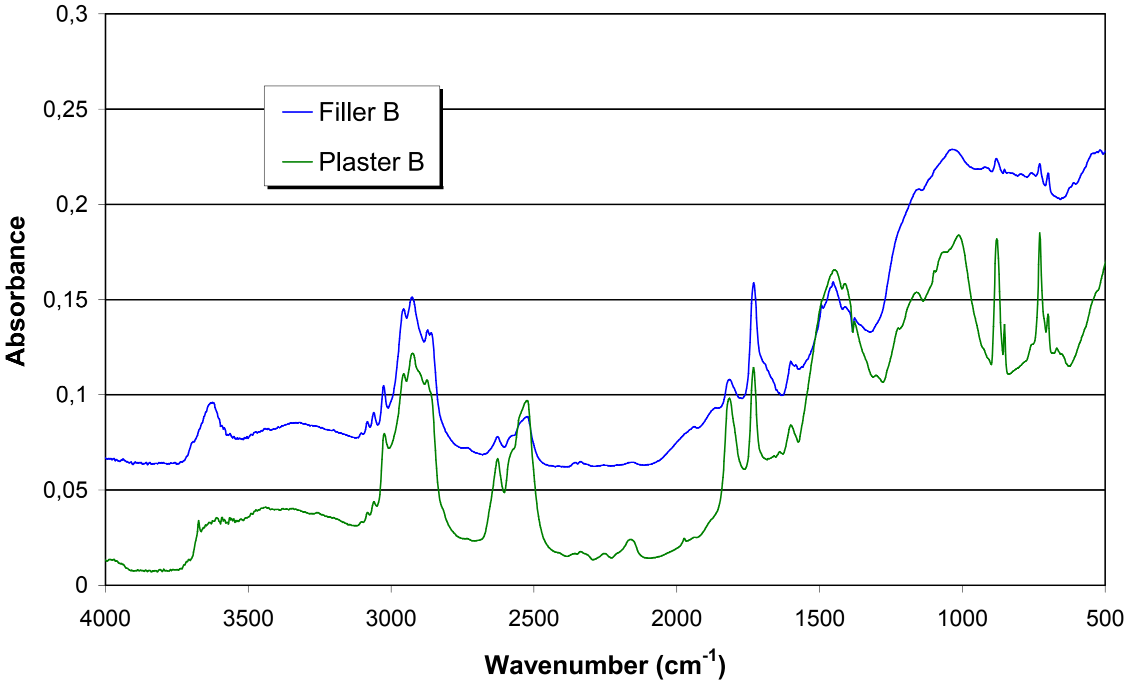

Figure 14. FTIR-spectra of filler B and plaster B. Both samples were stored in a climate room (21° C, RH 30 %) and analysed at the age of 14 days.

Table 18. The spectral bands of fillers and plasters A and B.

Wavenumber (cm^{-1})	Compound
~3600 - 3100	O–H stretching in water or alcohol
3100 - 3020	aromatic C–H stretching vibration
3000 - 2850	asymmetric C–H stretching in –CH_2 and –CH_3 and symmetric C–H stretching in –CH_3. Could also include $CaCO_3$ absorption bands
2510, 1450, 880, 710	$CaCO_3$
1820, 1790, 1740	could assign C=O stretching in ester
1600	water
1250, 1190, 1170, 1030	asymmetric and symmetric C–O–C stretching characteristic of ethers and carboxylic esters
950	C–H out-of-plane deformation characteristic of a vinyl group
800	C–H out-of-plane deformation characteristic of aromatics
1080, 1020	C–O stretching in alcohol or ester
940	C–H out-of-plane deformation of =CH_2 in vinyl hydrocarbon
880 - 700	could assign aromatics

There are some differences between the spectral bands of the different products, which will be treated in the following. The aromatic C–H stretching vibration is observed only for filler and plaster B. Of the bands assigning C=O stretching in ester the band at 1820 cm^{-1} is only observed for filler and plaster B, while the band at 1790 cm^{-1} is only observed for filler and plaster A. Furthermore, the bands assigning C–O–C stretching at 1250 cm^{-1} and 1190 cm^{-1} is only observed for filler and plaster A, while the band at 1170 cm^{-1} is only observed for filler and plaster B. Thus, even though the FTIR-spectra of the two products are quite similar their binders have most probably somewhat different compositions.

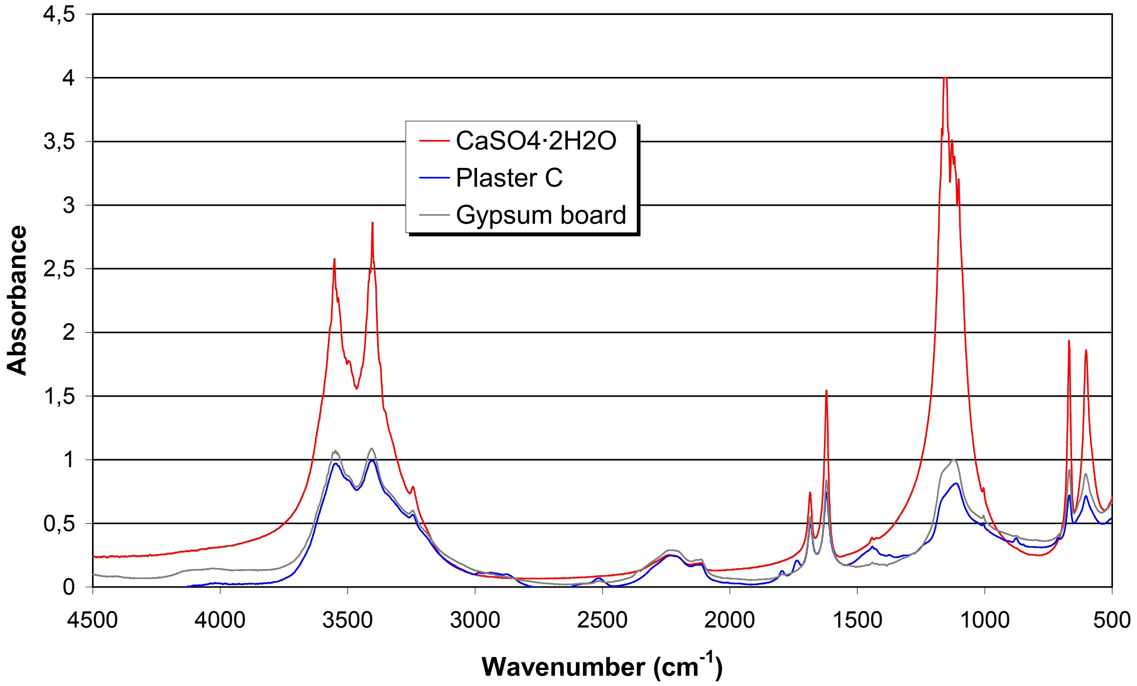

Figure 15. FTIR-spectra of plaster C, the core of the gypsum board and gypsum (pro analysi).

Plaster C consists mainly of gypsum, as is shown in Figure 15. It has a weak band at 2520 cm^{-1}, which assigns $CaCO_3$. Other differences between plaster C and gypsum occur at 1805 cm^{-1}, 1750 cm^{-1}, 1450 cm^{-1}, and 890 cm^{-1}. The first two bands assign C=O stretching vibration in ester, while the two latter bands assign $CaCO_3$. The FTIR-spectrum of the core of the gypsum board also presented in Figure 15, indicates that the gypsum of the gypsum board is a rather pure product.

7.2 MICROSCOPY

7.2.1 Light microscopy

All paint and glue samples in Part I were examined by light microscopy. The only difference that could be observed was that the sample of adhesive A, which was stored at the RH 80 % target relative humidity, had air bubbles on the surface. A visual inspection, on the other hand, showed that a sample that had been stored in the RH 80 % target relative humidity looked wet, i.e. there was a thin water layer on top of its surface and the sample also felt soft when touched while a sample that had been stored at RH 20 % target relative humidity looked (and felt) dry. The samples that had been stored at RH 50 % target relative humidity were intermediate.

7.2.2 Environmental Scanning Electron Microscopy (ESEM)

The ESEM was used both for looking at the sample topography and for element analysis. The latter will be dealt with first in the following, since this gives additional information to the preceding chapter on FTIR-spectra. Figures 16-19 show the element analysis of some of the one day old paint and adhesive samples. The other results, including primers, paints, and adhesives not shown here, are presented in Appendix A. The element analysis is applicable only for elements having the molecular weight of oxygen and higher.

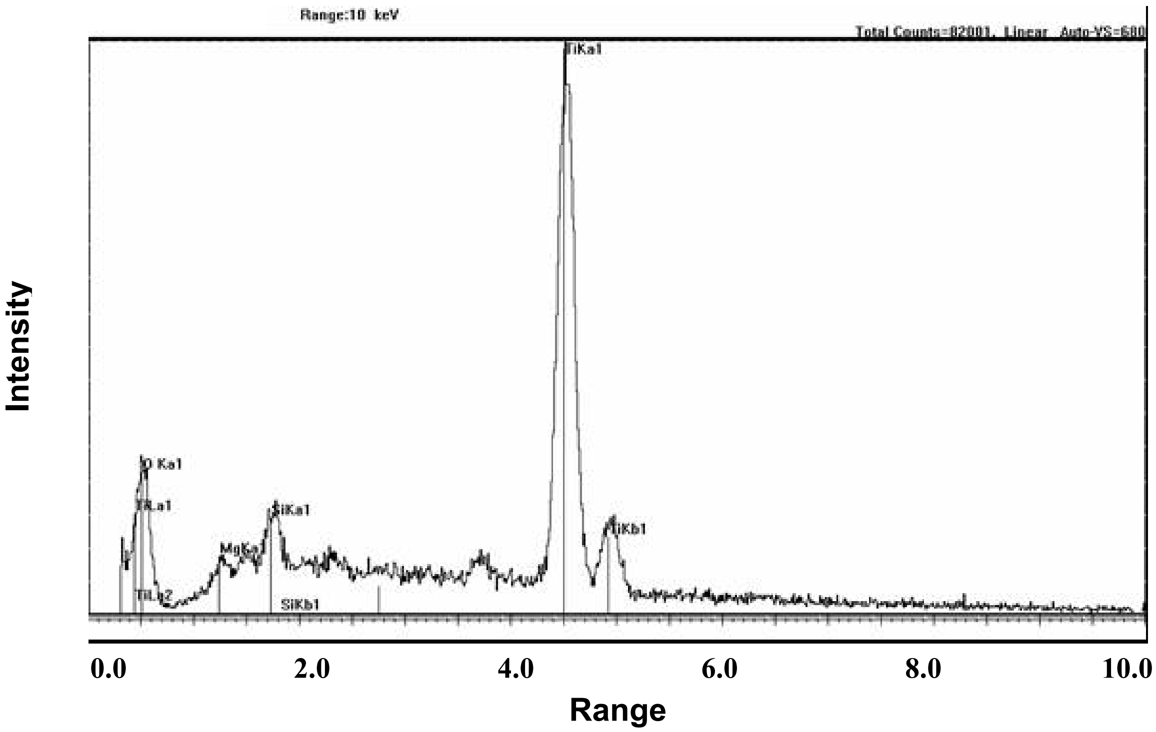

Figure 16. Element analysis of paint A.

Paint A, Figure 16, contains titanium (Ti) that originates from TiO_2, which is a very common white pigment in paints. Paint A also contains some magnesium (Mg) and silicon (Si). Their origin is most probably the filler used in the paint. Paint C, Figure 17, contains beside titanium and magnesium also calcium (Ca), which originates form $CaCO_3$ that is used as filler in paints. The aluminium that is observed for topcoat C probably stems from the sample stud that the paint was applied onto.

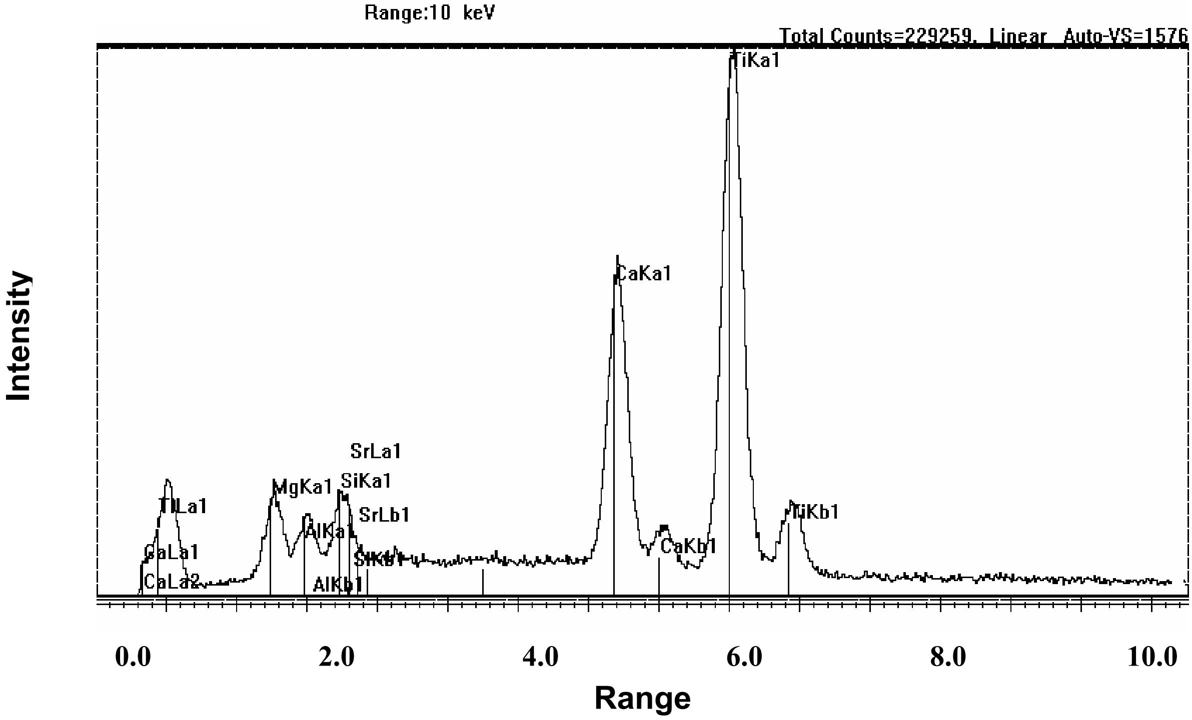

Figure 17. Element analysis of paint C.

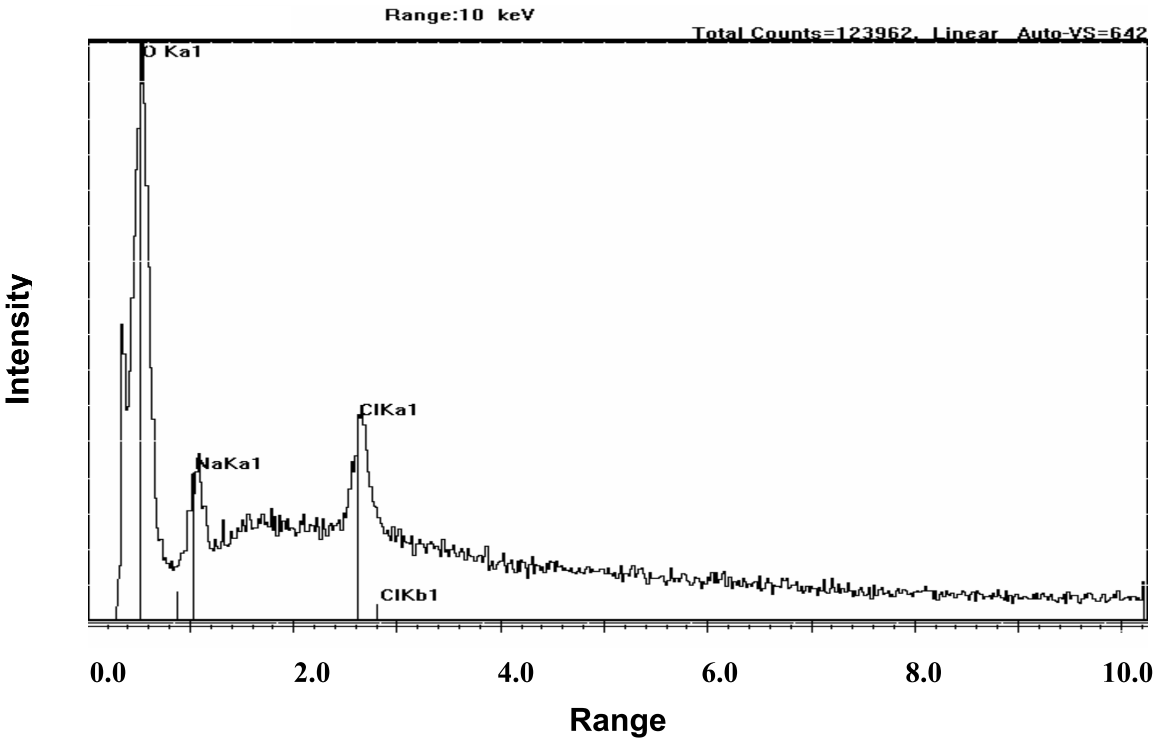

Figure 18. Element analysis of adhesive A.

Adhesive A, Figure 18, contains sodium (Na) and chloride (Cl). Chloride probably derives from the copolymer, which could be a vinyl acetate/vinyl chloride copolymer. Sodium may derive from e.g. a plasticiser. The element analysis of adhesive C, Figure 19, does not show any specific elements except oxygen.

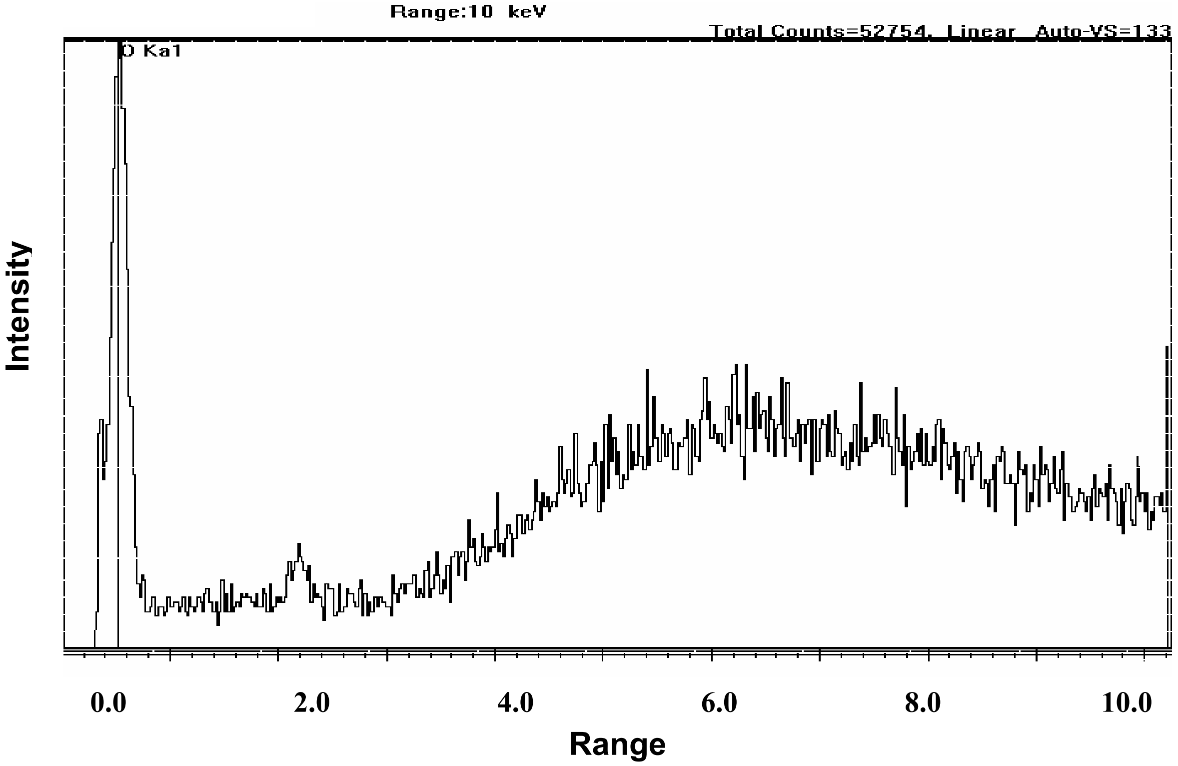

Figure 19. Element analysis of adhesive C.

ESEM-images of the different primers and paints are shown in Figures 20-22. The images clearly demonstrate the coarser structure of a primer compared with its respective paint. It can also be observed that the particle size distribution of a paint film covers several orders of magnitude.

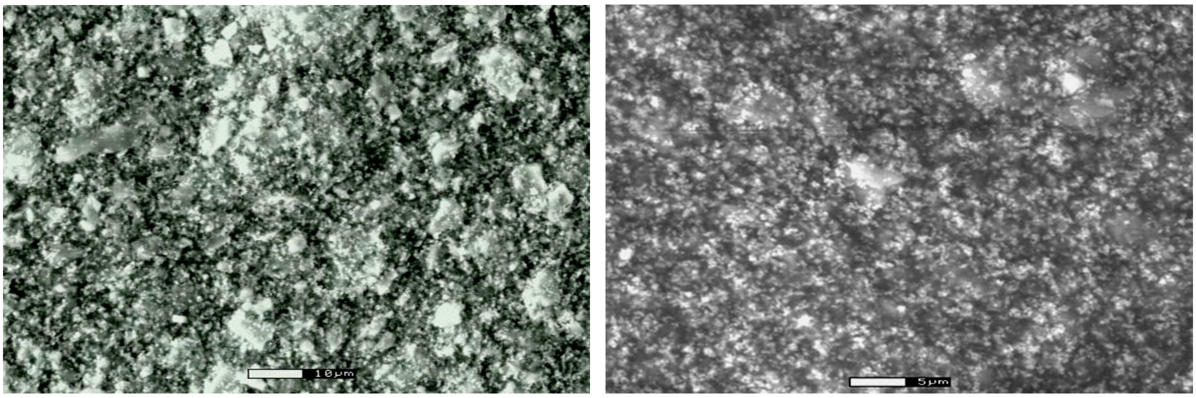

Figure 20. Primer A, ×1000 magnification (left) and paint A, ×2000 magnification (right).

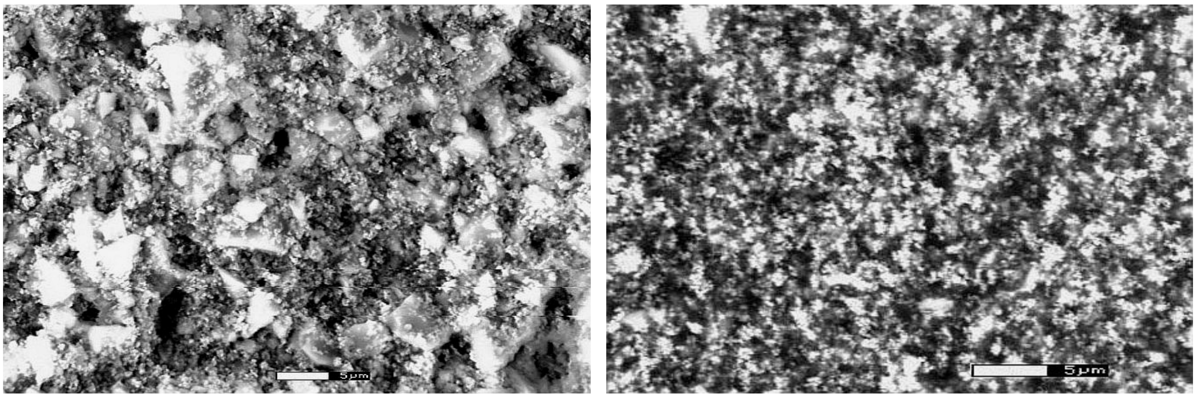

Figure 21. Primer B, ×2000 magnification (left) and paint B, ×2000 magnification (right).

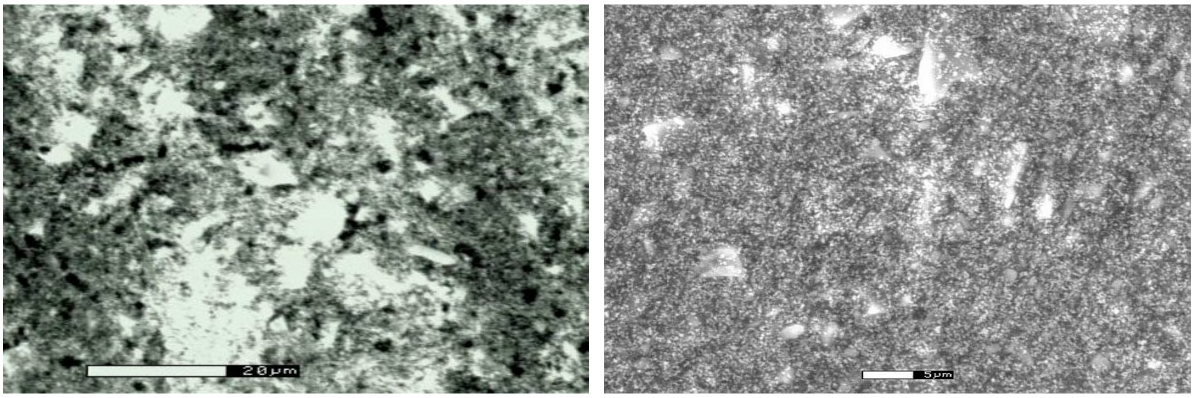

Figure 22. Primer C, ×1000 magnification (left) and paint C, ×2000 magnification (right).

ESEM-images of the different adhesives are shown in Figures 23 and 24. Adhesives A and B appear to have quite similar structures. There structure is somewhat flaky, but more compact than that of adhesive C. The surface of adhesive C is "bumpy" and appears to contain abundant air voids.

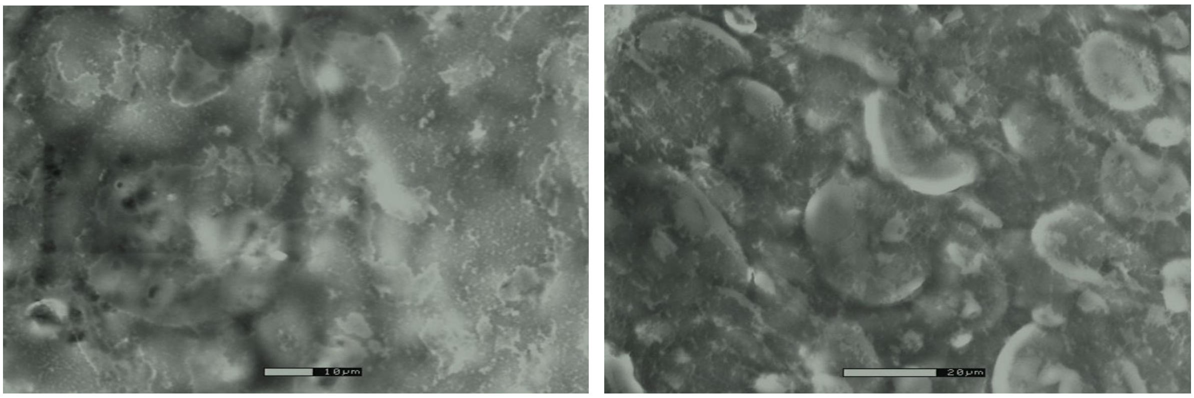

Figure 23. Adhesive A, ×1000 magnification (left) and adhesive B, ×975 magnification (right).

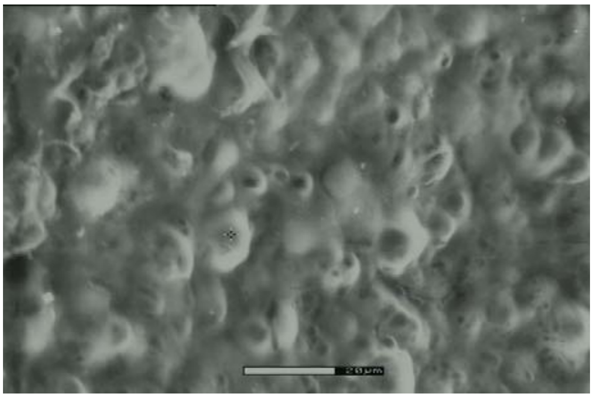

Figure 24. Adhesive C, ×950 magnification.

7.3 MERCURY INTRUSION POROSIMETRY (MIP)

The pore size distribution of the different plasters and the core of the gypsum board are presented in Figures 25-28. The relative humidity, whose measured values are presented in Chapter 7.5, seems to have the greatest impact on plaster A. Its pore size distribution is shifted towards bigger pores with increasing relative humidity of the storing conditions. It is also observed that samples stored at the target relative humidity of RH 80 % have a higher peak, i.e. a bigger pore volume in relation to a specific pore radius, compared with the other two humidities as far as plasters B and C are concerned. The pore radius values corresponding to the strongest peaks are 2950 nm and 3500 nm (plaster B), and 1000 nm (plaster C), respectively. The core of the gypsum board appears to be least affected by the storing conditions.

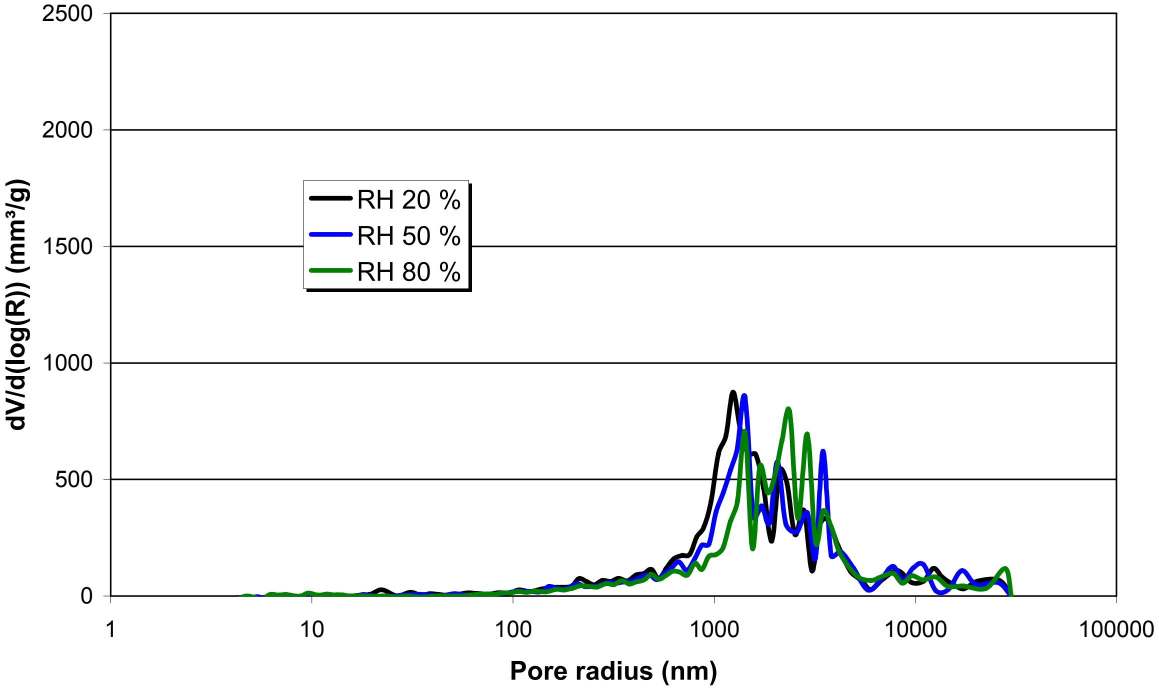

Figure 25. Pore size distribution of plaster A. The legend denotes the target relative humidity of the chamber air, which is also the measured relative humidity of the chamber air ±5 % RH at the time when the samples were taken out from the environmental chambers for preparation.

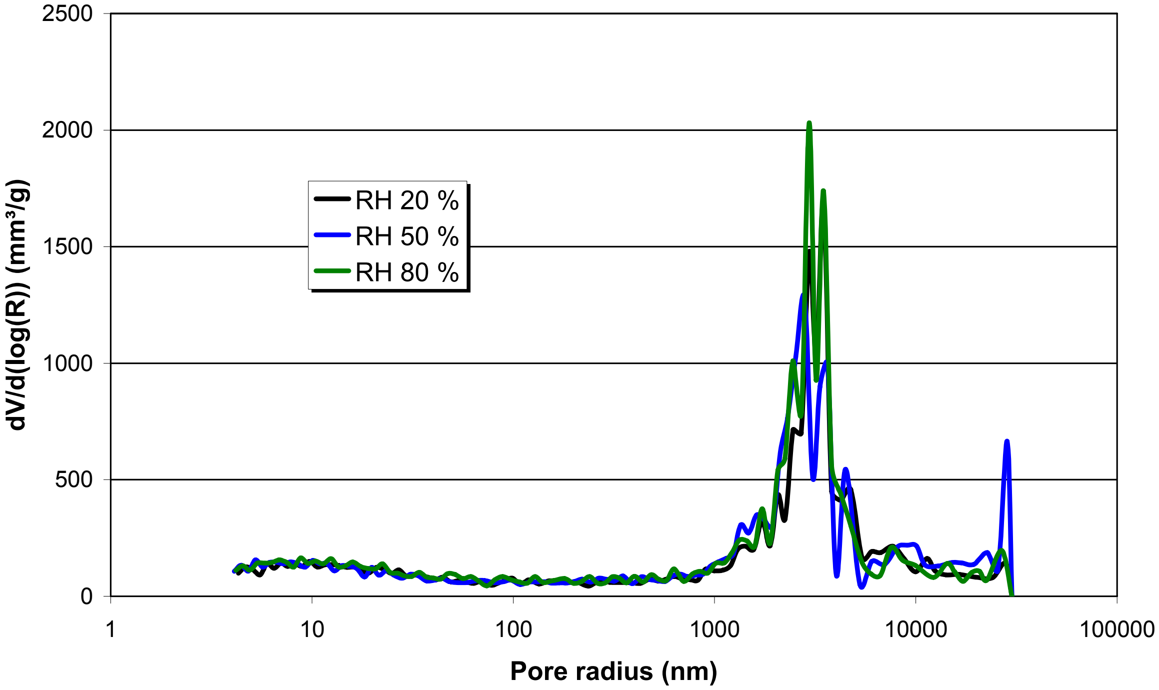

Figure 26. Pore size distribution of plaster B. The legend denotes the target relative humidity of the chamber air, which is also the measured relative humidity of the chamber air ±5 % RH at the time when the samples were taken out from the environmental chambers for preparation.

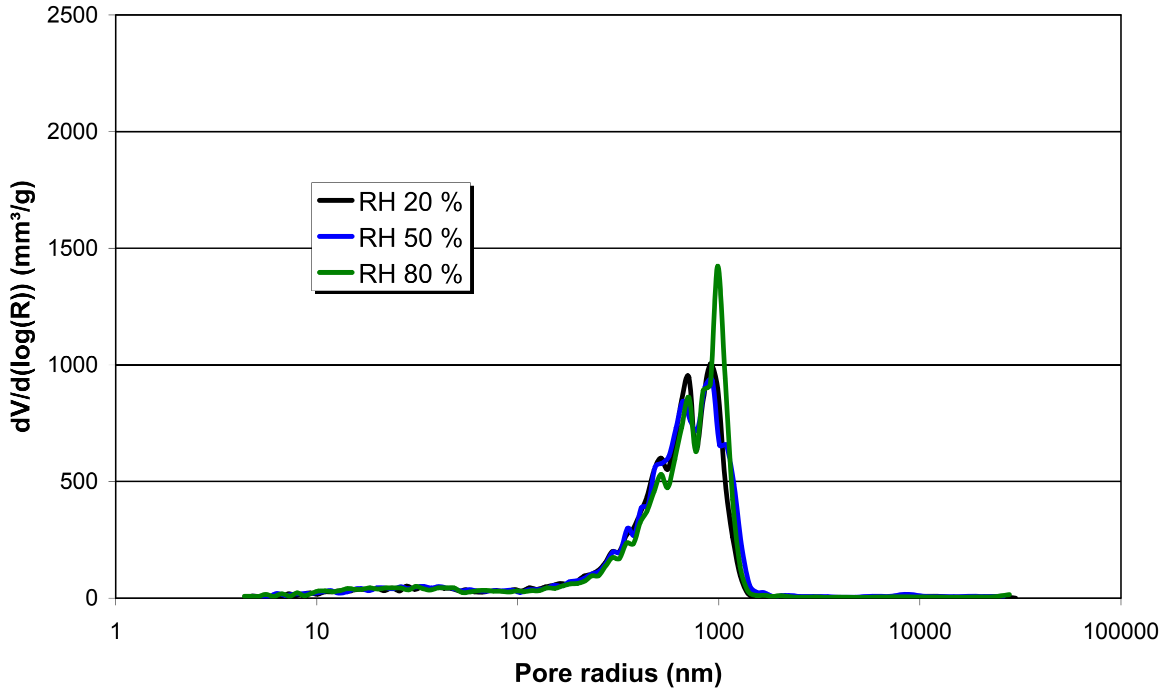

Figure 27. Pore size distribution of plaster C. The legend denotes the target relative humidity of the chamber air, which is also the measured relative humidity of the chamber air ±5 % RH at the time when the samples were taken out from the environmental chambers for preparation, except for the RH 80 %, whose measured relative humidity was 100 %.

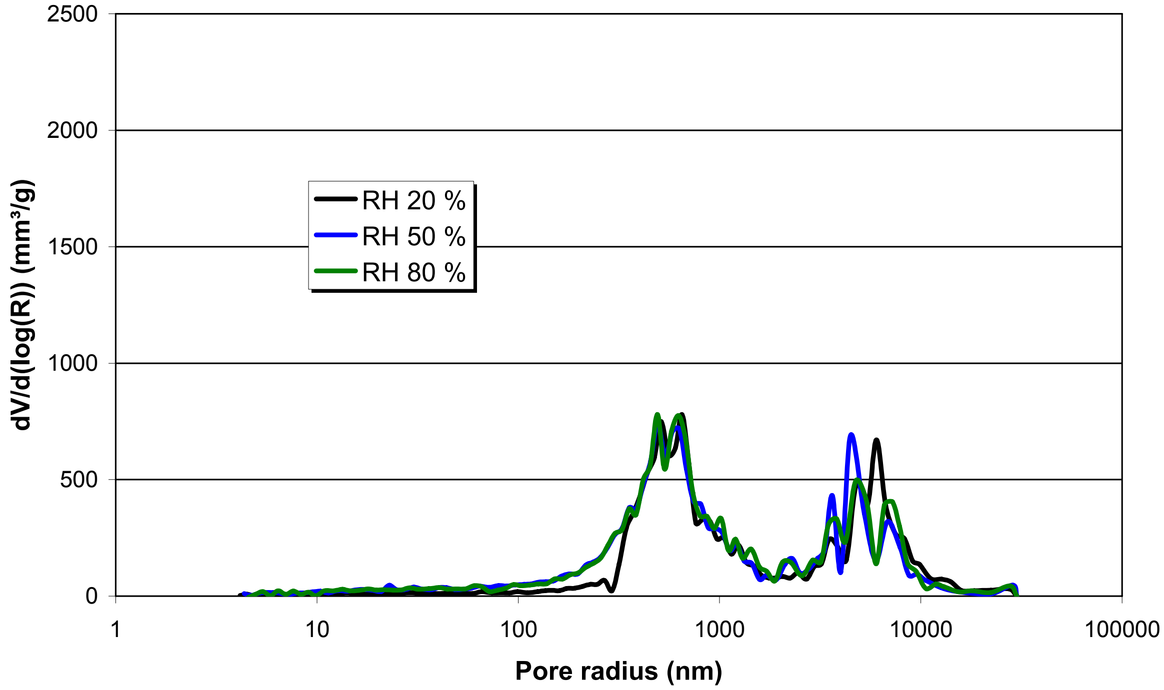

Figure 28. Pore size distribution of the core of the gypsum board. The legend denotes the target relative humidity of the chamber air, which is also the measured relative humidity of the chamber air ±5 % RH at the time when the samples were taken out from the environmental chambers for preparation.

The total porosity and the specific surface area of the different samples are presented in Table 19. Even though an increase in the relative humidity caused a shift in the pore size distribution curve of plaster A towards larger pores, this did not cause an increase in its total porosity. On the contrary, its total porosity decreased with increasing relative humidity of the storing conditions. The shift in the pore size distribution could be caused by an increase in the internal moisture content caused by the higher relative humidity of the ambient air. The increase in the total porosity with decreasing relative humidity, on the other hand, could be a consequence of the increased water evaporation. There was, however, no distinct difference in the relative weight changes at the different relative humidities.

The total porosity of plaster B, on the other hand, increased with increasing relative humidity. This could be a consequence of an increase in the internal moisture content. There was, however, no observable shift in the pore size distribution. Plaster C and the core of the gypsum board did not show any definite trends as far as their total porosity at different relative humidities is concerned.

The specific surface area of plaster B increased with increasing relative humidity of the surrounding air. This is the only observable trend, all samples considered, regarding the influence of relative humidity on the specific surface area.

The total porosity and, especially, the specific surface area differ quite much between different plasters. Plaster A has the smallest total porosity and specific surface area, while the total porosities of plasters B and C are fairly equal. The specific surface area is largest for plaster B. Thus, plaster B has considerably more pores and they also encompass a larger pore size distribution than is the case for the other plasters. This can also be observed in Figures 6-8. The total porosity of the core of the gypsum board is higher than that of the plasters, but its specific surface area is intermediate.

Table 19. Total porosity and specific surface area of the plasters and the core of the gypsum board. The relative humidity indicates the target relative humidity value of the environmental chambers at the time when the samples were taken out from the chambers for sample preparation ±5 % RH.

Sample	Relative humidity (%)	Total porosity (%)	Specific surface area (m^2/g)
Plaster A	20	54.7	1.2
	50	48.0	0.8
	80	47.7	1.0
Plaster B	20	56.5	24.8
	50	57.0	25.3
	80	59.4	26.1
Plaster C	20	52.9	6.4
	50	55.0	6.5
	100	54.5	6.8
Core of gypsum board	20	67.2	10.3
	50	67.1	9.9
	80	69.2	9.8

7.4 pH-MEASUREMENTS

The pH of the products according to their operational safety sheets and the measured values of the top layers one hour and one day after the finish of a test series are presented in Table 20. The structures studied consisted of (from the top to the bottom layer) paint or adhesive, primer (no primer for adhesives), plaster, filler, and CSB. The pH of plaster B applied onto filler B, the pH of plaster C, and the pH of gypsum board are also presented in Table 20.

Table 20. The pH-values of the different samples.

Material	Declared pH	Measured pH at 1 hour	Measured pH at 1 day
Paint A	-	6 - 8	5
Paint B	7.8 - 8.4	6 - 8	6 - 7
Adhesive A	~6	5 - 7	5
Adhesive B	6.5 - 7.5	5 - 7	5
Plaster B	9	9$^{1)}$	7
Plaster C	7 - 8	4 - 7$^{1)}$	5
Gypsum board	7 - 8	5	5

$^{1)}$ The pH-value was determined immediately after the samples had been removed from the test chambers

The pH-value of paints A and B was higher the higher the relative humidity of the storing conditions after one hour exposure to room air. The pH-values were somewhat higher on plaster C than on plaster B and higher for paint B than for paint A. The pH of the paints decreased more slowly than that of the adhesives.

Also both adhesives A and B had a higher pH-value the higher the relative humidity of the storing conditions after one hour exposure to room air. The pH-value was again somewhat higher for adhesives spread onto plaster C than was the case for plaster B. The toothing of the spatula that was used for spreading the adhesives caused shifts in the pH-values. The pH-value was usually higher between brows and lower on their top. The phenomenon was more pronounced for samples stored at lower relative humidities.

The pH of plaster B was about 9 immediately after it had been removed from a climate chamber irrespective of the relative humidity it had been stored at. After one hour exposure to room air, its pH-value had dropped to about 8. The corresponding values for plaster C were 4-5, 5, and 7 when stored at RH 20 %, RH 50 %, and RH 80 % target relative humidities (note: the measured value of the RH 80 % chamber was 100 % throughout the testing period), respectively, immediately after it had been removed from a climate chamber. One hour later the pH was about 5 for all three samples.

The pH of the adhesives and paints applied onto gypsum board was not measured, since it was not considered to be as much affected by the substrate. The relative humidity of the room air was between 25 % and 50 % during the measurements presented in the preceding paragraphs.

7.5 RELATIVE HUMIDITY

The relative humidity of the chamber air was recorded for the first hours after a sample had been introduced into a climate chamber and after that once a day until the end of a test series. The results are presented in the following sections in a chronological order.

7.5.1 Part I. Single material layers on a glass substrate

The measured relative humidity of the chamber air as a function of time for paints A and C, all three adhesives, plasters A and C, and the gypsum board on a glass plate in a climate chamber is presented in Figures 29-31. The relative humidity values in the legend boxes denote the target relative humidity, which is also the relative humidity of an empty chamber ±5 % RH. The start of a test is denoted by time 0. Paints and gypsum board do not affect the relative humidity of the chamber air almost at all, as can be observed in Figures 29 and 31. However, it is to be noted that the second measurement of the relative humidity in the figures is not until day 1, i.e. 24 hours after the introduction of a sample into a chamber. The adhesives, and especially the plasters, do however affect it. A slower drying of adhesives stored at higher relative humidities could also be visually detected, since they turned from white to colourless during the drying process and this change occurred later the higher the relative humidity of the test chamber air.

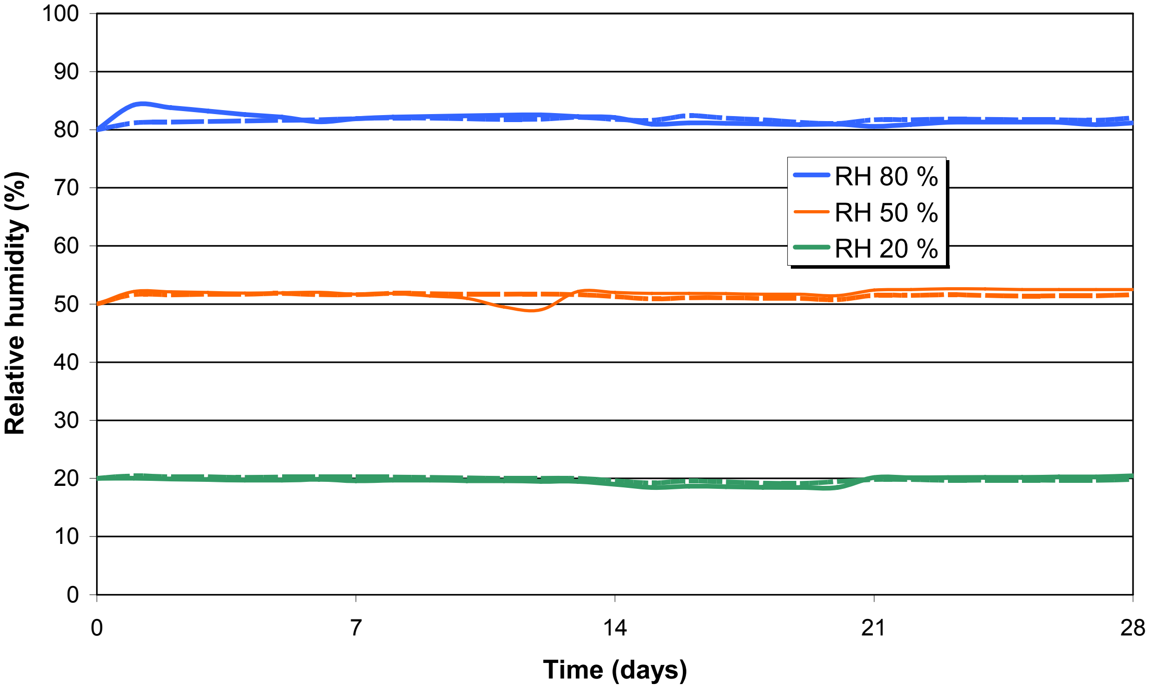

Figure 29. The measured relative humidity of the test chamber air. Paint A is marked by a solid line and paint C by a dashed line. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 14, and 28 days.

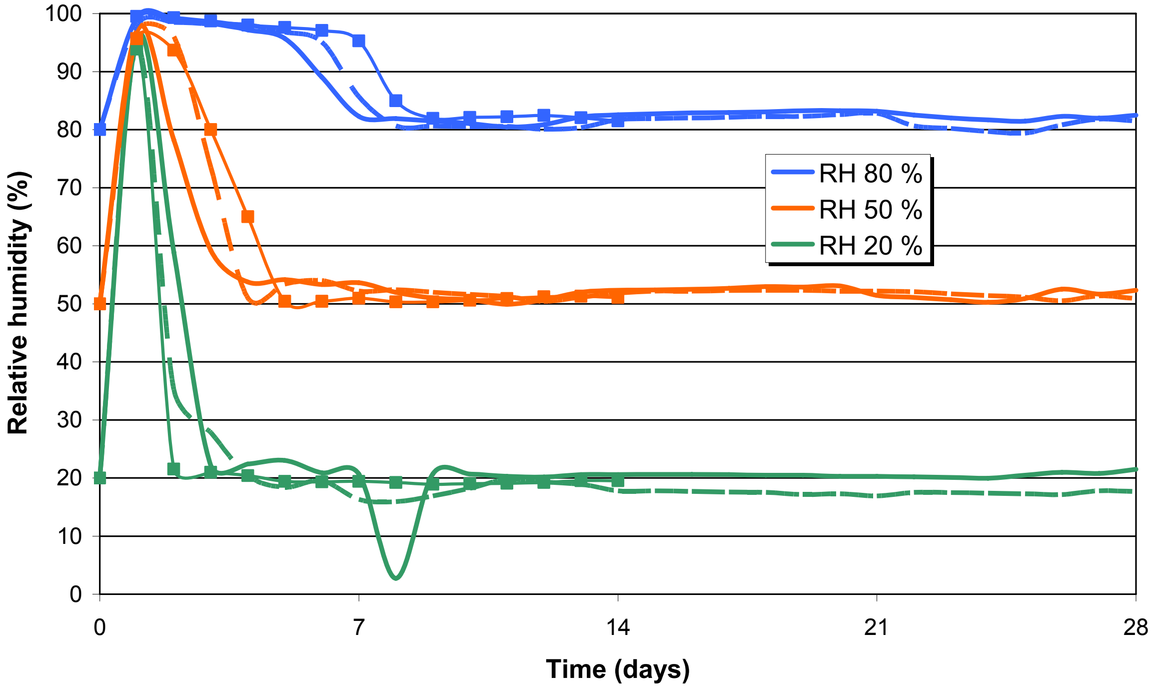

Figure 30. The measured relative humidity of the test chamber air. Adhesive A is marked by a solid line and adhesive C by a dashed line. The measurement period for adhesive B (boxed line) was 14 days. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 14, and 28 days (adhesives A and C) and at 1, 7, and 14 days (adhesive B).

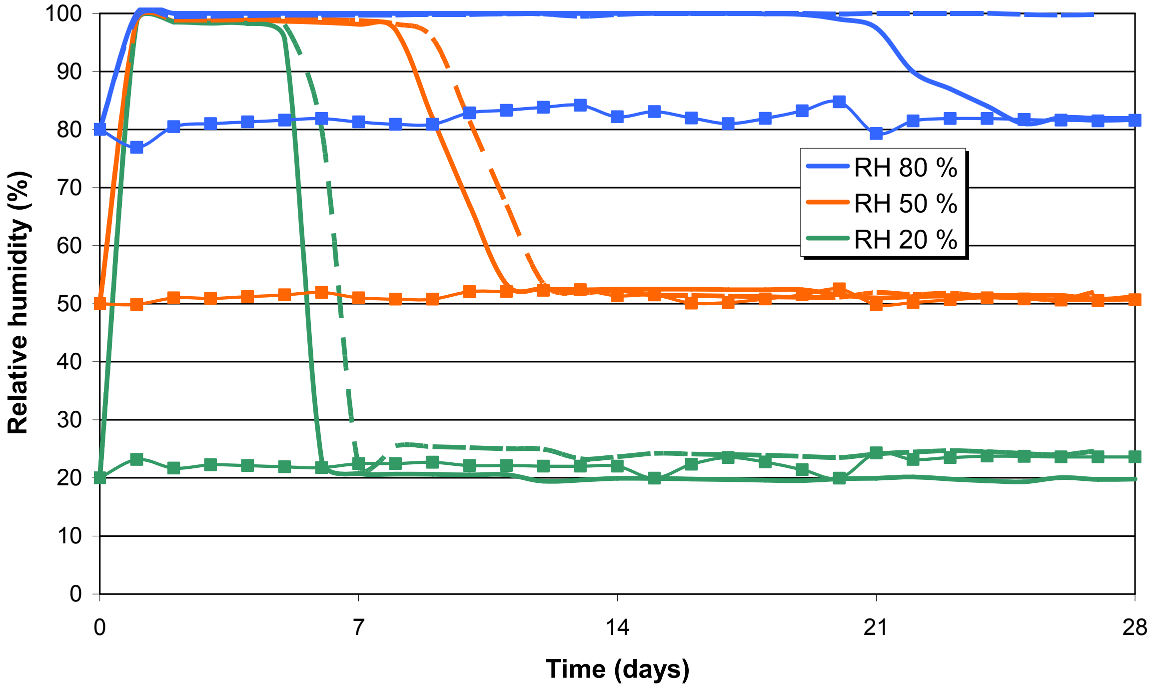

Figure 31. The measured relative humidity of the chamber air. Plaster A is marked by a solid line and plaster C by a dashed line. The sample thickness of the plasters was 3 mm. The gypsum board is marked by a boxed line. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 14, and 29 days (plaster A), at 1, 14, and 27 days (plaster C) and at 1, 14, and 28 days (gypsum board).

Both plasters had condensed moisture on the chamber walls and lid in the RH 50 % and RH 80 % chambers. This condensation was non-observable after 1 day (plaster A) and after 9 days (plaster C) in the RH 50 % chamber. Regarding the RH 80 % chamber, plaster A had no observable condensation after 22 days, while plaster C had condensation throughout the whole testing period of 27 days. The high relative humidity of the storing conditions made the plasters feel soft at the time when they were removed from the test chambers. This could also be noted as reduced cohesion and adhesion during FTIR-sample preparation.

7.5.2 Part II. Material combinations on a glass substrate

The measured relative humidity as a function of time of primers and their respective paints and plasters with their respective fillers (note: plaster C has no filler) spread onto a glass plate and introduced into a climate chamber (time 0) is presented in Figures 32 and 33. Paint C requires a different primer depending on the substrate, which is why its humidity history is presented with both primer A and primer C. Primer A is a water-borne product that is recommended as a primer for both paints A and C and primer C is an alkyd primer recommended for paint C.

The water-borne products affected the relative humidity in the RH 80 % chamber by raising it to 90-95 % during the first day. Otherwise the relative humidity level is unaffected by the paints. (This applies also to the combination of a water-borne primer and alkyd paint). The combinations of filler and plaster A or B and a single, 6 mm layer, of plaster C, on the other hand, kept the relative humidity level high throughout the whole testing period. Only the combinations of filler and plaster A and B in the RH 20 % chamber and filler and plaster A in the RH 50 % chamber had relative humidity values below 95 % before the end of the testing period of 14 days. All samples caused condensation of water on the chamber walls and lid in the RH 50 % and RH 80 % chambers. This condensation was non-observable after 6 days for the combinations of filler and plaster A and B and after 12 days for plaster C in the RH 50 % chamber only. Regarding the RH 20 % chamber, there was no observable condensation for plaster C after 1 day, while the other two product composites caused no observable condensation at all.

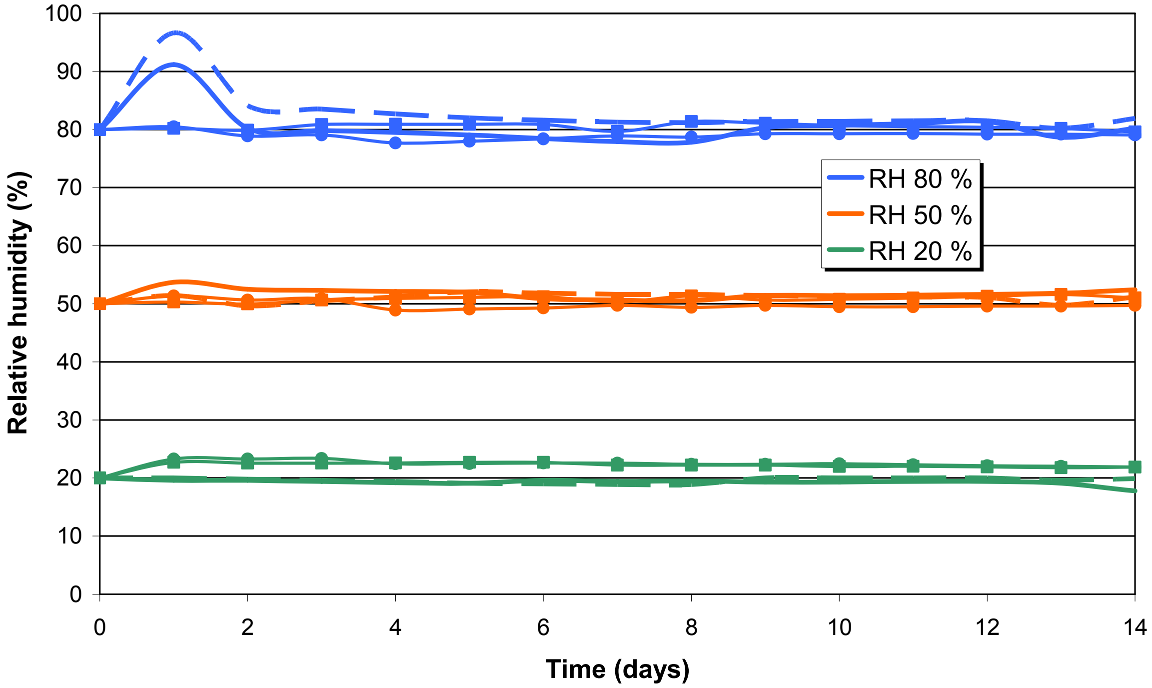

Figure 32. The measured relative humidity of the chamber air. The combination of primer A and paint A is marked by a solid line, primer B and paint B by a dashed line, primer A and paint C by a boxed line, and primer C and paint C by a circled line. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 7, and 14 days.

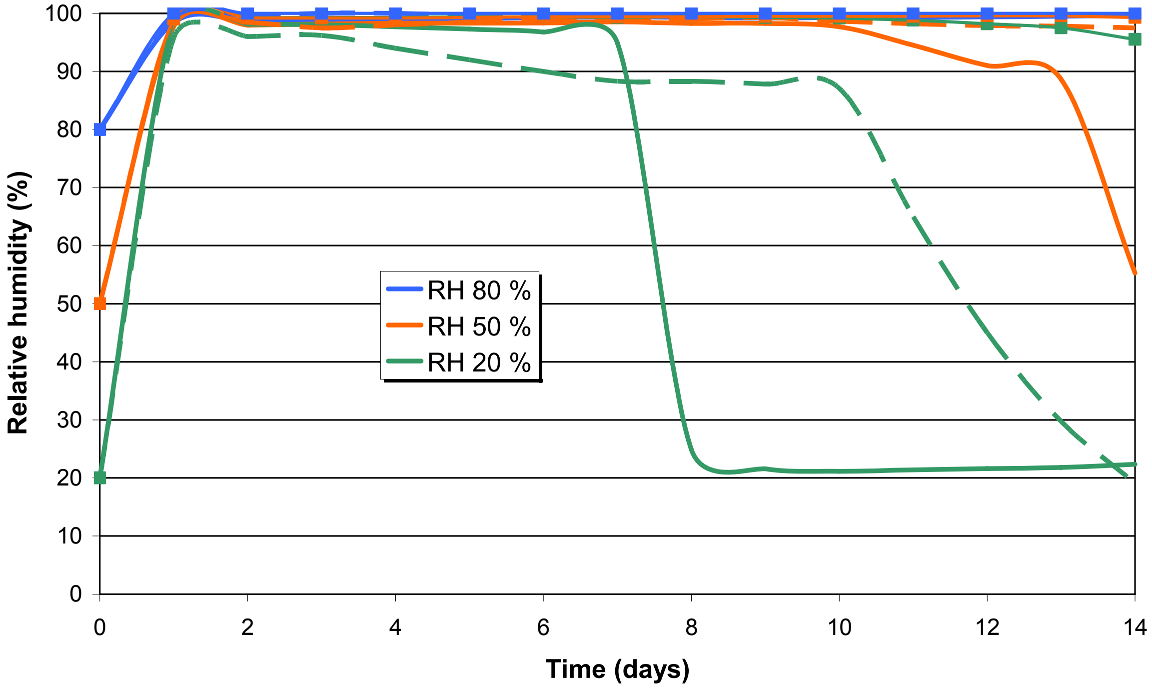

Figure 33. The measured relative humidity of the chamber air. The combination of filler A and plaster A is marked by a solid line, filler B and plaster B by a dashed line, and a 6 mm layer of plaster C by a boxed line. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 7, and 14 days.

7.5.3 Part III. Material combinations on gypsum board and CSB

The measured relative humidity as a function of time of the chamber air with adhesives A and B and primers and paints A and B spread onto a gypsum board and introduced into a climate chamber (time 0) is presented in Figure 34. It can be observed that the adhesives caused a higher rise in the relative humidity than does the combinations of primer and paint. The same phenomenon was observed in Figures 30 and 32, where the adhesives and respective combinations of primer and paint were spread onto a glass plate. It can also be observed that the rise is not as high as was the case for the glass plate. This indicates that part of the moisture in the adhesive has been absorbed by the gypsum board. The colour change of the adhesives from white to colourless occurred also earlier than was the case when they were applied onto glass plates. The colour change was more difficult to observe when the adhesives were applied onto plasters because of the colour of the substrate. However, it was noted that adhesive A applied onto the combination of filler and plaster B looked white still after two days in the chamber with the RH 20 % target relative humidity. This can be observed also in Figure 35. It can also be observed regarding the combinations of primer and paint A and B that the gypsum board had absorbed some of the moisture from the primer already during sample preparation and this contributed to the rise in the relative humidity in the chambers with RH 20 % and RH 50 % target relative humidities.

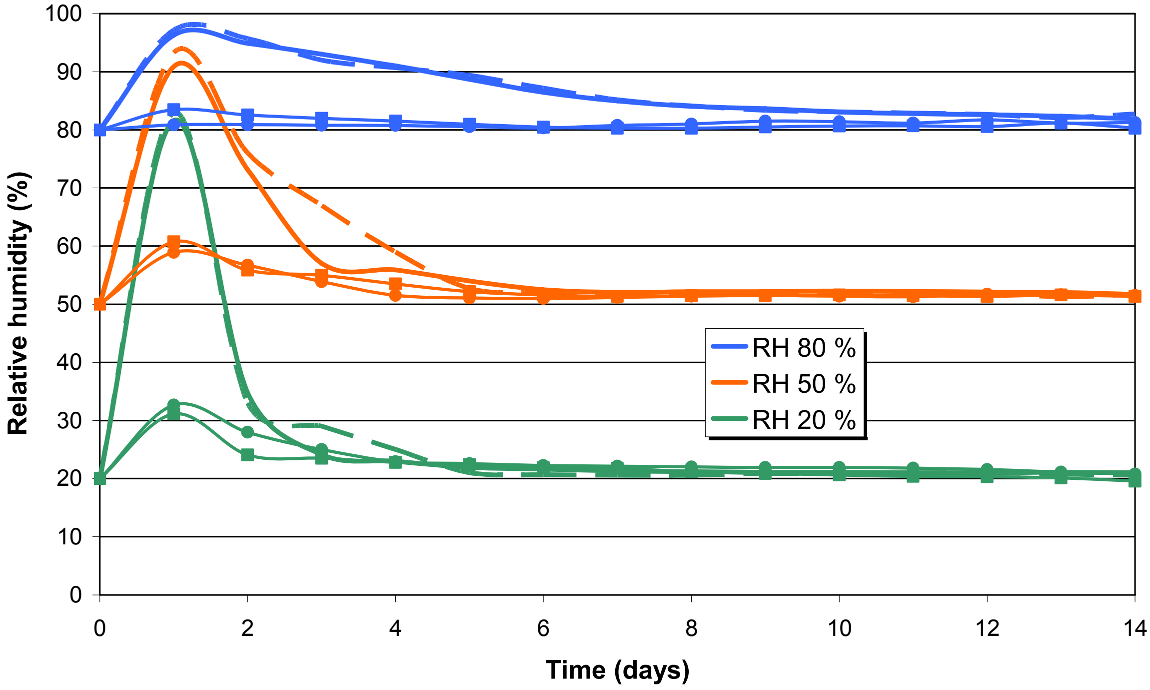

Figure 34. The measured relative humidity of the chamber air. Adhesives A and B spread onto gypsum board are marked by solid and dashed lines, respectively. The combinations of primer A and paint A and primer B and paint B spread onto gypsum board are marked by boxed and circled lines, respectively. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 7, and 14 days.

The measured relative humidity as a function of time of the chamber air with adhesives A and B spread onto the combination of filler and plaster B and a 6 mm layer of plaster C and introduced into a climate chamber (time 0) is presented in Figure 35. It can be observed that the humidity level stays higher for a longer period of time than was the case for the gypsum board. This is caused by the moisture evaporating from the plaster (+filler) through the adhesive layer. The humidity level is, however, not as high as it is for plasters without a coating. There are two factors that affect this result. One is that the plasters dried for one day before the application of the adhesive according to the manufacturer's recommendations and the other factor is that some of the moisture in the plaster was most probably absorbed by the calcium silicate brick that the plaster or filler was applied onto. Thus, the measured humidity results indicate that material combinations should be considered as separate entities and no general conclusions should be made based on single structural components. This will be dealt with further in the following chapters.

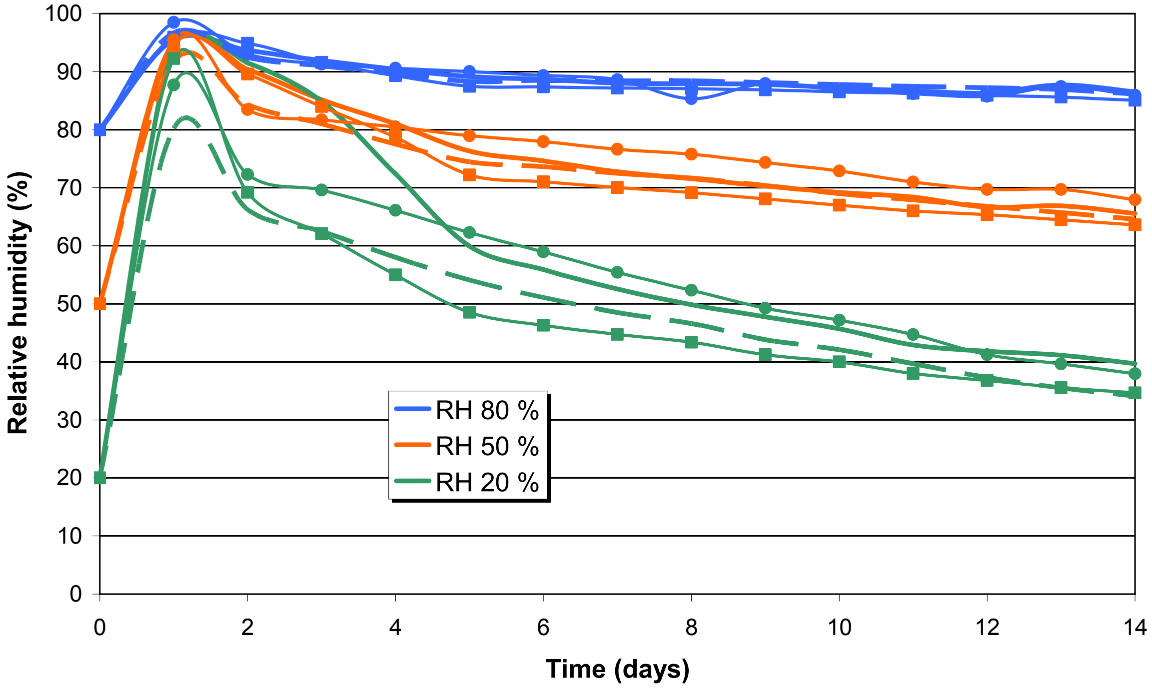

Figure 35. The measured relative humidity of the chamber air. Adhesive A spread onto the combination of filler and plaster B and a 6 mm layer of plaster C is marked by solid and dashed lines, respectively. Adhesive B spread onto the combination of filler and plaster B and a 6 mm layer of plaster C is marked by boxed and circled lines, respectively. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 7, or 14 days depending on the criteria set by the factorial design.

The measured relative humidity as a function of time of the chamber air with the combinations of primer A and paint A and primer B and paint B spread onto the combination of filler B and plaster B and a 6 mm layer of plaster C and introduced into a climate chamber (time 0) is presented in Figure 36.

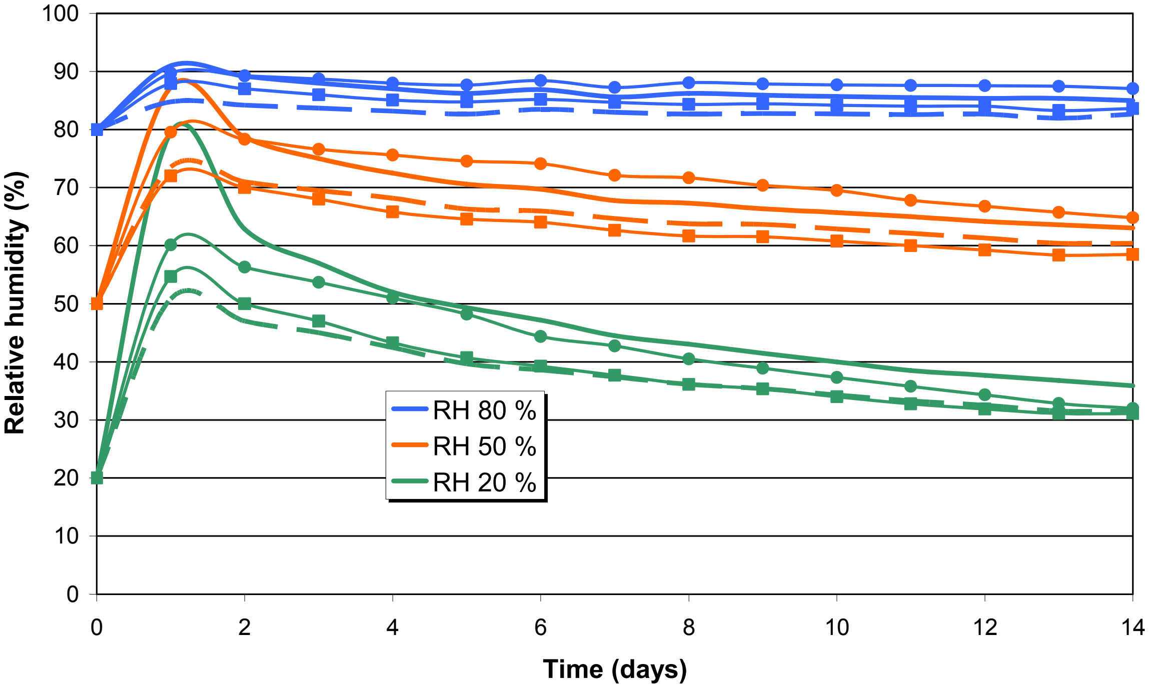

Figure 36. The measured relative humidity of the chamber air. The combination of primer A and paint A spread onto the combination of filler B and plaster B and a 6 mm layer of plaster C is marked by solid and dashed lines, respectively. The combination of primer B and paint B spread onto the combination of filler B and plaster B and a 6 mm layer of plaster C is marked by boxed and circled lines, respectively. The legend box indicates the target relative humidity. Duplicate VOC-samples were collected at the age of 1, 7, or 14 days depending on the criteria set by the factorial design.

It is to be observed that the second measurement of the relative humidity of the chamber air in Figures 29-36 is at 1 day. Water-borne materials caused a rapid rise of the relative humidity of the chamber air only hours after their introduction into the chamber. This is demonstrated in Figure 37. The relative humidity rises to 90 - 100 % already 1 hour after the introduction of adhesive C spread onto a glass plate irrespective of the initial relative humidity of the chamber air. The relative humidity of the laboratory room at the start of the test was approximately 20 %. The gypsum board causes an initial rise in the humidity level for the first hours at RH 20 % and a small decrease at the other two relative humidities. The relative humidity of the laboratory room at the start of the test was approximately 30 %. The relative humidity reaches equilibrium, however, in 24 hours. Paint C also causes an initial decrease of the relative humidity in the RH 50 % and RH 80 % chambers. The relative humidity of the laboratory room at the start of the test was also approximately 30 %. Equilibrium is again reached in about 24 hours.

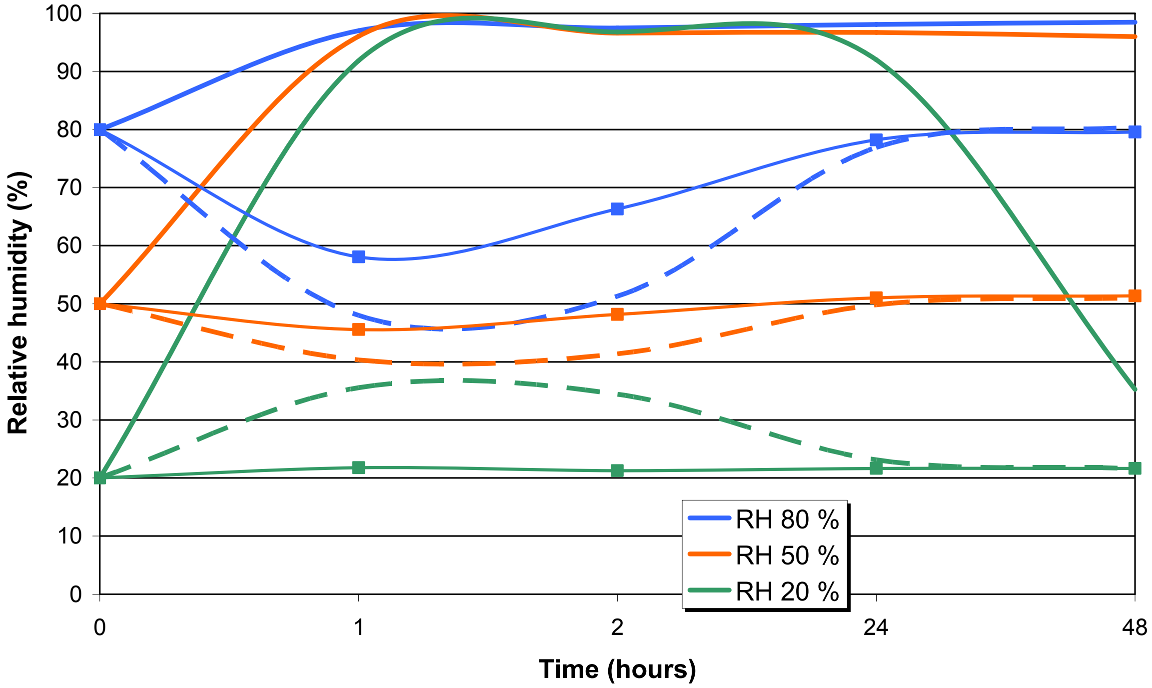

Figure 37. The measured relative humidity of the chamber air during the first 48 hours of a test. All samples are applied onto a glass plate. Adhesive C is marked by a solid line, gypsum board is marked by a dashed line, and paint C is marked by a boxed line.

7.6 WEIGHT CHANGES

The weight of the samples was recorded during sample preparation and after the chamber measurements were finished for each material/material combination. The results are presented in the following chapters in a chronological order. The numerical values are presented in Appendix B.

7.6.1 Part I. Single material layers on a glass substrate

The relative weight change of paints A and C and adhesives A and C before and after the chamber measurements are shown in Figure 38. The weight change of the water-borne materials (paint A and both adhesives) was smaller the higher the target relative humidity of the chamber air. The weight change of the alkyd resin paint (paint C) was not affected by the relative humidity of the storing conditions. The measured relative humidity values were presented in Figure 30.

The weight change of plasters A and C and the gypsum board are shown in Figure 39. The weight change of plaster A was not affected by the relative humidity of the storing conditions. The weight change of the gypsum board followed that of the water borne materials. This was, on the other hand, an expected result, since the relative humidity of the laboratory room where the samples were prepared was approximately 30 % at the time of the start of the testing. Thus, the gypsum board absorbed moisture from the surrounding air at RH 80 %, which explains its negative value. The measured relative humidity values were presented in Figure 31.

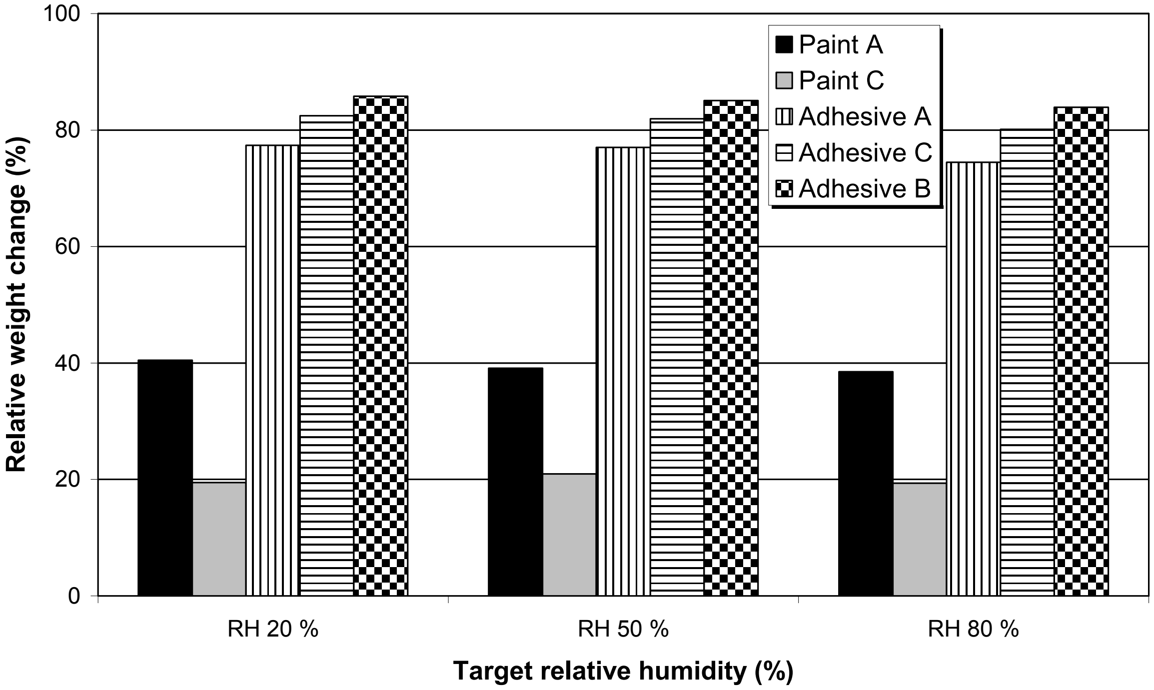

Figure 38. Relative weight change of paints A and C and adhesives A and C after 28 days and adhesive B after 14 days in respective target relative humidity.

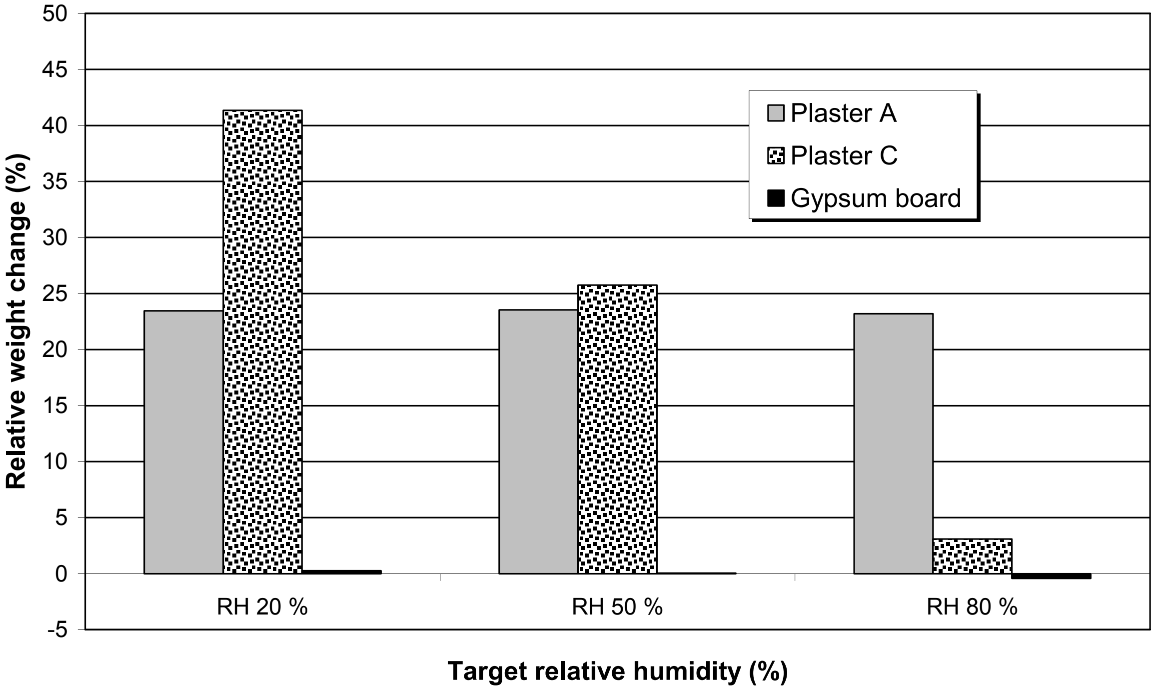

Figure 39. Relative weight change of plasters A and C and the gypsum board after 28±1 day in respective target relative humidity. The thickness of the plaster layer is 3 mm.

7.6.2 Part II. Material combinations on a glass substrate

The relative weight change of the combinations of primer and paint are presented in Figure 40. The relative weight change of the water-borne paints decreased with increasing relative humidity of the storing conditions, as could be expected. The same phenomenon is also observed for the combination of primer A and paint C. This indicates that the paint does not form an impervious layer, but rather an integral product together with its primer. It can also be noted that the relative weight change of the water-borne paints is about 3-times higher than that of the alkyd paint. The measured relative humidity values were presented in Figure 32.

The relative weight change of plasters A and B with their respective fillers and a 6 mm layer of plaster C are presented in Figure 41. The weight change of plaster A was, when used in combination with its filler, affected by the high relative humidity contrary to what was observed for the single layer of the plaster. This indicates that the evaporation from plaster A when applied onto a filler is affected both by the high relative humidity of the surrounding air and by its substrate resulting in a decreased relative weight change. The measured relative humidity values were presented in Figure 33.

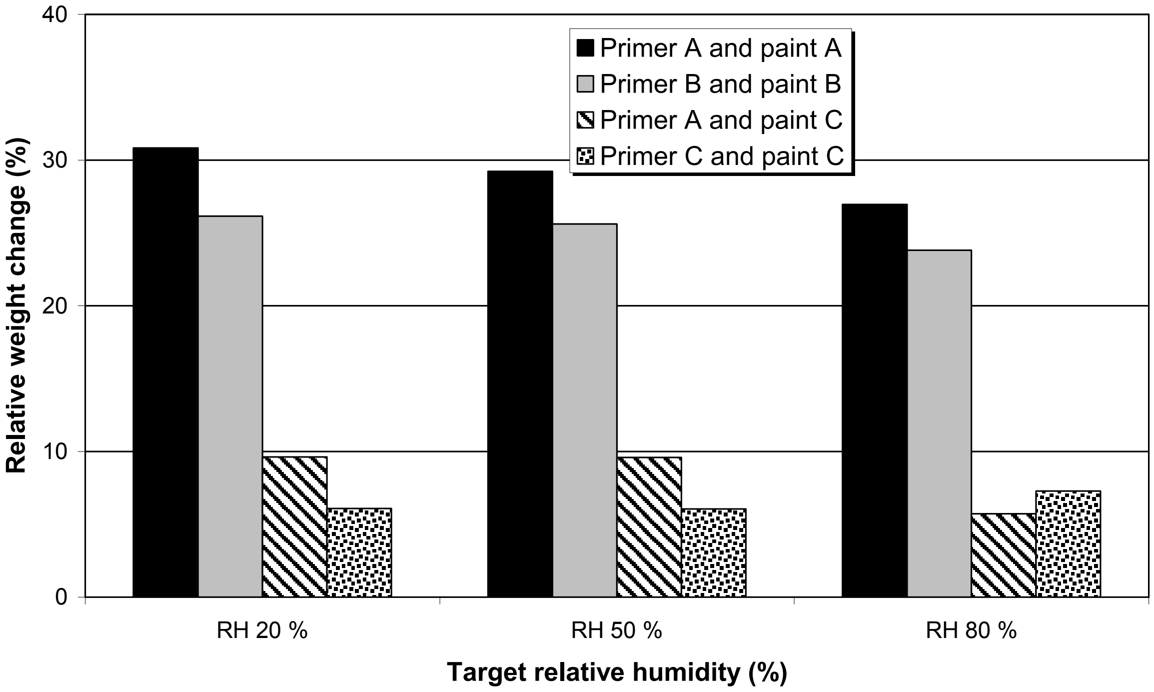

Figure 40. Relative weight change of the different paints after 14 days in respective target relative humidity.

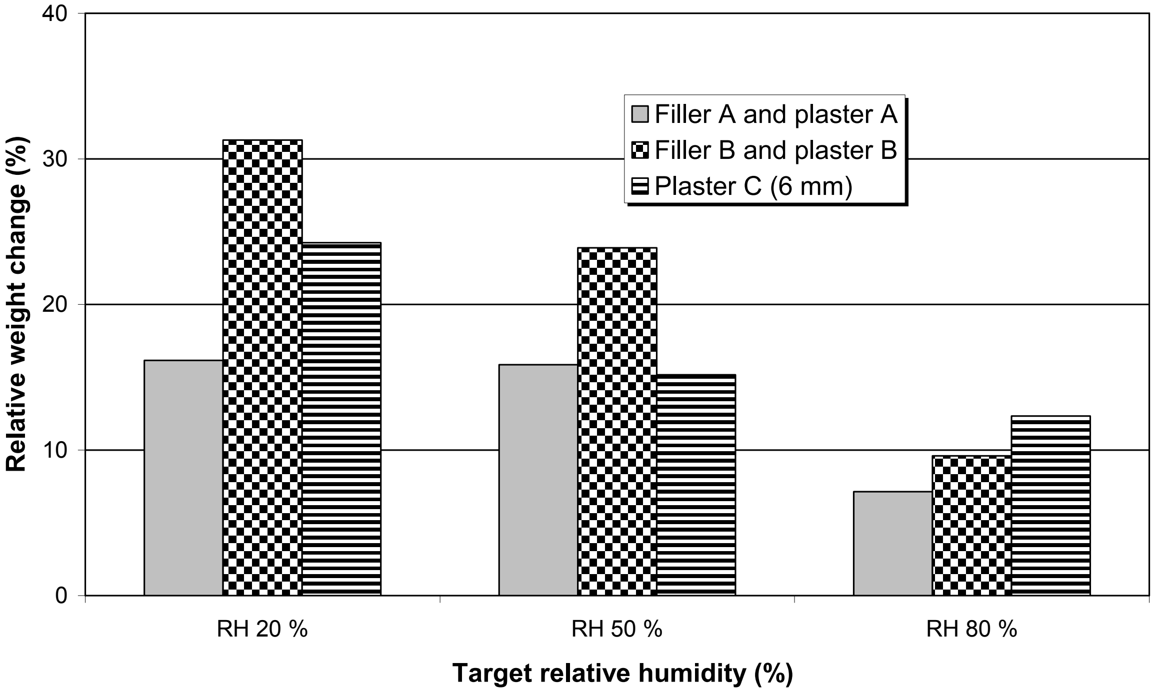

Figure 41. Relative weight change of the different filler and plaster combinations and a 6 mm layer of plaster C after 14 days in respective target relative humidity.

7.6.3 Part III. Material combinations on gypsum board and CSB

The relative weight change of the material combinations applied onto gypsum board (GB) and calcium silicate brick (CSB) are presented in Figures 42-44. The relative weight change of adhesive B applied onto gypsum board is higher than that of adhesive A. The weight change of adhesive B applied onto gypsum board and stored at the different relative humidities is lower and decreases more pronouncedly with increasing relative humidity compared with the glass substrate. This is caused by the fact that the moisture in the adhesive is partly absorbed by the gypsum board. The same observation can be made for the combinations of primer and paint The weight change of the combination of primer A and paint A is higher than that of the combination of primer B and paint B when spread onto gypsum board, as was observed for the glass plate, and the weight change at the different relative humidities is lower and decreases more pronouncedly with increasing relative humidity compared with the glass substrate. The exception to the foregoing is the fact that the relative weight change at the RH 20 % target relative humidity is somewhat higher when primer s and paints are spread onto gypsum board than was the case when they were spread onto glass. This is probably caused by the fact that the gypsum board had absorbed some of the moisture from the primer already during sample preparation and this contributes to the weight change. The measured relative humidity values of material combinations on gypsum board and CSB were presented in Figures 34-36.

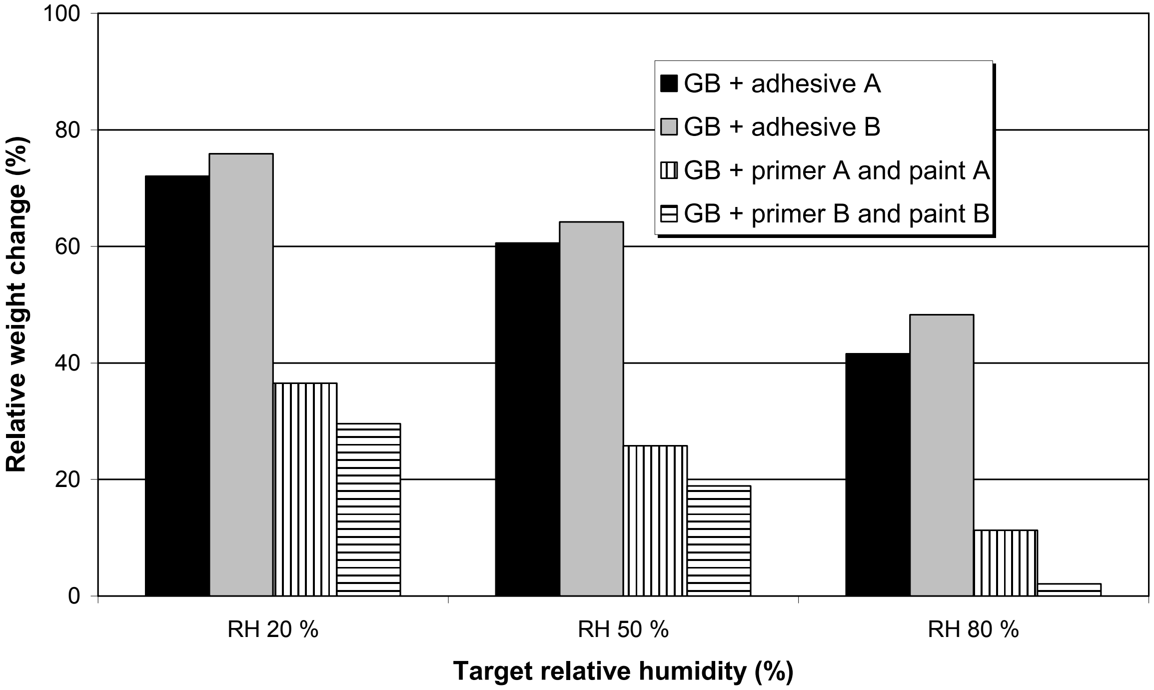

Figure 42 Relative weight change of adhesives A and B and the combinations of primer and paint A and B spread onto gypsum board after 14 days in respective target relative humidity.

The combination of filler and plaster B and a 6 mm layer of plaster C cause approximately a 3-4 -times higher relative weight change at the target relative humidities of RH 20 % and RH 50 % when the two adhesives A and B were applied onto them, compared with gypsum board. The difference becomes smaller at the target relative humidity of RH 80 %. The difference in the relative weight change is approximately 8-12 times higher on the combination of filler and plaster B and a 6 mm layer of plaster C applied onto CSB than on the gypsum board as far as the combinations of primer and paint at all three different target relative humidities are concerned. The reason for the difference between paints and adhesives is probably that the paints are more permeable than the adhesives and the contribution from the substrate to the weight change is, thus, bigger.

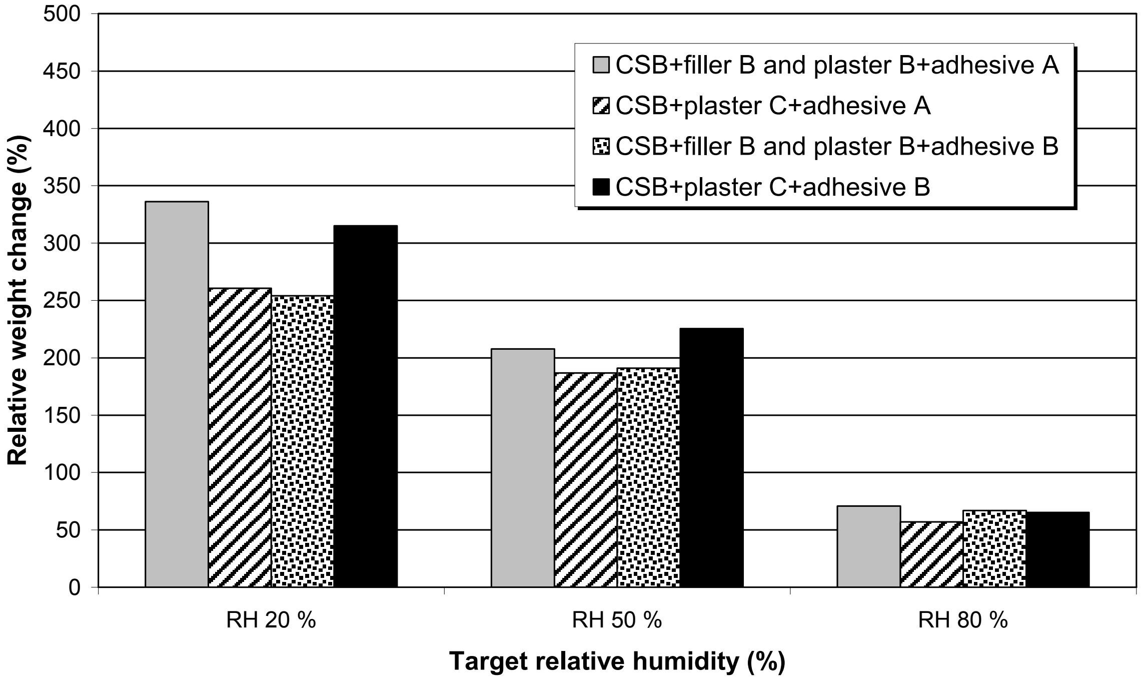

Figure 43. Relative weight change of adhesives A and B and spread onto filler and plaster B and a 6 mm layer of plaster C applied onto CSB after 14 days in respective target relative humidity.

Furthermore, it can be observed that the combination of filler B and plaster B reverses the internal weight change order between adhesives A and B that was observed for the gypsum board and plaster C. The same is observed for the combinations of primer and paint A and B applied onto plaster C compared with the gypsum board and filler B and plaster B.

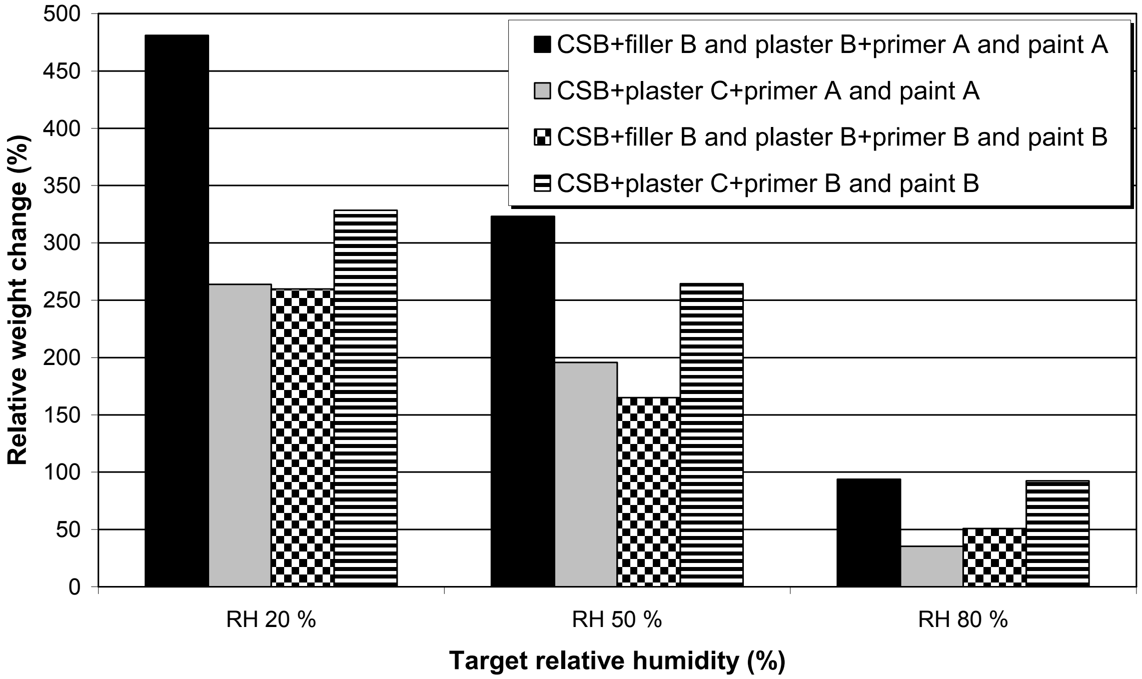

Figure 44. Relative weight change of the combinations of primer and paint A and B spread onto the combination of filler and plaster B and a 6 mm layer of plaster C after 14 days in respective target relative humidity.

When comparing the measured relative humidity values, presented in the preceding chapter, with the relative weight changes it can be observed that a higher measured relative humidity corresponds to a bigger relative weight change especially regarding painting products and adhesives independent of the substrate. This is a consequence of water evaporation. Furthermore, there was no observable correlation between relative humidity and the weight change of especially the alkyd paint, but this held, surprisingly, true also for plaster A. Finally, the gypsum board obviously maintained moisture equilibrium with its surroundings.

7.7 VOC EMISSIONS

7.7.1 Background VOC concentrations

The background VOC concentrations were measured always before the start of a test series. The results are presented in Appendix C in connection with respective material emission results.

The average background concentration of VOCs of the test chamber air was 21.4 µg/m³ (81 measurements) and its standard deviation was 14.7 µg/m³. The average background concentrations were 14.3 µg/m³, 22.3 µg/m³, and 27.6 µg/m³ at RH 20±5 %, RH 50±5 %, and RH 80±5 % target relative humidities, respectively. This could indicate that either the chamber with a higher relative humidity was more difficult to clean due to adsorption of VOCs on the chamber walls or that the deionised water used to adjust the relative humidity of the chamber air was not free of VOCs.

The average background concentration of VOCs measured with the FLEC-cell was 24.9 µg/m³ (27 measurements) and its standard deviation was 12.9 µg/m³. However, the result is influenced by the fact that, nevertheless, for some measurements the TVOC concentration was below the detection limit that was the value used in the calculations.

The background concentration was always subtracted from the measured sample concentrations before converting the values into area specific emission rates (SER_a). This might give rise to a small error in the sample concentrations measured at 7, 14, or 28 days from the test chamber air, since the background concentration might decrease with time. However, this was not confirmed.

The area specific emission rates calculated as TVOC ($TVOC_{SERa}$) and a more detailed study on the behaviour of certain single compounds is presented in the following chapters. All results are calculated as a mean of two consecutively collected (test chamber) or simultaneously collected (FLEC-cell) samples.

7.7.2 Part I. VOC emissions from single material layers on a glass substrate

7.7.2.1 Paint A

The $TVOC_{SERa}$ of paint A spread onto a glass plate are presented in Figure 45 and the SER_a of the most abundant compounds are presented in Table 21. The $TVOC_{SERa}$ of paint A is higher the higher the relative humidity of the storing conditions irrespective of the point of sample collection when samples are collected from the test chamber. The same trend is observed for the most abundant compounds at 1 day except for 1,2-propanediol. At 14 days the SER_a of all single compounds is <5 µg/m²·h except for 1,2-propanediol at the RH 20 % target relative humidity. At 28 days the SER_a of all single compounds is typically <1 µg/m²·h with a few exceptions. The most conspicuous exception is dichloromethane that is present at the RH 50 % target relative humidity having a SER_a of 29 µg/m²·h. The compound lies, however, outside the TVOC-region and is of unknown origin. What is also noteworthy is that compounds within a chemical group and the number of chemical groups are different at different relative humidities and points of time. The detailed results of samples collected from the test chambers are presented in Appendix C, Tables C2 to C4.

The SER_a of single compounds collected using the FLEC-cell at 28 days is in general so low, < 2 µg/m²·h, that a detailed analysis is superfluous. The only compound with an elevated SER_a is 2-butanone, 6 µg/m²·h emitted from the sample stored at RH 80 % target relative humidity. The samples collected from the environmental chambers also had very low SER_a-values at 28 days, so the results confirm each other. The detailed results of samples collected using the FLEC-cell are presented in Appendix C, Table C110.

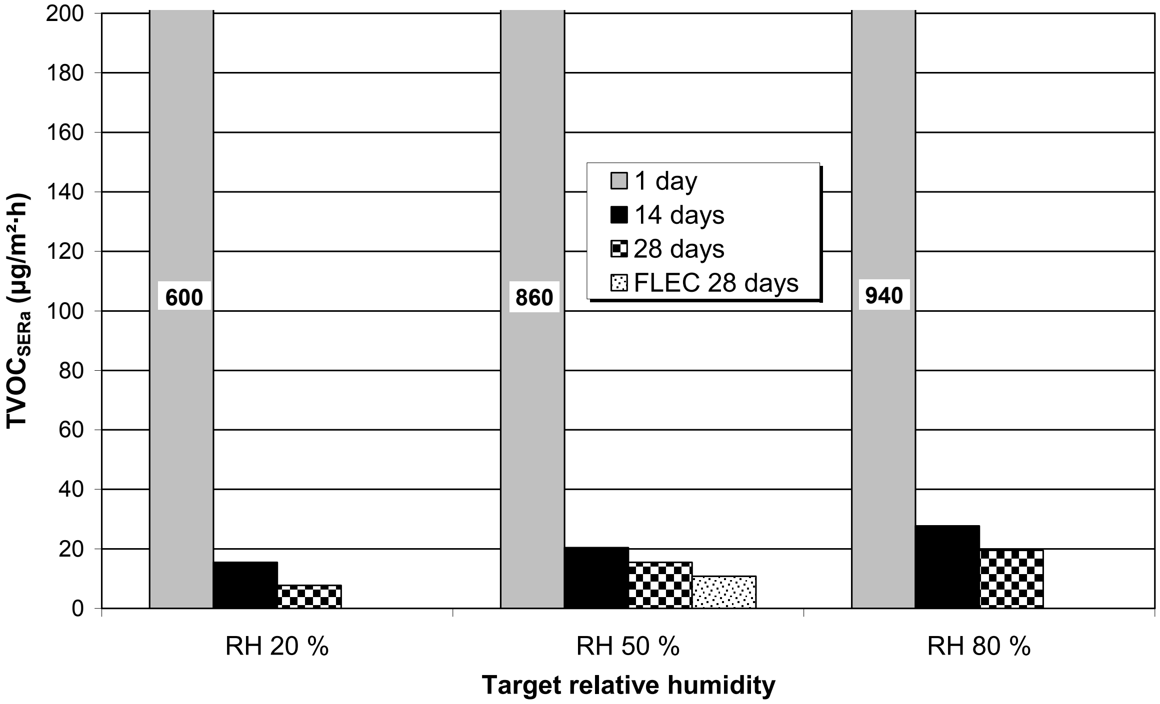

Figure 45. TVOC$_{SERa}$ of paint A spread onto a glass plate. The measured relative humidities were 20±5 %, 50±5 %, and 85±2 % at 1 day. At the other sample collection points the measured relative humidities were the same as the target relative humidities ±5% RH.

Table 21. The most abundant compounds emitted from paint A spread onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
1,2-propanediol	570	800	560			
hydrocarbon mixture	260	300	390			
2-(2-ethoxyethoxy)ethanol	130	200	200			
1-dodecene	80	110	210			
texanol	10	15	20			
14 days						
1,2-propanediol	15	2	2			
1-dodecene	4	5	5			
28 days						
1-dodecene	2	2	1	2	2	1
2-butanone	0	4	0	0	3	6

7.7.2.2 Paint C

The TVOC$_{SERa}$ of paint C spread onto a glass plate are presented in Figure 46 and the SER$_a$ of the most abundant compounds are presented in Table 22. The TVOC$_{SERa}$ of paint C is highest at RH 50 % target relative humidity irrespective of the point of sample collection.

One factor that contributes to the result is the fact that the weight difference between the samples at the start of the test period was quite large. Expressed as factors, the weights of the samples were 1.024, 1.092, and 1.00 at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. Taking this into consideration it can be deduced that the $TVOC_{SERa}$ of paint C is rather unaffected by the relative humidity of the storing conditions. The main chemical group emitted from paint C at 1 and 14 days is a mixture of hydrocarbons quantified as toluene-equivalents, which contains mainly aliphatic and alicyclic compounds in the boiling point range 130 °C to 250 °C. Their SER_a has the same trend than that of $TVOC_{SERa}$ as regards relative humidity at 1 day, but not anymore at 14 days. Other abundant compounds are different aldehydes and acids. The SER_a of aldehydes is higher the higher the relative humidity of the storing conditions at 1 day, but this trend is not observable later. Acids do not show any trend regarding relative humidity. The most abundant aldehyde is hexanal while the most abundant acid at 1 day is 2-ethylhexanoic acid and later on hexanoic acid. It is also noteworthy that acids with equal or higher boiling points than that of 2-ethylhexanoic acid are not present at 1 day but are present later on and that the SER_a of some acids is higher at 28 days than at 14 days. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C6 to C8.

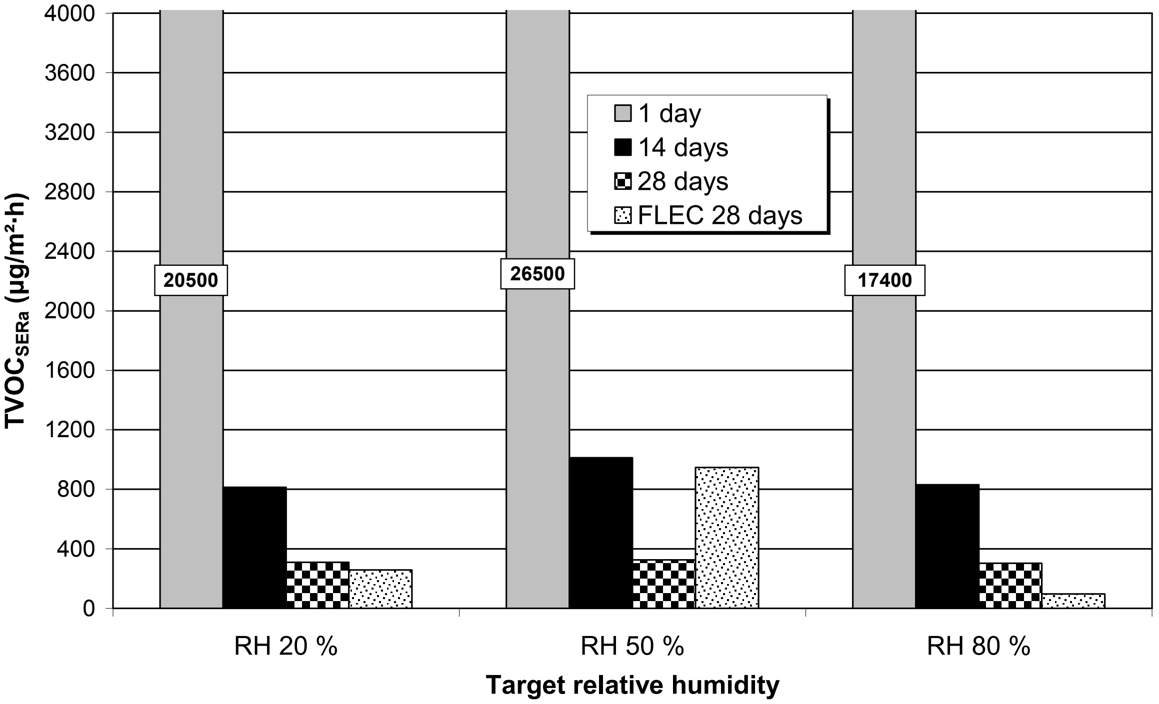

Figure 46. $TVOC_{SERa}$ of paint C spread onto a glass plate. The measured relative humidities were the same as the target relative humidities ±5% RH.

Table 22. The most abundant compounds emitted from paint C spread onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
hydrocarbon mixture	16800	21700	12100			
hexanal	1300	1500	1500			
2-ethylhexanoic acid	800	900	750			
pentanal	450	550	600			
hexanoic acid	350	350	450			
14 days						
hydrocarbon mixture	350	300	250			
hexanoic acid	170	280	240			
2-ethylhexanoic acid	160	170	120			
hexanal	80	100	80	2	2	1
28 days						
hexanoic acid	320	360	220	280	620	130
2-ethylhexanoic acid	30	30	30	20	40	10
hexanal	30	30	30	70	220	25
pentanoic acid	30	30	15	40	110	10
acetic acid	15	10	5	75	160	30

The $TVOC_{SERa}$ of the two different sample collection methods was about equal in size at the target relative humidity of RH 20 %, but FLEC sample collection resulted in a higher $TVOC_{SERa}$ at RH 50 % and a lower $TVOC_{SERa}$ at RH 80 % than what was obtained for test chambers. Hexanoic acid and hexanal were also the most abundant single compounds irrespective of sample collection method at 28 days, but there is quite a big difference in the SER_a-values between the two sample collection methods especially for samples stored at RH 50 % target relative humidity. The high SER_a of hexanal and hexanoic acid at RH 50 % is also the main reason for the differences in $TVOC_{SERa}$-values between the two sample collection methods. Pentanoic acid and acetic acid was also quite abundant in the samples collected using the FLEC-cell compared with the test chamber. The detailed results of the samples collected using the FLEC-cell are presented in Appendix C, Table C112.

7.7.2.3 Adhesive A

The $TVOC_{SERa}$ of adhesive A applied onto a glass plate are presented in Figure 47 and the SER_a of the most abundant compounds are presented in Table 23. There is no clear trend of the $TVOC_{SERa}$ of the adhesive regarding the relative humidity of the storing conditions except for 28 days, when it is higher the higher the relative humidity of the test chamber air irrespective of the sample collection method.

At 1 day the most abundant compounds are acetic acid and propyl benzoate. The SER_a of acetic acid is 1.5-times higher at RH 20 % than at the other two relative humidities. At 14 and 28 days acetic acid is still the most abundant single compound and its SER_a is higher the higher the relative humidity of the storing conditions also for samples collected using the FLEC-cell. Propyl benzoate is no longer observable at 14 days. The number of aliphatic, alicyclic and aromatic compounds increases with time and their SER_a is highest at 14 days. As far as other compounds are concerned, the number of chemical groups is higher at 28 days than at 14 days, but the SER_a of individual compounds is low, < 4 µg/m²·h. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C10 to C12.

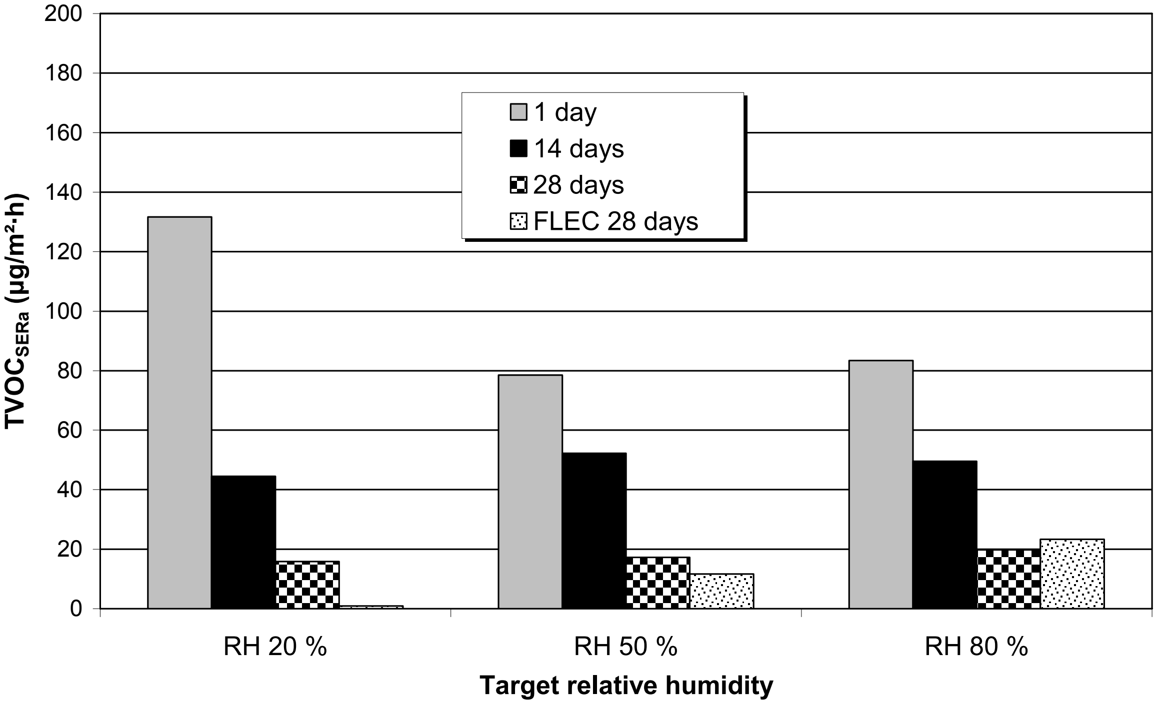

Figure 47. $TVOC_{SERa}$ of adhesive A sapplied onto a glass plate. The measured relative humidities were 95±5 %, 97±5 %, and 99±2 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively, at 1 day. At the other sample collection points the measured relative humidities were the same as the target relative humidities ±5% RH.

The by far most abundant compound in samples collected using the FLEC-cell is acetic acid, as was the case for the samples collected from the test chambers. Its SER_a is also higher the higher the relative humidity of the storing conditions. 2-butanone and butyl phthalate have also somewhat abundant SER_a-values for samples stored at the RH 80 % target relative humidity when collected using the FLEC-cell, i.e. 11 µg/m²·h and 9 µg/m²·h, respectively. These compounds were, however, not observed in any of the samples collected from the test chambers. The detailed results of the samples collected using the FLEC-cell are presented in Appendix C, Table C114.

Table 23. The most abundant compounds emitted from adhesive A applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
acetic acid	120	70	75			
propyl benzoate	25	25	30			
14 days						
acetic acid	10	20	70			
p,m-xylene	10	10	10			
28 days						
acetic acid	7	10	25	4	30	55

7.7.2.4 Adhesive C

The $TVOC_{SERa}$ of adhesive C applied onto a glass plate are presented in Figure 48 and the SER_a of the most abundant compounds are presented in Table 24. The $TVOC_{SERa}$ is higher the lower the relative humidity of the storing conditions at 1 day, while the trend is the opposite at 14 and 28 days for samples collected from the test chambers. However, the $TVOC_{SERa}$ is lower the higher the relative humidity of the storing conditions when the samples are collected using the FLEC-cell.

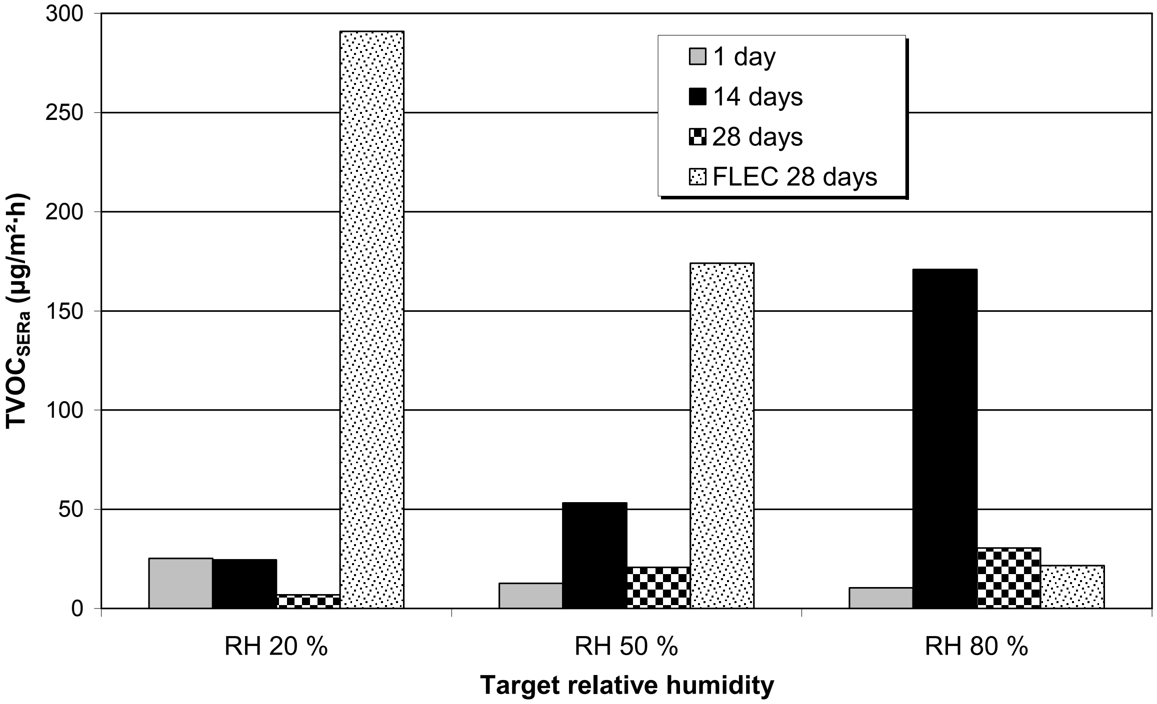

Figure 48. $TVOC_{SERa}$ of adhesive C applied onto a glass plate. The measured relative humidities were 94±5 %, 97±5 %, and 98±2 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively, at 1 day. At the other sample collection points the measured relative humidities were the same as the target relative humidities ±5% RH.

Table 24. The most abundant compounds emitted from adhesive C applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
acetic acid	340	230	180			
1,2-propanediol	85	40	15			
14 days						
acetic acid	15	60	110			
1,2-propanediol	3	85	230			
28 days						
acetic acid	5	20	30	360	360	50
1,2-propanediol	1	40	50	450	150	55

As far as the two most abundant compounds, 1,2-propanediol and acetic acid, are concerned their SER_a follows the same trend as that of $TVOC_{SERa}$ irrespective of time and sample collection method. The SER_a of aldehydes and ketones which were somewhat abundant compounds at 1 day is almost zero at 14 and 28 days. Furthermore it can be noted that the number of aromatic compounds is quite high at 14 and 28 days and that their SER_a is highest at 14 days. The number of chemical groups is higher at 28 days than at 14 days, but the SER_a of the individual compounds is low, < 3 µg/m²·h for samples collected from the test chambers. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C14 to C16.

Other significant differences between the two sample collection methods, except the trends of $TVOC_{SERa}$ and the two most abundant species as regards the relative humidity of the storing conditions, are that ketones and esters were observed only using the FLEC-cell. Other chemical groups that are observed only using the FLEC-cell are nitrogen and especially sulphur containing compounds. The detailed results of the samples collected using the FLEC-cell are presented in Appendix C, Table C116.

7.7.2.5 Plaster A

The $TVOC_{SERa}$ of a 3 mm layer plaster A applied onto a glass plate are presented in Figure 49 and the SER_a of the most abundant compounds are presented in Table 25. There is no clear trend of the $TVOC_{SERa}$ of the plaster regarding the relative humidity of the chamber air for samples collected from the test chambers except at 29 days, when it is higher the higher the relative humidity of the storing conditions. However, this trend is not observed for samples collected using the FLEC-cell.

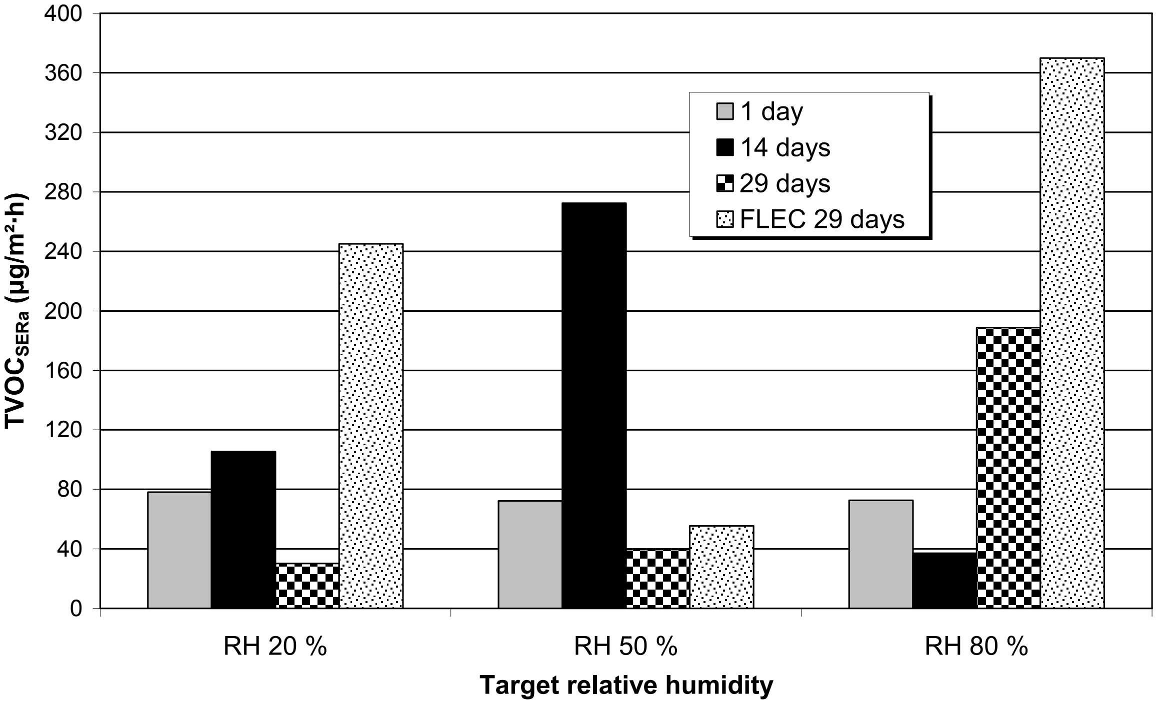

Figure 49. TVOC$_{SERa}$ of a 3 mm layer of plaster A applied onto a glass plate. The measured relative humidities were 99±5 %, 99±5 %, and 100±3 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively, at 1 day. The corresponding values were 20±5 %, 50±5 %, and 100±3 % at 14 days, respectively, and at 28 days they were the same as the target relative humidities ±5% RH.

Table 25. The most abundant compounds emitted from plaster A applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
1-methoxy-2-propanol	20	20	20			
1,2-propanediol	10	7	4			
14 days						
1,2-propanediol	160	250	30			
acetic acid	10	15	5			
2-(2-ethoxyethoxy)ethanol	7	35	1			
29 days						
1,2-propanediol	5	20	30	280	50	420
2-(2-ethoxyethoxy)ethanol	3	3	20	8	2	15
bis(2-hydroxypropyl)ether	1	15	30	0	0	5

The SER$_a$ of the other compounds except those presented in Table 25 is < 5 µg/m²·h regardless of the point of sample collection or the sample collection method. The detailed results of the samples collected from the test chambers and by using the FLEC cell are presented in Appendix C, Tables C18 to C20 and Table 118, respectively.

When the TVOC$_{SERa}$ of plaster A and the humidity profiles of the different environmental chambers (Figure 31) is compared, it can be observed that at day 1 the TVOC$_{SERa}$ is relatively low and the relative humidity of all three chambers is approximately 100 %. At 14 days the measured relative humidity of the RH 20 % chamber had been approximately 20 % for seven days, while the measured relative humidity of the RH 50 % chamber had reached the RH 50 % level three days before the time of sample collection. Thus, it is possible that the drying of the plaster in the RH 20 % chamber had lead to a relatively rapid emission process followed by a relatively low and stable, i.e. a diffusion-controlled, emission rate. Thus, the relatively high TVOC$_{SERa}$ of the RH 50 % chamber at 14 days could be a consequence of the drying process that had ended three days before the sample collection, since the same phenomenon can be observed for the RH 80 % chamber at 29 days, for which the drying process had also finished three days before the time of the sample collection. Thus, it seems that a drying process causes an increase in the SER$_a$, while a high relative humidity, and possibly also the condensation of water on the chamber walls that was observed and possible sink effects related to it, results in low SER$_a$.

7.7.2.6 *Plaster C*

The TVOC$_{SERa}$ of a 3 mm layer of plaster C applied onto a glass plate are presented in Figure 50 and the SER$_a$ of the most abundant compounds are presented in Table 26.

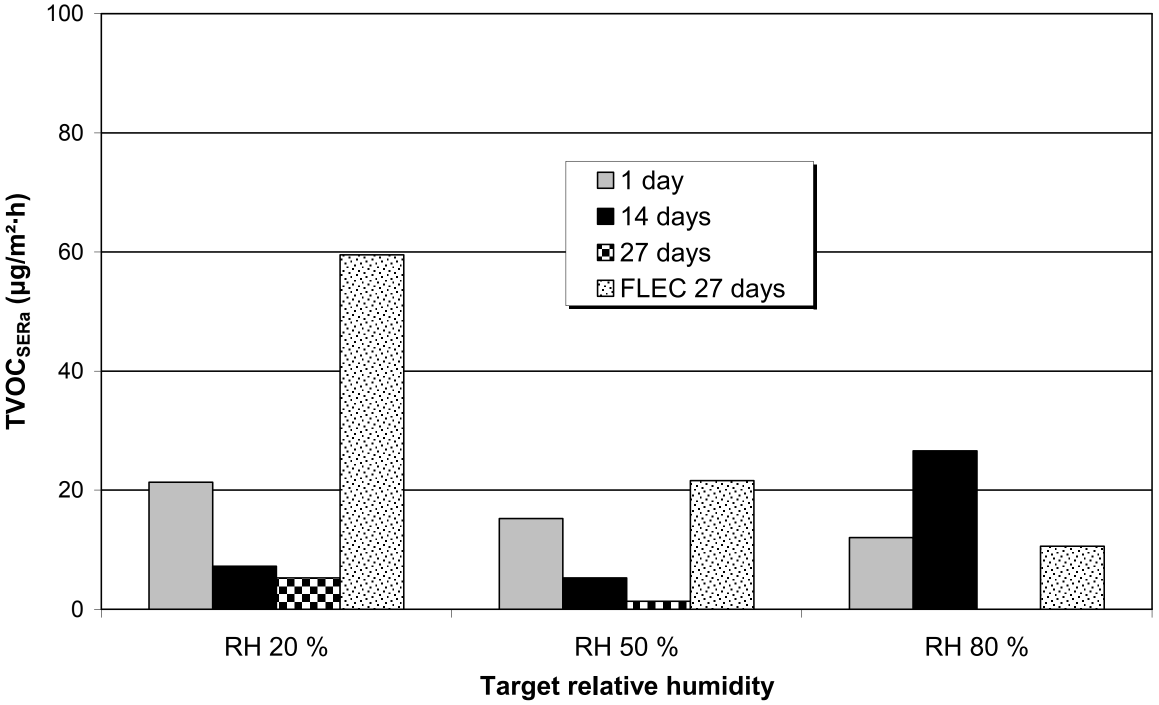

Figure 50. TVOC$_{SERa}$ of a 3 mm layer of plaster C applied onto a glass plate. The measured relative humidities were 99±3 % at all three different target relative humidities at 1 day. The corresponding values were 25±5 %, 50±5 %, and 99±3 % at 14 and 27 days, respectively.

Table 26. The most abundant compounds emitted from plaster C applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
all compounds	≤ 3	≤ 3	≤ 2			
14 days						
hydrocarbon mixture	0	0	20			
27 days						
p,m-xylene	< 1	< 1	< 1	10	4	1
toluene	-	-	-	15	4	1

The $TVOC_{SERa}$ of plaster C is lower the higher the relative humidity of the storing conditions at 1 and 27 days. The same trend is observed for samples collected using the FLEC-cell at 27 days. At 14 days the $TVOC_{SERa}$ is highest at RH 80 %. This is influenced by a mixture of mainly aliphatic and alicyclic compounds with boiling points between 230 °C and 280 °C, which were quantified as toluene-equivalents. The origin of this hydrocarbon mixture is unknown, but what is interesting is that it is observed also at 14 days at RH 20 % and RH 50 % target relative humidities for the 6 mm layer of the plaster. This will be dealt with in Chapter 7.7.3.6. In general it can be stated that the SER_a of single compounds collected from the test chambers is so low, < 1 µg/m²·h, that a more detailed analysis is superfluous. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C22 to C24.

The $TVOC_{SERa}$ is about one order of magnitude higher when samples are collected using the FLEC-cell compared with the test chambers. The SER_a of the other compounds except those presented in Table 26 is generally < 3 µg/m²·h irrespective of the storing conditions. The detailed results of the samples collected using the FLEC-cell are presented in Appendix C, Table C120.

As far as plaster C is concerned, it consists of gypsum and probably also of some organic component(s), which was also dealt with in Chapter 7.1.3. However, the amount of organics seems to be small, or at least their effect on the VOC-emissions is negligible in practice, which is also the reason why the connection between relative humidity and emissions referred to in the preceding about plaster A can not be observed.

7.7.2.7 Gypsum board

The $TVOC_{SERa}$ of the gypsum board applied on a sheet of glass are presented in Figure 51 and the SER_a of the most abundant compounds are presented in Table 27.

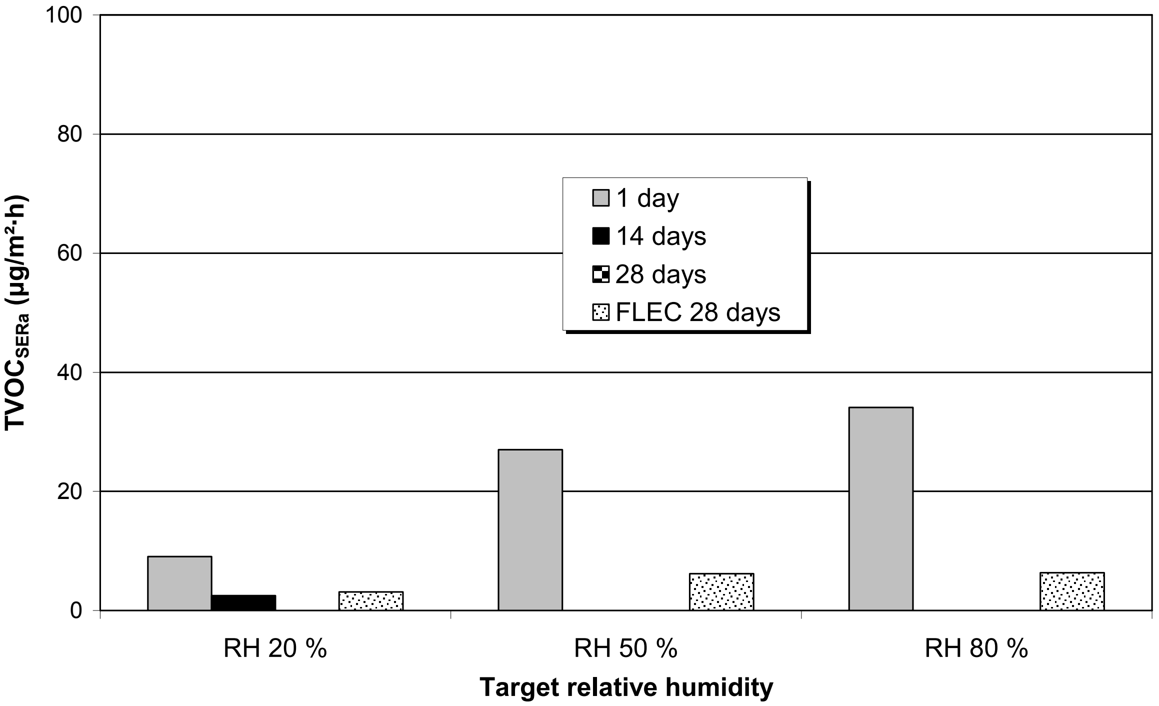

Figure 51. TVOC$_{SERa}$ of the gypsum board applied onto a glass plate. The measured relative humidities were the same as the target relative humidities ±5% RH.

Table 27. The most abundant compounds emitted from the gypsum board applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
hexanal	2	5	10			
halogen containing compounds	5	5	2			
14 days						
all compounds	≤ 1	≤ 1	≤ 1			
28 days						
all compounds	< 1	< 1	< 1	< 1	≤ 1	≤ 2

The TVOC$_{SERa}$ of the gypsum board is higher the higher the relative humidity of the storing conditions at 1 day. At 14 and 28 days it is > 0 µg/m²·h only at RH 20 % at 14 days. The SER$_a$ of the single compounds at 14 and 28 days is so low, ≤ 2 µg/m²·h, that further analysis is superfluous. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C26 to C28 and the detailed results of the samples collected using the FLEC-cell are presented in Table C122.

A comparison of the TVOC$_{SERa}$-values at 28 days of the materials studied in Part I with the requirements of the Finnish classification of building materials (CIC 2001) reveal that paint C is the only product not fulfilling the requirement of a TVOC$_{SERa}$-value < 200 µg/m²·h for samples collected from the test chamber. All other products, also the adhesives studied although not classified, fulfil the requirement irrespective of the relative humidity of the storing conditions. It is in this context noteworthy that the $\text{TVOC}_{\text{SERa}}$ of plaster A stored in the RH 80 % chamber is quite close to the reference value. The sample was collected at the age of 29 days. When examining the $\text{TVOC}_{\text{SERa}}$-values of the samples collected by using the FLEC-cell, it can be noted that paint C stored in the RH 80 % would fulfil the requirement, while adhesive C stored in the RH 20 % chamber and plaster A stored in the RH 20 % and RH 80 % chambers would not fulfil the requirement.

7.7.3 Part II. VOC emissions from material combinations on a glass substrate

7.7.3.1 Primer A and paint A

The $\text{TVOC}_{\text{SERa}}$ of the combination of primer A and paint A spread onto a glass plate are presented in Figure 52 and the SER_a of the most abundant compounds are presented in Table 28. The $\text{TVOC}_{\text{SERa}}$ of the combination of primer A and paint A is higher the higher the relative humidity of the storing conditions for samples collected from the test chamber at 7 and 14 days. At 1 day the $\text{TVOC}_{\text{SERa}}$ at RH 20 % and RH 80 % target relative humidities is almost equal, while it is approximately 4 $\text{mg/m}^2{\cdot}\text{h}$ higher at RH 50 %. The differences in the sample weights were less than 2 % at the start of the test, so the reason for the differences in the $\text{TVOC}_{\text{SERa}}$-values at 1 day is difficult to explain.

The SER_a of 1,2-propanediol follows that of $\text{TVOC}_{\text{SERa}}$ regarding the relative humidity of the storing conditions at 1 and 7 days, while the SER_a texanol is higher the higher the relative humidity of the storing conditions. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C34 to C36.

The $\text{TVOC}_{\text{SERa}}$ of the samples collected by using the FLEC-cell are quite similar to the values obtained from the test chambers. The SER_a of 1,2-propanediol is about twice as high when collected using the FLEC-cell than when collected from the test chamber for samples stored at RH 20 % and RH 80 % target relative humidities. However, the SER_a of texanol and all the other compounds collected are also quite similar irrespective of the sample collection method. The detailed results of the samples collected using the FLEC-cell are presented in Appendix C, Table C126.

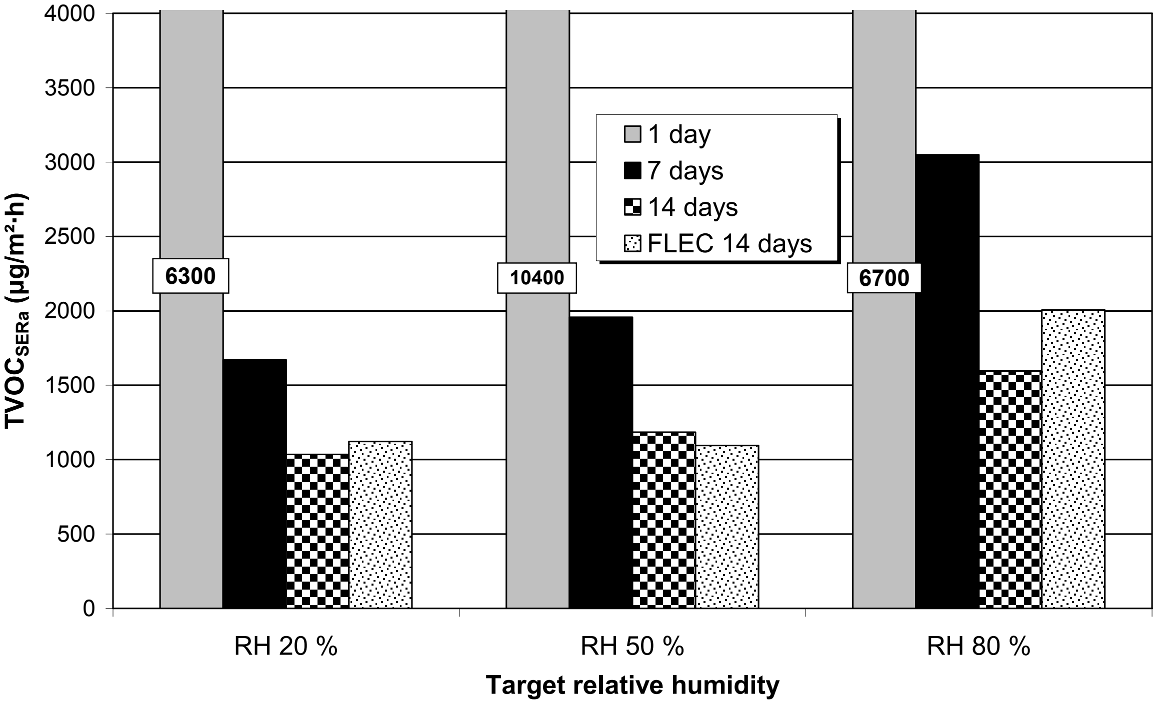

Figure 52. TVOC$_{SERa}$ of the combination of primer A and paint A spread onto a glass plate. The measured relative humidities were 20±5 %, 55±5 %, and 90±5 % at 1 day. At the other sample collection points the measured relative humidities were the same as the target relative humidities ±5% RH.

Table 28. The most abundant compounds emitted from the combination of primer A and paint A spread onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
1,2-propanediol	3650	5500	2750			
texanol	1700	1800	2000			
2-(2-butoxy-isopropoxy)-2-propanol	110	170	200			
1-dodecene	80	110	190			
7 days						
1,2-propanediol	750	850	1450			
texanol	1100	1150	1350			
14 days						
1,2-propanediol	300	250	650	650	250	1250
texanol	950	1000	1050	1000	1100	1350

7.7.3.2 Primer B and paint B

The TVOC$_{SERa}$ of the combination of primer B and paint B spread onto a glass plate are presented in Figure 53 and the SER$_a$ of the most abundant compounds are presented in Table

29. The $TVOC_{SERa}$ does not show any clear trend as far as the relative humidity of the storing conditions is concerned for samples collected from the test chamber air. At 1 and 14 days it is highest at RH 50 % and lowest at RH 20 %. At 7 days the $TVOC_{SERa}$ is higher the higher the relative humidity. This holds true also when the samples are collected using the FLEC-cell at 14 days, thus there is a discrepancy in the test results between the two sample collection methods.

The SER_a of the two most abundant compounds, 1,2-propanediol and 2-(2-butoxyethoxy)ethanol, follow the trend of $TVOC_{SERa}$ at 1 and 7 days for samples collected from the test chambers. Acetic acid occurs only at 7 and 14 days. It has a high SER_a-value especially at RH 50 % and RH 80 % target relative humidities. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C38 to C42.

The most abundant compounds are the same irrespective of the sample collection method. However, there is no observable trend regarding the SER_a-values as far as the two methods or the relative humidity of the storing conditions are concerned. The detailed results of the samples collected using the FLEC-cell are presented in Appendix C, Table C128.

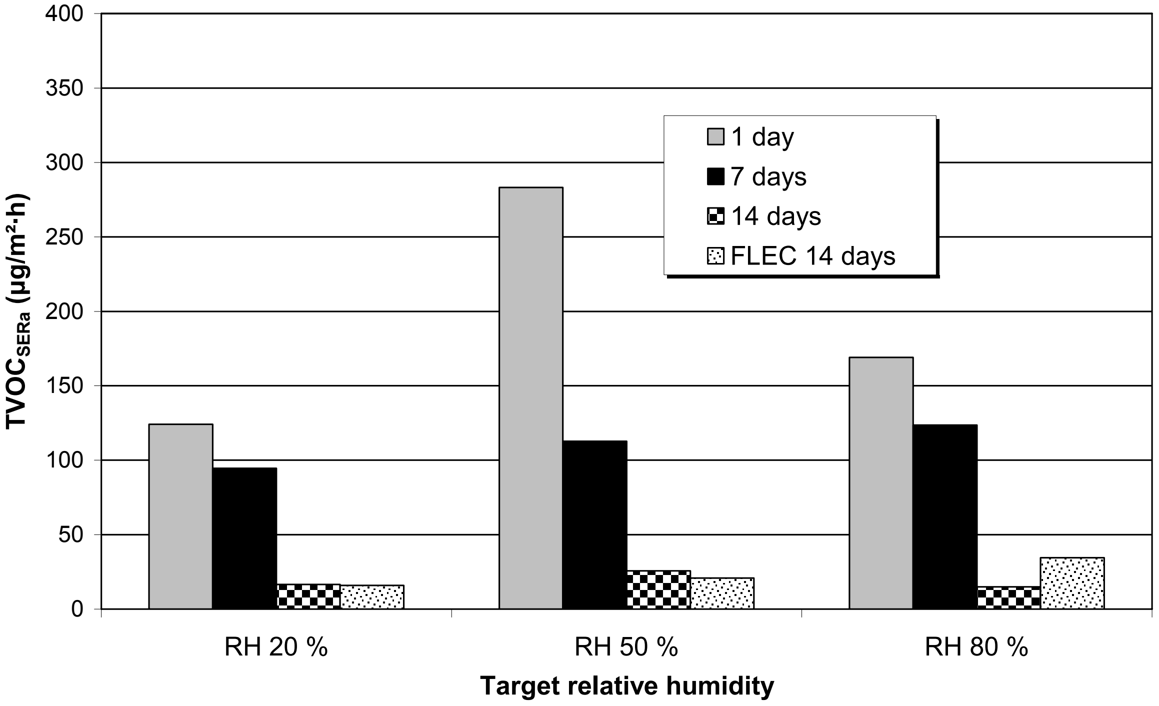

Figure 53. $TVOC_{SERa}$ of the combination of primer B and paint B spread onto a glass plate. The measured relative humidities were 20±5 %, 50±5 %, and 95±5 % at 1 day. At the other sample collection points the measured relative humidities were the same as the target relative humidities ±5% RH.

Table 29. The most abundant compounds emitted from the combination of primer B and paint B spread onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
1,2-propanediol	150	600	110			
2-(2-butoxyethoxy)ethanol	20	150	130			
2-(2-ethoxyethoxy)ethanol	15	70	20			
7 days						
1,2-propanediol	60	100	140			
2-(2-butoxyethoxy)ethanol	25	70	90			
2-(2-ethoxyethoxy)ethanol	10	15	20			
acetic acid	0	170	60			
14 days						
1,2-propanediol	25	30	35	70	20	75
2-(2-butoxyethoxy)ethanol	10	35	35	10	10	25
2-(2-ethoxyethoxy)ethanol	15	4	3	5	2	5
acetic acid	30	55	50	40	40	45

7.7.3.3 Primer A and paint C

The $\mathrm{TVOC_{SERa}}$ of the combination of primer A and paint C spread onto a glass plate are presented in Figure 54 and the $\mathrm{SER_a}$ of the most abundant compounds are presented in Table 30. The $\mathrm{TVOC_{SERa}}$ is higher the higher the relative humidity of the storing conditions irrespective of the point of sample collection for samples collected from the test chambers, while it is of approximately equal size for samples collected using the FLEC-cell.

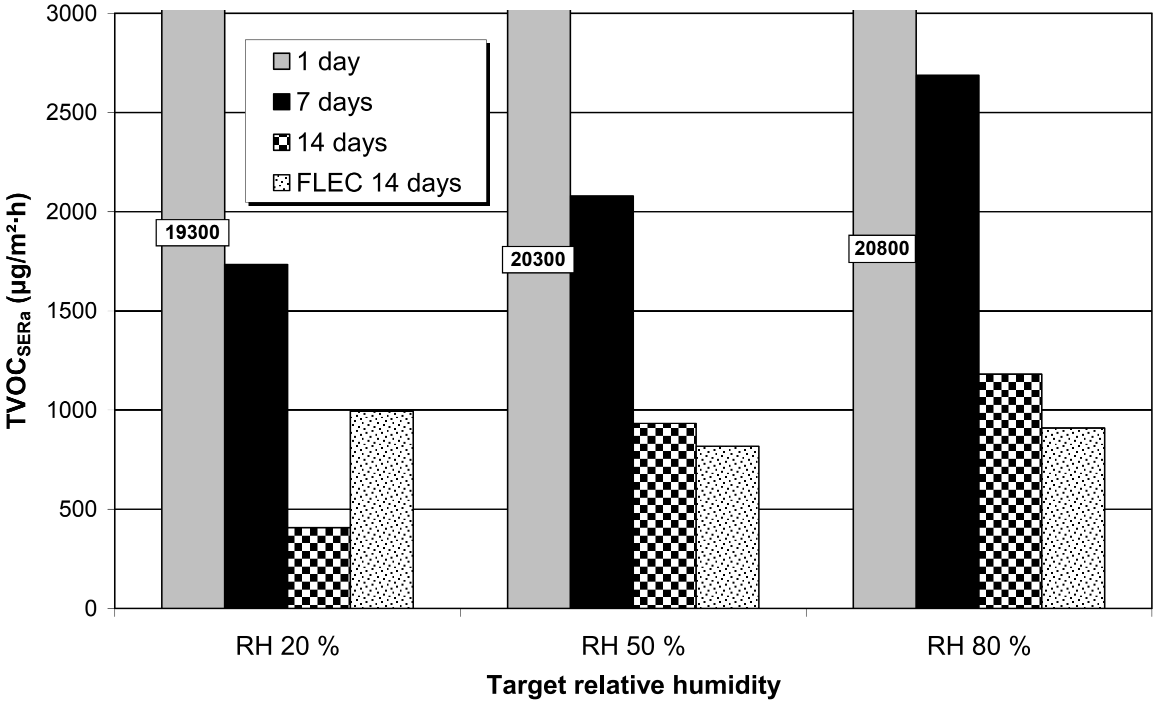

Figure 54. TVOC$_{SERa}$ of the combination of primer A and paint C spread onto a glass plate. The measured relative humidities were the same as the target relative humidities ±5% RH at every sample collection point.

Only aldehydes and ketones follow the trend of TVOC$_{SERa}$ as regards the relative humidity of the chamber air irrespective of the point of sample collection. Also texanol follows the same trend, but only at 7 and 14 days. The trend of texanol applies also to samples collected using the FLEC-cell. When examining the other results of the samples collected using the FLEC-cell, it can be observed that the hydrocarbon mixture, aldehydes, ketones, and some acids have a lower SER$_a$ the higher the relative humidity of the storing conditions.

A comparison of the results from the two sample collection methods shows that the SER$_a$ of single compounds are approximately of equal size, except that the SER$_a$ of aldehydes are higher and that of acids are lower when collected using the FLEC-cell compared with samples collected from the chamber air. It can also be observed in Table 30 that the SER$_a$ of 1,2-propanediol is distinctly higher for the sample stored at RH 20 % target relative humidity when collected using the FLEC-cell than when collected from the test chamber air. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C42 to C44, and the detailed results of the samples collected using the FLEC-cell are presented in Table C130.

Table 30. The most abundant compounds emitted from the combination of primer A and paint C spread onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
hydrocarbon mixture	8100	8700	8500			
1,2-propanediol	7300	7600	7200			
texanol	2500	2600	2550			
hexanal	1750	2000	2500			
undecane	2050	1900	1950			
hexanoic acid	800	1000	900			
7 days						
hydrocarbon mixture	400	450	400			
1,2-propanediol	1200	1200	1850			
texanol	500	650	1000			
hexanal	200	200	250			
undecane	40	40	35			
hexanoic acid	300	400	350			
14 days						
hydrocarbon mixture	130	130	140	200	110	50
1,2-propanediol	470	450	560	700	460	550
texanol	210	320	530	210	290	500
hexanal	70	75	80	150	95	55
undecane	15	10	10	10	5	2
hexanoic acid	180	250	230	190	170	150

7.7.3.4 Primer C and paint C

The $TVOC_{SERa}$ of the combination of primer C and paint C spread onto a glass plate are presented in Figure 55 and the SER_a of the most abundant compounds are presented in Table 31. The $TVOC_{SERa}$ is higher the higher the relative humidity irrespective of storing conditions or the point of sample collection for samples collected from the test chambers, while the trend is the opposite for samples collected using the FLEC-cell.

The hydrocarbon mixture and aldehydes follow the trend of $TVOC_{SERa}$ as regards the relative humidity of the chamber air for samples collected from the test chamber air. When examining the results of the samples collected using the FLEC-cell, it can be observed that aliphatic hydrocarbons, 1-pentanol, some aldehydes and ketones, and most acids have a lower SER_a the higher the relative humidity of the storing conditions, which is the opposite to what can be observed from the test chamber results as far as the hydrocarbon mixture and aldehydes are concerned. This is also the major reason for the difference in the $TVOC_{SERa}$-values between the two sample collection methods for samples stored in the RH 20 % and RH 80 % target relative humidity chambers.

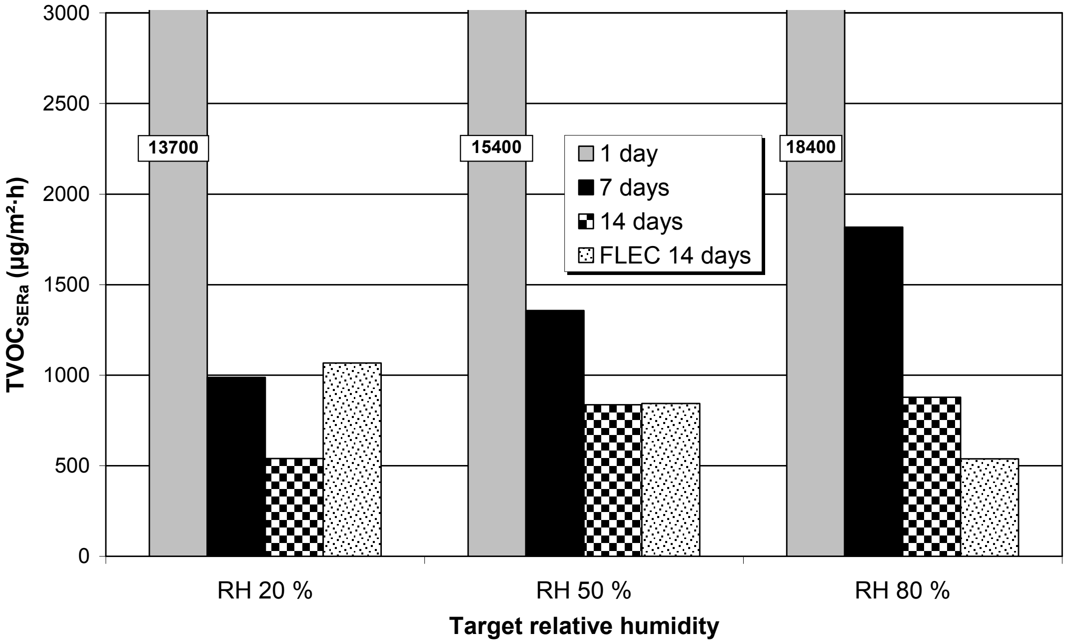

Figure 55. TVOC$_{SERa}$ of the combination of primer C and paint C spread onto a glass plate. The measured relative humidities were the same as the target relative humidities ±5% RH at every sample collection point.

Table 31. The most abundant compounds emitted from the combination of primer C and paint C spread onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
hydrocarbon mixture	7500	8500	10500			
undecane	2000	2100	2400			
hexanal	1300	1600	2400			
hexanoic acid	1000	1000	800			
2-ethylhexanoic acid	1000	1000	800			
7 days						
hydrocarbon mixture	400	500	750			
undecane	70	80	20			
hexanal	100	160	280			
hexanoic acid	420	560	590			
2-ethylhexanoic acid	150	210	260			
14 days						
hydrocarbon mixture	180	250	330	410	310	180
undecane	25	30	15	55	25	5
hexanal	50	90	150	120	110	110
hexanoic acid	310	430	410	480	420	340
2-ethylhexanoic acid	70	120	150	70	85	90

The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C46 to C48, and the detailed results of the samples collected using the FLEC-cell are presented in Table C132.

7.7.3.5 Filler A and plaster A

The $TVOC_{SERa}$ of the combination of filler A and plaster A applied onto a glass plate are presented in Figure 56 and the SER_a of the most abundant compounds are presented in Table 32. The $TVOC_{SERa}$ of the combination of filler A and plaster A has no clear trend regarding the relative humidity of the storing conditions irrespective of the point of sample collection or the sample collection method. However, what was noted about the influence of relative humidity and the condensation of moisture on the chamber's inner surfaces on the emission process concerning plaster A (Chapter 7.7.2.5) most probably applies also here. Thus, a moisture content close to 100 % hinders the emission of VOCs and the emission process starts only when the relative humidity of the surrounding air is below a critical value.

The most abundant single compound emitted at 7 and 14 days is 1,2-propanediol and its SER_a is also probably related to the relative humidity of the storing conditions, since its value is quite high already in the RH 20 % chamber at 7 days when the measured relative humidity of the chamber air was approximately 95 %. Since the relative humidity of the RH 50 % chamber has started to decline only three days before the 14 days sample collection point the evaporation of moisture from the sample is probably still quite rapid resulting in a strong emission of 1,2-propanediol. The $TVOC_{SERa}$-value is also highest at that point for the RH 50 % chamber irrespective of the sample collection method.

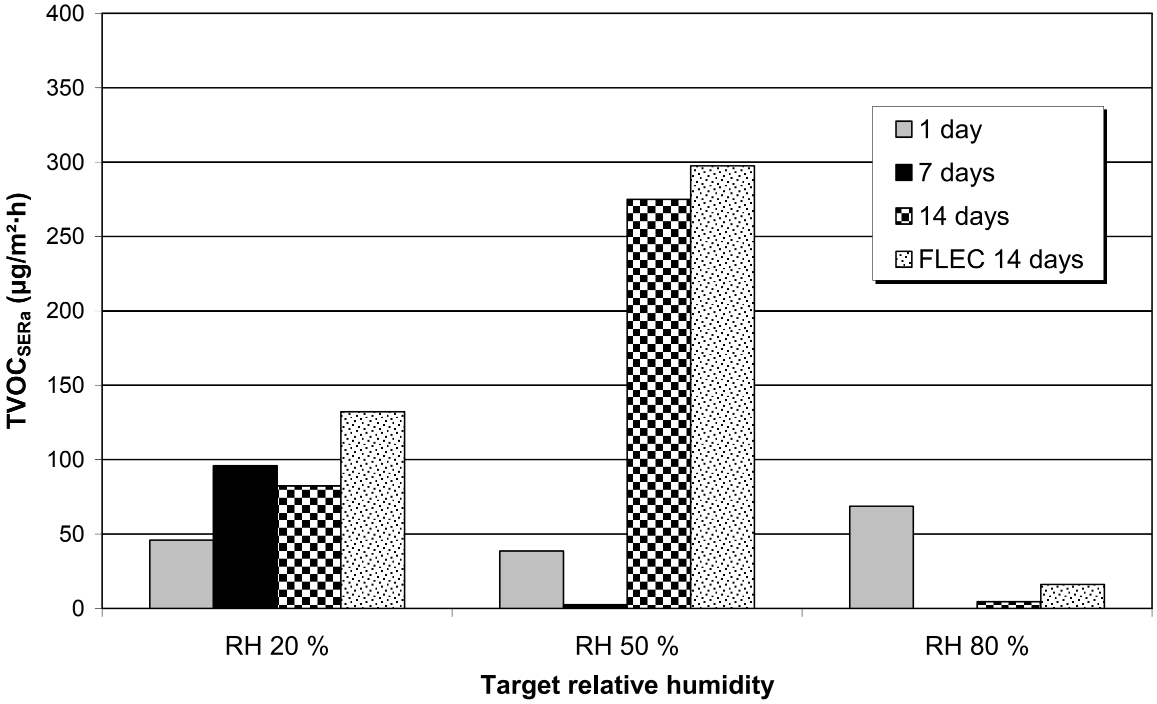

Figure 56. TVOC$_{SERa}$ of the combination of filler A and plaster A applied onto a glass plate. The measured relative humidities were 98±3 % at all three different target relative humidities at 1 day. At 7 days the measured values were 95±5%, 98±3%, and 98 ±3% and at 14 days they were 20±5%, 55±5%, and 98±3% in the RH 20 %, RH 50 %, and RH 80 % chambers, respectively.

Table 32. The most abundant compounds emitted from the combination of filler A and plaster A applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
2-(2-butoxyethoxy)ethanol	3	15	50			
1-methoxy-2-propanol	20	15	15			
2-methyl-2-propanol	15	15	25			
7 days						
1,2-propanediol	160	15	0			
1-methoxy-2-propanol	10	8	7			
14 days						
1,2-propanediol	300	600	10	450	800	0
2-(2-ethoxyethoxy)ethanol	10	55	1	7	35	0
dipropylene methyl glycol ether	3	25	1	4	25	1
acetic acid	10	8	5	15	10	8

When comparing the results from the two sample collection methods it can be observed that the TVOC$_{SERa}$-values, as well as the SER$_a$ of the single compounds are of equal size, except for 1,2-propanediol, which has approximately 1.5-times higher values when collected using the FLEC-cell compared with that of the samples collected from the chamber air for samples stored in the RH 20 % and RH 50 % target relative humidity chambers. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C50 to C52, and the detailed results of the samples collected using the FLEC-cell are presented in Table C134.

7.7.3.6 Filler B and plaster B

The $TVOC_{SERa}$ of the combination of filler B and plaster B applied onto a glass plate are presented in Figure 57 and the SER_a of the most abundant compounds are presented in Table 33. The $TVOC_{SERa}$ are of about equal size at 1 day irrespective of the relative humidity of the storing conditions. This probably depends, as was the case for the combination of filler and plaster A, on the fact that the relative humidity of the chamber air was approximately 100 % by the time of sample collection. At 7 and 14 days the $TVOC_{SERa}$ is lower the higher the relative humidity. This trend is observed also for samples collected using the FLEC-cell.

The SER_a of the most abundant compounds follow that of $TVOC_{SERa}$ at 1 and 7 days, except for texanol. At 14 days the most abundant compounds are still the same, but two glycol ethers, 2-(2-ethoxyethoxy)ethanol and 2-(2-butoxyethoxy)ethanol now occur abundantly and their SER_a follow the trend of $TVOC_{SERa}$ irrespective of the sample collection method.

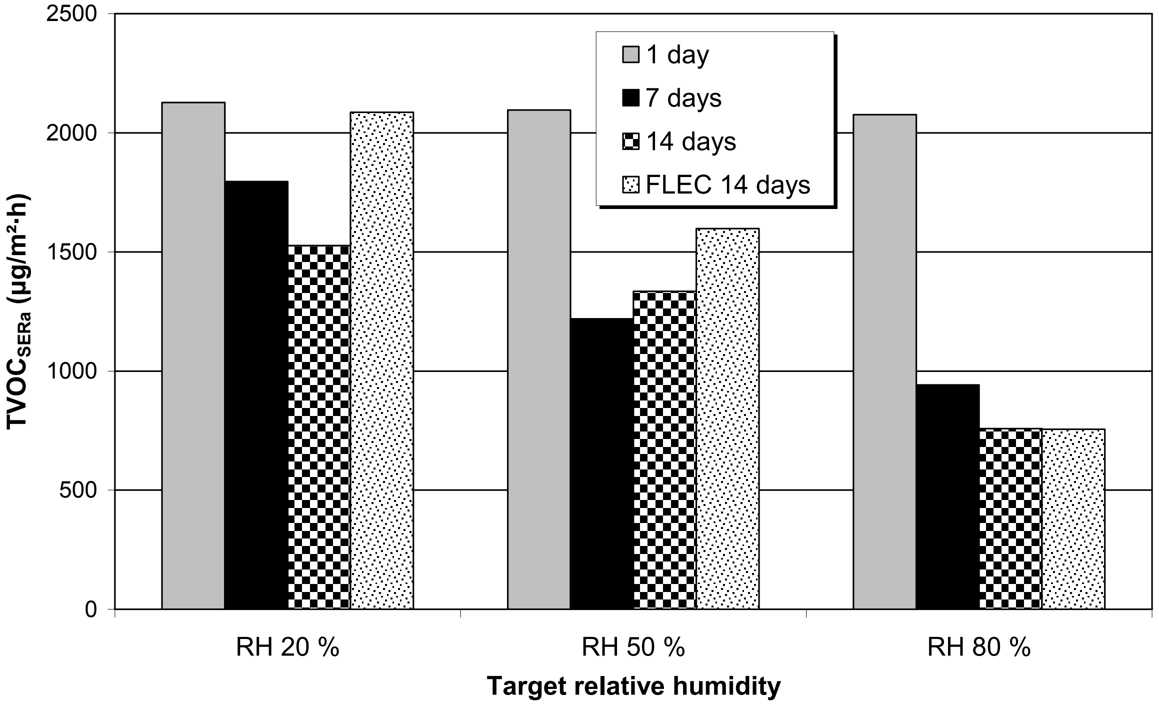

Figure 57. $TVOC_{SERa}$ of filler B and plaster B applied onto a glass plate. The measured relative humidities were 95±3 %, 98±3 %, and 99±3 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively, at 1 day. At 7 days the corresponding values were 85±5%, 99±3%, and 99 ±3% and at 14 days they were 20±5%, 98±3%, and 99±3%.

A comparison of the SER_a of the single compounds as well as the $TVOC_{SERa}$ of the two different sample collection methods shows that the values are somewhat higher when using the FLEC-cell compared with the results from the test chambers. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C54 to C56, and the detailed results of the samples collected using the FLEC-cell are presented in Table C136.

Table 33. The most abundant compounds emitted from the combination of filler B and plaster B applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
2-ethyl-1-hexanol	1300	1200	1200			
4,4-dimethyl-1,3-oxazolidine	530	520	520			
2-methyl-2-propanol	250	210	200			
2-ethylhexyl acetate	150	140	140			
dimethyl perhydro-1,3-oxazine	90	95	90			
7 days						
2-ethyl-1-hexanol	450	400	350			
4,4-dimethyl-1,3-oxazolidine	740	370	270			
texanol	160	150	170			
dimethyl perhydro-1,3-oxazine	130	80	60			
2-ethylhexyl acetate	120	70	50			
14 days						
2-ethyl-1-hexanol	100	140	150	150	170	170
4,4-dimethyl-1,3-oxazolidine	580	580	300	800	690	220
texanol	60	150	170	75	150	160
dimethyl perhydro-1,3-oxazine	100	100	50	130	110	50
2-ethylhexyl acetate	15	90	40	210	120	50
2-(2-ethoxyethoxy)ethanol	230	40	10	380	40	6
2-(2-butoxyethoxy)ethanol	210	140	7	310	170	40

7.7.3.6 A 6 mm layer of plaster C

The $TVOC_{SERa}$ of the 6 mm layer of plaster C applied onto a glass plate are presented in Figure 58 and the SER_a of the most abundant compounds are presented in Table 34. The $TVOC_{SERa}$ is generally very low. The number of chemical groups increases with time, but the SER_a-values of the single compounds are still very low. A comparison of the results obtained with the two sample collection methods shows that the results are quite similar. The only exceptions are that the hydrocarbon mixture is only observed in the sample stored at the RH

50 % target relative humidity and that acetic acid is present only when samples are collected using the FLEC -cell.

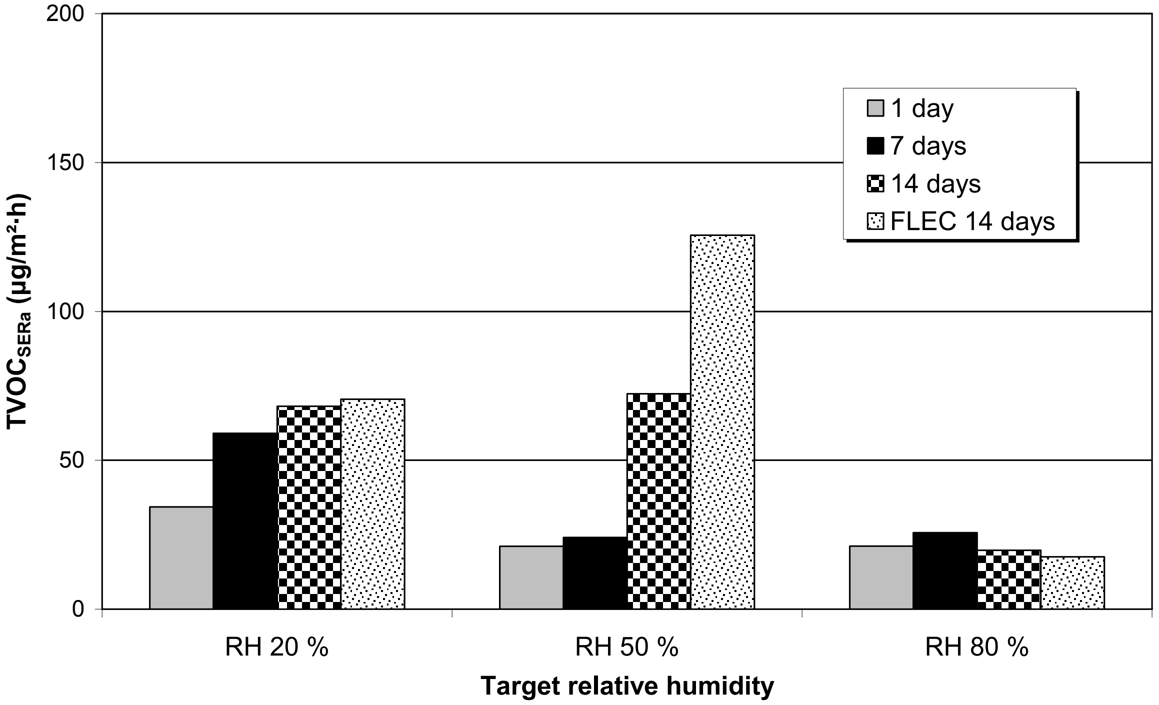

Figure 58. TVOC$_{SERa}$ of a 6 mm layer of plaster C applied onto a glass plate. The measured relative humidities were 99±3 % at all three different target relative humidities at 1 and 7 days. At 14 days they were 95±3 %, 99±3 %, and 99±3 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively.

Table 34. The most abundant compounds emitted from the 6 mm layer of plaster C applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
acetic acid	40	40	45			
acetone	15	10	15			
7 days						
all compounds	≤ 4	≤ 3	≤ 3			
14 days						
hydrocarbon mixture	50	55	0	0	65	0
acetic acid	-	-	-	25	15	25

A comparison with the emission results from the 3 mm layer of plaster C presented in Chapter 7.7.2.6 shows that the 3 mm layer had no acetic acid-emission at 1 day. The SER$_a$ of acetone was also lower. Neither of these two compounds is included, however, in the TVOC-range. The TVOC$_{SERa}$-values were about the same irrespective of the layer thickness. The hydrocarbon mixture that was observed at 14 days of the 3 mm layer at RH 80 % is now occurring at 14 days at RH 20 % and RH 50 % target relative humidities. Its origin is unknown, but it could be related to changes in the relative humidity, since the relative humidity starts to drop a day or two before sample collection (RH 20 % and RH 50 %, 6 mm layer) and there is a small downswing in the relative humidity of the RH 80 % chamber with the 3 mm layer at 14 days. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C58 to C60, and the detailed results of the samples collected using the FLEC-cell are presented in Table C138.

7.7.3.7 Adhesive B

The $TVOC_{SERa}$ of adhesive B applied onto a glass plate are presented in Figure 59 and the SER_a of the most abundant compounds are presented in Table 35. The $TVOC_{SERa}$ is lower the higher the relative humidity of the storing conditions at 1 day, while it is higher the higher the relative humidity of the storing conditions at 7 and 14 days for samples collected from the test chambers. The $TVOC_{SERa}$ of the samples collected using the FLEC-cell does not show any trend as regards the relative humidity of the storing conditions.

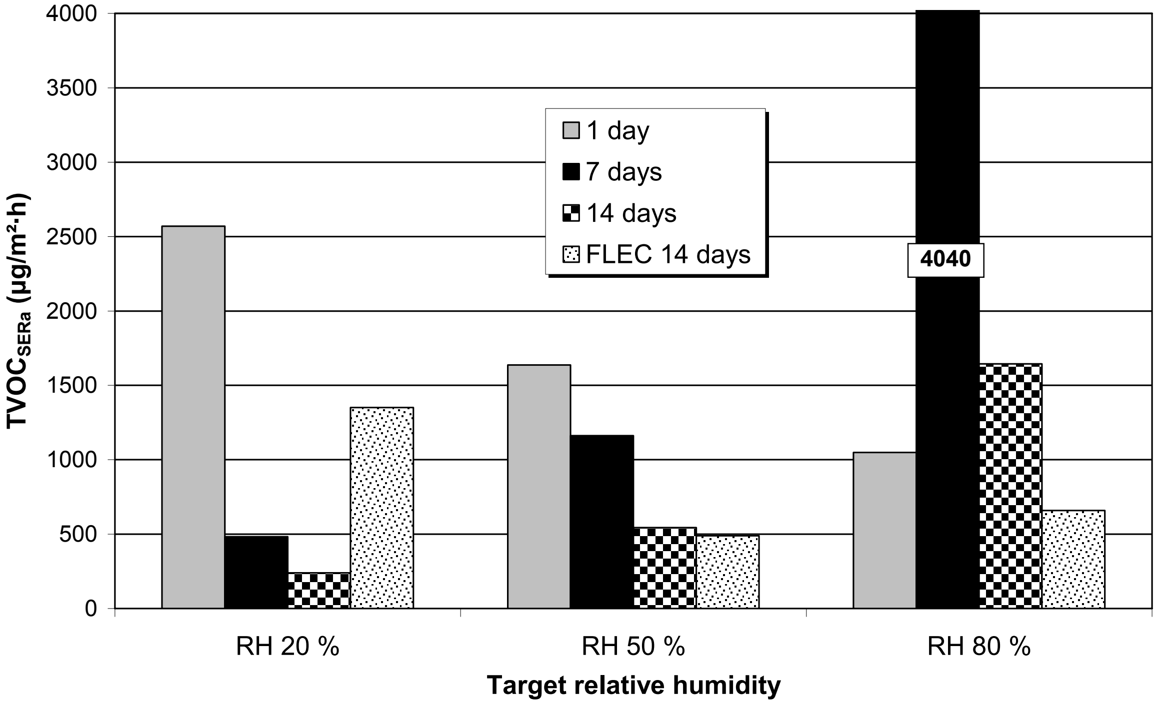

Figure 59. $TVOC_{SERa}$ of adhesive B applied onto a glass plate. The measured relative humidities were 95±5 %, 95±5 %, 99±3 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 days were 20±5 %, 50±5 %, and 95±3 %, while at 14 days they were the same as the target values ±5 % RH.

The by far most abundant single compound is 2-(2-butoxyethoxy)ethanol. Its SER_a has the same trend as that of the $TVOC_{SERa}$ irrespective of the sample collection method. Other compounds that have elevated SER_a-values are 2-butoxyethanol, 2-(2-butoxyethoxy)ethyl acetate, and acetic acid at 1 day and acetic acid at 7 days. The SER_a of the other compounds is in general < 2 µg/m²·h. The last comment applies to both sample collection methods. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C30 to C32, and the detailed results of the samples collected using the FLEC-cell are presented in Table C124.

Table 35. The most abundant compound emitted from adhesive B applied onto a glass plate (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
2-(2-butoxyethoxy)ethanol	2850	2000	1350			
7 days						
2-(2-butoxyethoxy)ethanol	790	2140	5890			
14 days						
2-(2-butoxyethoxy)ethanol	380	940	2450	2440	780	1090

7.7.4 Part III. VOC emissions from material combinations on gypsum board and CSB

The materials tested in part III of this study were chosen based on the $TVOC_{SERa}$-values of the material combinations tested in part II and the $TVOC_{SERa}$-values of the three adhesives at 14 days. The least and most emitting ones were chosen. The respective $TVOC_{SERa}$-values are presented in Table 36.

Table 36. $TVOC_{SERa}$-values of materials and material combinations spread onto a glass plate at 14 days. RH indicates the target relative humidities of the test chambers.

Material or material combination	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
Primer A and paint A	1040	1180	1600	1122	1095	2005
Primer B and paint B	20	25	15	16	21	35
Primer A and paint C	410	930	1180	994	818	909
Primer C and paint C	540	840	880	1067	844	538
Adhesive A	45	50	50	-	-	-
Adhesive B	240	540	1640	1350	489	659
Adhesive C	25	50	170	-	-	-
Filler A and plaster A	80	280	5	132	298	16
Filler B and plaster B	1530	1340	760	2086	1598	756
6 mm layer of plaster C	70	70	20	71	60	18

The selected materials and material combinations were, thus, the combination of primer A and paint A, the combination of primer B and paint B, adhesive A, adhesive B, the combination of filler B and plaster B, and plaster C. Even though the $TVOC_{SERa}$ of adhesive A was higher than that of adhesive C at the target relative humidity of 20 % (the measured values were the same as the target values ±5 % RH) the $TVOC_{SERa}$-values of adhesive A were more even at the different relative humidities of the storing conditions, which is the reason for its selection.

7.7.4.1 The combination of primer A and paint A spread onto gypsum board

The $TVOC_{SERa}$ of primer A and paint A spread onto gypsum board are presented in Figure 60 and the SER_a of the most abundant compounds are presented in Table 37. The $TVOC_{SERa}$ shows no clear trend regarding the relative humidity of the storing conditions irrespective of the point of sample collection or the sample collection method. However, the SER_a of texanol is higher the higher the relative humidity of the storing conditions at 1 day and the same applies to 1,2-propanediol at 14 days when the samples are collected from the test chamber air. Other compounds having $SER_a > 10$ μg/m²·h at 1 day are 1-dodecene, benzaldehyde, acetone, n-butyl acetate, butyl propanoate, and styrene. The SER_a of butyl ether is higher the higher the relative humidity, while the trend is the opposite for 2-(2-ethoxyethoxy)ethanol and texanol.

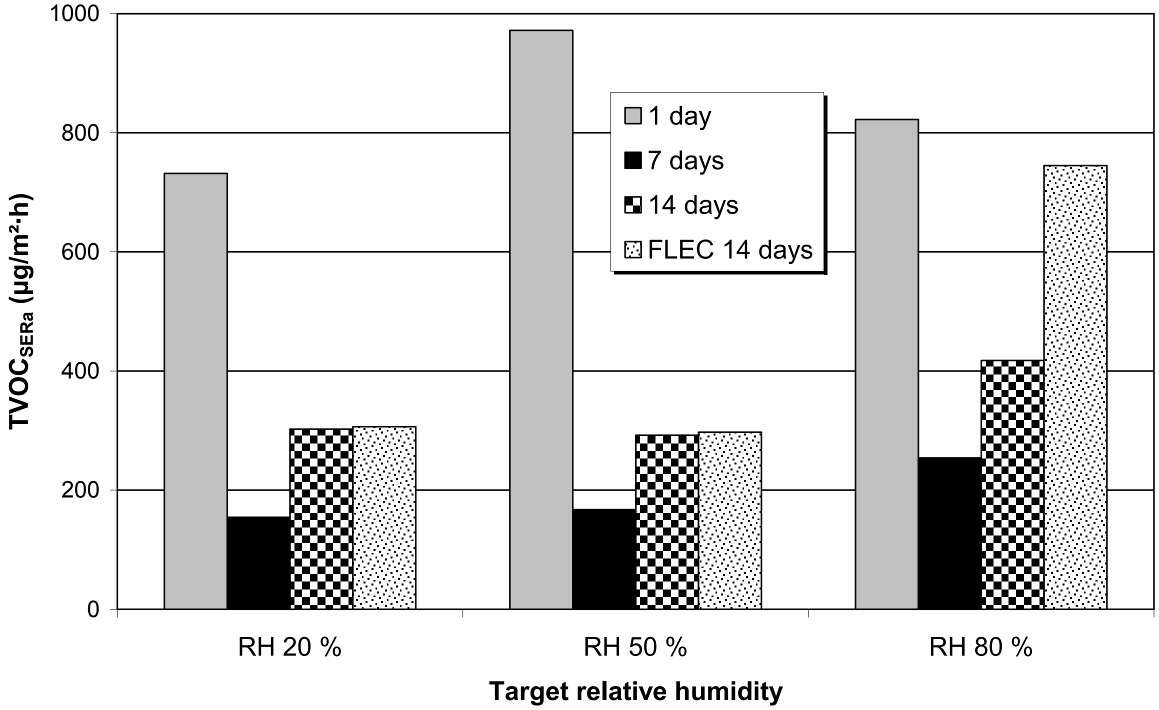

Figure 60. $TVOC_{SERa}$ of the combination of primer A and paint A spread onto gypsum board. The measured relative humidities were 30±5 %, 60±5 %, and 85±5 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 and 14 days were the same as the target values ±5 % RH.

Table 37. The most abundant compounds emitted from the combination of primer A and paint A spread onto gypsum board (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
1,2-propanediol	1550	1680	1150			
texanol	560	670	870			
2-(2-ethoxyethoxy)ethanol	150	140	60			
acetic acid	75	230	40			
7 days						
1,2-propanediol	300	310	450			
texanol	400	380	420			
14 days						
1,2-propanediol	75	160	320	260	170	770
texanol	350	310	350	290	300	390

When comparing the SER_a of the single compounds collected with the two sample collection methods it can be observed that the $TVOC_{SERa}$, as well as the SER_a of 1,2-propanediol and texanol is of equal size irrespective of the sample collection method especially for samples stored at the RH 50 % target relative humidity. The SER_a of the other compounds observed are in general < 4 µg/m²·h irrespective of the sample collection method or the relative humidity of the storing conditions, except for acetic acid. Its SER_a is 86 µg/m²·h for the sample stored at RH 20 % target relative humidity and 24 µg/m²·h for the sample stored at RH 80 % target relative humidity when collected using the FLEC-cell. This is 10 and 40 -times higher than what was observed for the samples collected from the chamber air, respectively. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C62 to C64, and the detailed results of the samples collected using the FLEC-cell are presented in Table C140.

7.7.4.2 The combination of primer B and paint B spread onto gypsum board

The $TVOC_{SERa}$ of primer B and paint B spread onto gypsum board are presented in Figure 61 and the SER_a of the most abundant compounds are presented in Table 38. The $TVOC_{SERa}$ is higher the higher the relative humidity of the storing conditions at 1 day. At 7 and 14 days there is no clear trend regarding the relative humidity, but the $TVOC_{SERa}$ is very low, < 10 µg/m²·h at 7 days. The values at 14 days in Figure 61 are a bit misleading, since they were, except for one measurement, below the detection limit of 30 µg/m³, which corresponds to 14 µg/m²·h irrespective of the sample collection method.

The SER_a of 1,2-propanediol is higher the higher the relative humidity of the storing conditions, while 2-propanol does not have any clear trend regarding relative humidity at 1 day for samples collected from the test chamber air. 2-(2-butoxyethoxy)ethanol is observed only at the target relative humidity of RH 80 %. 2-(2-butoxyethoxy)ethanol and 1,2-propanediol have a SER_a > 5 µg/m²·h at the target relative humidity of RH 80 % at 7 days while it is ≤ 2 µg/m²·h for the other compounds. At 14 days the SER_a of all compounds, except for acetic acid at RH 50 % and RH 80 %, is ≤ 1 µg/m²·h.

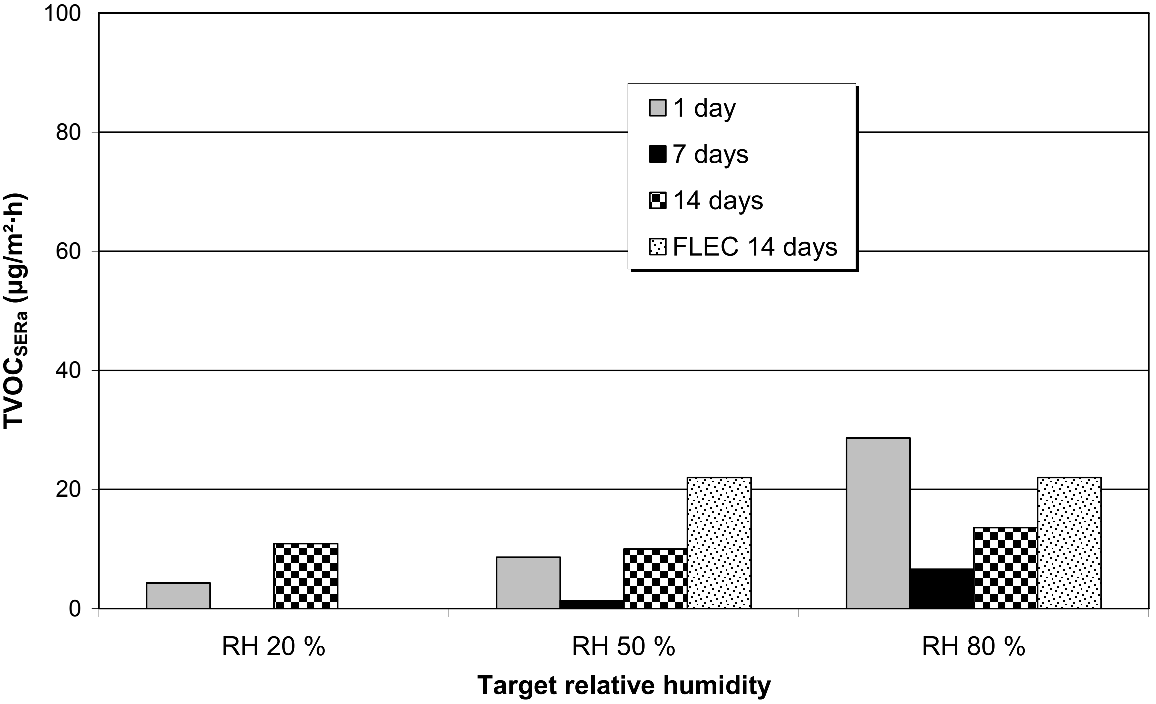

Figure 61. $TVOC_{SERa}$ of the combination of primer B and paint B spread onto gypsum board. The measured relative humidities were 35±5 %, 60±5 %, and 80±5 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 and 14 days were the same as the target values ±5 % RH.

Table 38. The most abundant compounds emitted from the combination of primer B and paint B spread onto gypsum board (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
2-(2-butoxyethoxy)ethanol	0	0	100			
1,2-propanediol	0	50	70			
2-propanol	20	30	30			
7 days						
2-(2-butoxyethoxy)ethanol	0	0	18			
1,2-propanediol	0	0	9			
14 days						
1,2-propanediol	0	0	5	1	0	2
acetic acid	1	8	5	0	8	4

When comparing the results from the two sample collection methods it can be observed that they are very consistent. However, the concentrations of the different compounds are very low. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C66 to C68, and the detailed results of the samples collected using the FLEC-cell are presented in Table C142.

7.7.4.3 Adhesive A applied onto gypsum board

The $TVOC_{SERa}$ of adhesive A applied onto gypsum board are presented in Figure 62 and the SER_a of the most abundant compounds are presented in Table 39.

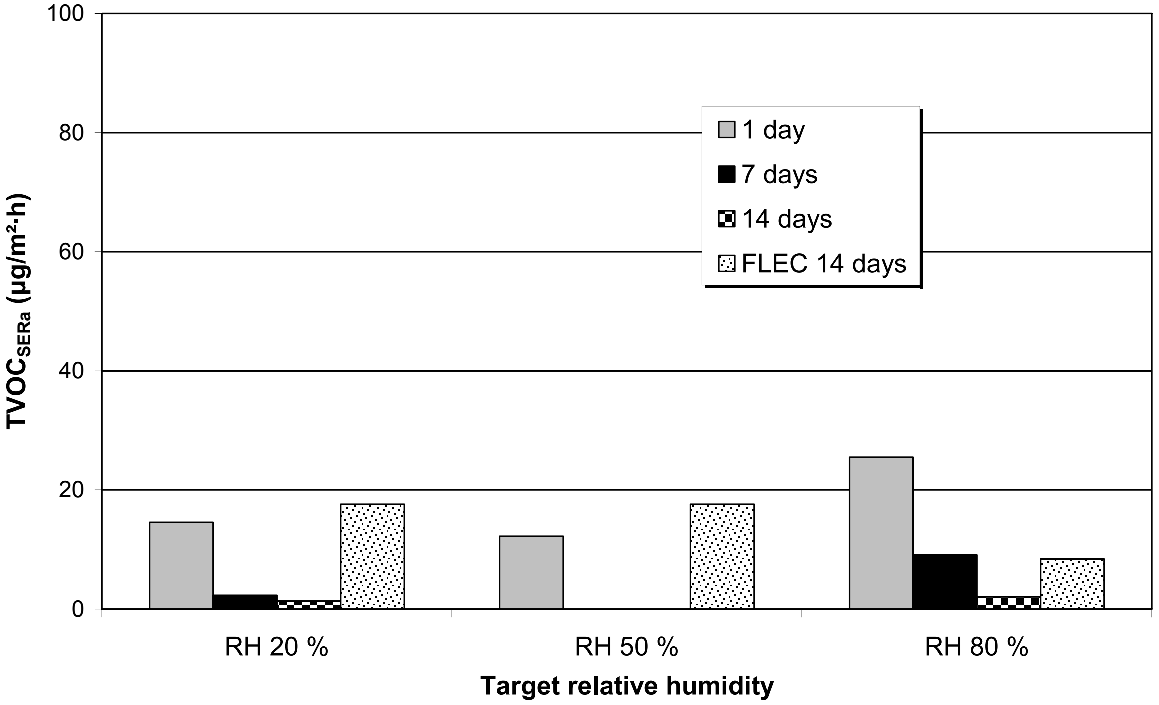

Figure 62. $TVOC_{SERa}$ of adhesive A applied onto gypsum board. The measured relative humidities were 80±5 %, 90±5 %, and 95±3 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 days were 20±5 %, 50±5 %, and 85±5 %. At 14 days the measured values were the same as the target values ±5 % RH.

The $TVOC_{SERa}$ does not show any clear trend regarding the relative humidity of the storing conditions irrespective of the point of sample collection or the sample collection method, and the level is overall very low. Acetic acid is the most abundant single compound, but its SER_a-values are also low, being highest for the sample stored at the target relative humidity of 80 %. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C70 to C72, and the detailed results of the samples collected using the FLEC-cell are presented in Table C144.

Table 39. The most abundant compounds emitted from adhesive A applied onto gypsum board (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
acetic acid	15	8	15			
2-methyl-2-propanol	6	7	10			
hexanal	6	6	8			
7 days						
acetic acid	0	3	10			
2-methyl-2-propanol	-	-	-			
hexanal	1	1	1			
14 days						
acetic acid	4	9	15	0	7	15
nonanal	1	1	2	2	2	4
decanal	1	0	1	2	3	6

7.7.4.4 Adhesive B applied onto gypsum board

The $\mathrm{TVOC}_{\mathrm{SERa}}$ of adhesive B applied onto gypsum board are presented in Figure 63 and the SER_a of the most abundant compounds are presented in Table 40.

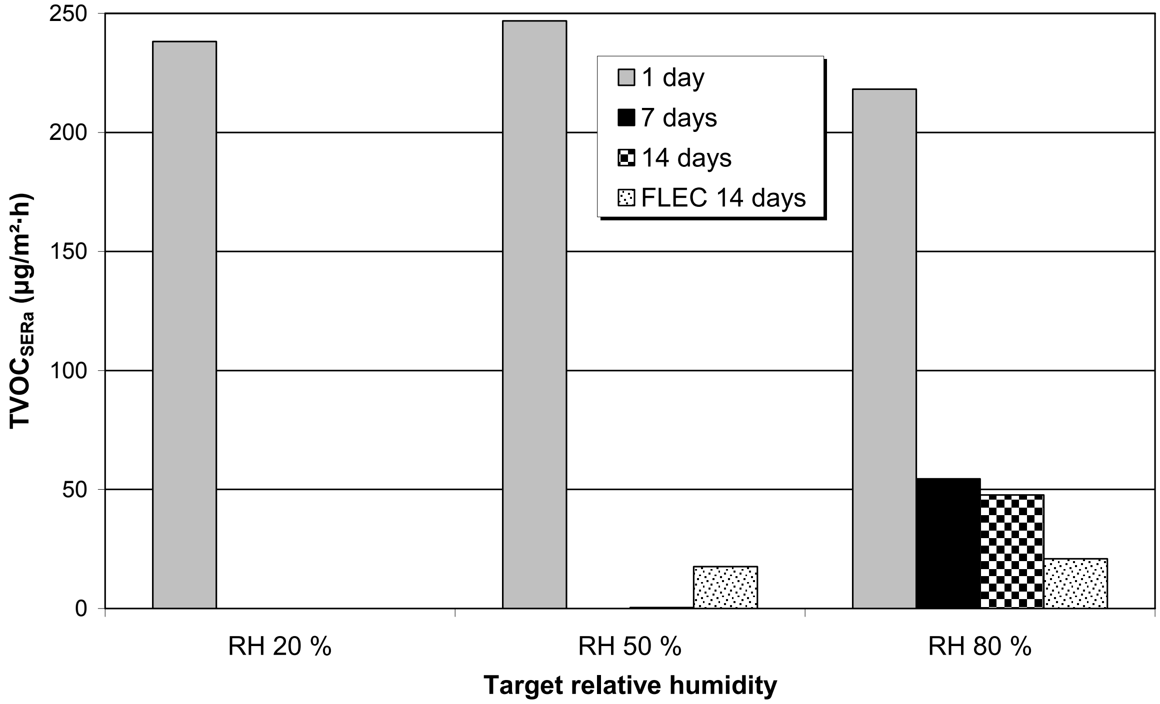

Figure 63. $\mathrm{TVOC}_{\mathrm{SERa}}$ of adhesive B applied onto gypsum board. The measured relative humidities were 85±5 %, 95±5 %, and 98±3 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 days were 20±5 %, 50±5 %, and 85±5 %. At 14 days the measured values were the same as the target values ±5 % RH.

Table 40. The most abundant compounds emitted from adhesive B applied onto gypsum board (µg/m²·h). The relative humidity values indicate the target values of the test chambers.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
2-(2-butoxyethoxy)ethanol	350	340	290			
acetic acid	15	45	15			
7 days						
2-(2-butoxyethoxy)ethanol	0	4	70			
acetic acid	0	6	15			
14 days						
2-(2-butoxyethoxy)ethanol	0	5	64	0	0	18
acetic acid	5	5	10	0	6	13

The $\mathrm{TVOC}_{\mathrm{SERa}}$ does not show any clear trend regarding the relative humidity of the storing conditions for samples collected from the test chambers. Moreover, it is elevated at 7 and 14 days only for samples stored in the RH 80 % target relative humidity. The same observation can be made also for samples collected using the FLEC-cell, since the value for the RH 50 % chamber is actually below the detection limit, even though the detection limit value has been used in the calculations.

The by far most abundant single compound is 2-(2-butoxyethoxy)ethanol for samples collected from the test chambers. Acetic acid is also quite abundant at all three points of sample collection. These two compounds are also the most abundant ones in the samples collected using the FLEC-cell. The SER_a-values for the other compounds not presented in Table 40 are in general very low irrespective of the point of sample collection or the sample collection method. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C74 to C76, and the detailed results of the samples collected using the FLEC-cell are presented in Table C146.

7.7.4.5 The combination of primer A and paint A spread onto the combination of filler B and plaster B applied onto CSB

The $\mathrm{TVOC}_{\mathrm{SERa}}$ and the SER_a of the most abundant compounds are presented in Table 41. The $\mathrm{TVOC}_{\mathrm{SERa}}$-values are of very equal size irrespective of the sample collection method for each respective storing condition. Of the most abundant compounds 1,2-propanediol, 2-(2-butoxyethoxy)ethanol, and texanol stem mainly from the primer and paint, while 4,4-dimethyl-1,3-oxazolidine and 2-ethyl-1-hexanol stem from the filler and plaster. The SER_a of 1,2-propanediol and 2-(2-butoxyethoxy)ethanol is lower the higher the relative humidity of the storing conditions, opposite to that of $\mathrm{TVOC}_{\mathrm{SERa}}$, while the SER_a of texanol, 2-ethyl-1-hexanol and the nitrogen containing compound is higher the higher the relative humidity at 1 day. At 14 days the $\mathrm{TVOC}_{\mathrm{SERa}}$ and the SER_a of all six compounds is higher the higher the relative humidity of the storing conditions irrespective of the sample collection method. A comparison of the magnitude of the SER_a-values shows that the sample collection method does not affect the results. This holds true also for the $TVOC_{SERa}$-values, as been stated above. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C78 to C80, and the detailed results of the samples collected using the FLEC-cell are presented in Table C148.

Table 41. The $TVOC_{SERa}$ and the SER_a of the most abundant compounds emitted from the combination of primer A and paint A spread onto the combination of filler B and plaster B applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 80±5 %, 85±5 %, and 90±5 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 and 14 days were 45±5 %, 65±5 %, and 85±5 %.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
$TVOC_{SERa}$	3750	-	4830			
1,2-propanediol	2350	-	1750			
texanol	1630	-	1900			
4,4-dimethyl-1,3-oxazolidine	580	-	1150			
2-(2-butoxyethoxy)ethanol	280	-	270			
2-ethyl-1-hexanol	200	-	270			
7 days						
$TVOC_{SERa}$	-	1600	-			
1,2-propanediol	-	1350	-			
texanol	-	720	-			
4,4-dimethyl-1,3-oxazolidine	-	140	-			
2-(2-butoxyethoxy)ethanol	-	200	-			
2-ethyl-1-hexanol	-	60	-			
14 days						
$TVOC_{SERa}$	540	-	1140	570	-	1040
1,2-propanediol	375	-	515	570	-	600
texanol	285	-	460	295	-	470
4,4-dimethyl-1,3-oxazolidine	35	-	240	30	-	180
2-(2-butoxyethoxy)ethanol	85	-	100	85	-	120
2-ethyl-1-hexanol	35	-	55	50	-	55

7.7.4.6 The combination of primer A and paint A spread onto plaster C applied onto CSB

The $TVOC_{SERa}$ and the SER_a of the most abundant compounds are presented in Table 42. The $TVOC_{SERa}$-values are of quite equal size, but the trend regarding the relative humidity of the storing conditions is the opposite for the two sample collection methods. All three of the most abundant single compounds emitted from primer A and paint A spread onto plaster C applied onto CSB stem from the primer and paint. The SER_a of texanol and 1-dodecene is higher the higher the relative humidity of the storing conditions, similar to that of $TVOC_{SERa}$, while the SER_a of 1,2-propanediol is lower the higher the relative humidity at 1 day. At 14 days the $TVOC_{SERa}$ and the SER_a of texanol is lower the higher the relative humidity of the storing conditions while the SER_a of 1,2-propanediol has the opposite trend. A comparison of the magnitude of the SER_a-values shows that the samples collected by using the FLEC-cell have higher SER_a-values than those collected from the test chamber air, which contradicts the $TVOC_{SERa}$-results for samples stored at RH 20 % target relative humidity. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C82 to C84, and the detailed results of the samples collected using the FLEC-cell are presented in Table C150.

Table 42. The $TVOC_{SERa}$ and the SER_a of the most abundant compounds emitted from the combination of primer A and paint A spread onto plaster C applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 50±5 %, 75±5 %, and 85±5 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 days were 35±5 %, 65±5 %, and 85±5 % and at 14 days they were 30±5 %, 60±5 %, and 80±5 %.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
$TVOC_{SERa}$	2620	3120	-			
1,2-propanediol	2760	2450	-			
texanol	1070	1360	-			
1-dodecene	90	140	-			
butyl ether	50	50	-			
7 days						
$TVOC_{SERa}$	-	-	940			
1,2-propanediol	-	-	760			
texanol	-	-	570			
1-dodecene	-	-	20			
14 days						
$TVOC_{SERa}$	450	-	380	390	-	510
1,2-propanediol	140	-	260	220	-	600
texanol	300	-	240	330	-	280
1-dodecene	7	-	10	10	-	10

7.7.4.7 The combination of primer B and paint B spread onto the combination of filler B and plaster B applied onto CSB

The $TVOC_{SERa}$ and the SER_a of the most abundant compounds are presented in Table 43. The SER_a of 2-ethyl-1-hexanol, 2-(2-butoxyethoxy)ethanol, and 4,4-dimethyl-1,3-oxazolidine is higher the higher the relative humidity of the storing conditions, while the SER$_a$ of 1,2-propanediol and acetic acid is lower the higher the relative humidity of the storing conditions at 1 day, i.e. the SER$_a$ of the two latter compounds has an opposite trend to that of TVOC$_{SERa}$ as regards the relative humidity of the storing conditions. At 14 days the SER$_a$ of the most abundant compounds, acetic acid excluded, follows the trend TVOC$_{SERa}$ being higher the higher the relative humidity of the storing conditions. 1,2-propanediol, (2-ethoxyethoxy)ethanol, and 2-(2-butoxyethoxy)ethanol stem from the paint while the other three abundant compounds stem from the plaster.

Table 43. The TVOC$_{SERa}$ and the SER$_a$ of the most abundant compounds emitted from the combination of primer B and paint B spread onto the combination of filler B and plaster B applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 55±5 %, 70±5 %, and 85±5 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 days were 35±5 %, 65±5 %, and 85±5 % and at 14 days they were 30±5 %, 60±5 %, and 80±5 %.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
TVOC$_{SERa}$	260	400	1300			
1,2-propanediol	150	110	55			
4,4-dimethyl-1,3-oxazolidine	65	85	820			
2-(2-butoxyethoxy)ethanol	250	420	430			
2-(2-ethoxyethoxy)ethanol	100	200	160			
acetic acid	190	65	0			
2-ethyl-1-hexanol	15	35	160			
7 days						
TVOC$_{SERa}$	-	-	650			
1,2-propanediol	-	-	35			
4,4-dimethyl-1,3-oxazolidine	-	-	270			
2-(2-butoxyethoxy)ethanol	-	-	260			
2-(2-ethoxyethoxy)ethanol	-	-	80			
acetic acid	-	-	-			
2-ethyl-1-hexanol	-	-	70			
14 days						
TVOC$_{SERa}$	25	-	320	25	-	320
1,2-propanediol	8	-	20	25	-	35
4,4-dimethyl-1,3-oxazolidine	5	-	160	0	-	80
2-(2-butoxyethoxy)ethanol	45	-	110	15	-	140
2-(2-ethoxyethoxy)ethanol	7	-	30	6	-	40
acetic acid	5	-	3	-	-	-
2-ethyl-1-hexanol	6	-	40	7	-	40

When comparing the results of the two sample collection methods it can be observed that the TVOC$_{SERa}$-values are of equal size. This holds quite well true also for the most abundant single compounds. The major exception is 4,4-dimethyl-1,3-oxazolidine stored at RH 80 % target relative humidity for which the SER_a is twice as high when collected from the chamber air compared with the FLEC-cell. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C86 to C88, and the detailed results of the samples collected using the FLEC-cell are presented in Table C152.

7.7.4.8 The combination of primer B and paint B spread onto plaster C applied onto CSB

The $TVOC_{SERa}$ and the SER_a of the most abundant compounds are presented in Table 44. At 1 day the $TVOC_{SERa}$ and the SER_a of 2-(2-butoxyethoxy)ethanol and 2-propanol is higher the higher the relative humidity of the storing conditions, while the trend is the opposite for 1,2-propanediol. At 14 days the $TVOC_{SERa}$ and the SER_a of the most abundant compounds is higher the higher the relative humidity of the storing conditions irrespective of the sample collection method. The $TVOC_{SERa}$ and the SER_a-values are also of approximately equal size for the two sample collection methods. 2-(2-butoxyethoxy)ethanol and 1,2-propanediol stem from the paint while the origin of 2-propanol, which is quite abundant at 1 day, is unknown. What is also to be noted is that acetic acid is observed in two out of three samples collected using the FLEC-cell while it is not present in the test chamber samples.

Table 44. The $TVOC_{SERa}$ and the SER_a of the most abundant compounds emitted from the combination of primer B and paint B spread onto plaster C applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 65±5 %, 80±5 %, and 90±5 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 7 days were 50±5 %, 70±5 %, and 85±5 % and at 14 days they were 40±5 %, 65±5 %, and 85±5 %.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
$TVOC_{SERa}$	55	-	105			
1,2-propanediol	120	-	60			
2-(2-butoxyethoxy)ethanol	100	-	140			
2-propanol	15	-	25			
7 days						
$TVOC_{SERa}$	10	-	-			
1,2-propanediol	7	-	-			
2-(2-butoxyethoxy)ethanol	15	-	-			
14 days						
$TVOC_{SERa}$	5	15	20	10	8	40
1,2-propanediol	2	2	10	1	2	15
2-(2-butoxyethoxy)ethanol	3	7	20	2	5	30
acetic acid	-	-	-	0	25	30

The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C90 to C92, and the detailed results of the samples collected using the FLEC-cell are presented in Table C154.

7.7.4.9 Adhesive A applied onto the combination of filler B and plaster B applied onto CSB

The TVOC$_{SERa}$ and the SER$_a$ of the most abundant compounds are presented in Table 45. The TVOC$_{SERa}$ does not have any clear trend as regards the relative humidity of the storing conditions at 1 day, but at 14 days it is higher the higher the relative humidity irrespective of the sample collection method.

Table 45. The TVOC$_{SERa}$ and the SER$_a$ of the most abundant compounds emitted from adhesive A applied onto the combination filler B and plaster B applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 95±3 % at all three different target relative humidities at day 1. At 7 days the measured values were 50±5 %, 70±5 % and 85±5 %at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values at 14 days were 40±5 %, 65±5 %, and 85±5 %.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
TVOC$_{SERa}$	2750	2950	2750			
4,4-dimethyl-1,3-oxazolidine	1650	1900	1750			
2-ethyl-1-hexanol	670	540	530			
dimethyl perhydro-1,3-oxazine	260	300	270			
2-(2-butoxyethoxy)ethanol	190	210	190			
acetone	80	65	55			
7 days						
TVOC$_{SERa}$	-	-	950			
4,4-dimethyl-1,3-oxazolidine	-	-	510			
2-ethyl-1-hexanol	-	-	90			
dimethyl perhydro-1,3-oxazine	-	-	60			
2-(2-butoxyethoxy)ethanol	-	-	285			
2-(2-ethoxyethoxy)ethanol	-	-	110			
14 days						
TVOC$_{SERa}$	130	-	580	100	-	660
4,4-dimethyl-1,3-oxazolidine	45	-	305	15	-	360
2-ethyl-1-hexanol	30	-	55	15	-	40
texanol	3	-	45	4	-	55
2-(2-butoxyethoxy)ethanol	35	-	150	55	-	180
2-(2-ethoxyethoxy)ethanol	15	-	50	25	-	55

The trend of $\mathrm{TVOC}_{\mathrm{SERa}}$ applies also to the most abundant single compounds. However, it is to be noted that the measured relative humidity of all three chambers was approximately equal at 1 day. All five most abundant single compounds at 1 day stem from the filler and plaster. The major differences at 7 and 14 days compared with 1 day is that 2-(2-ethoxyethoxy)ethanol and texanol also become quite abundant. However, these two compounds also stem from the filler and plaster.

When comparing the results from the two sample collection methods with each other, it can be observed that also the SER_a of the most abundant compounds follow the trend of $\mathrm{TVOC}_{\mathrm{SERa}}$ as regards the relative humidity of the storing conditions and that the emission rates are of approximately equal size. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C94 to C96, and the detailed results of the samples collected using the FLEC-cell are presented in Table C156.

7.7.4.10 Adhesive A applied onto plaster C applied onto CSB

The $\mathrm{TVOC}_{\mathrm{SERa}}$ and the SER_a of the most abundant compounds are presented in Table 46. The $\mathrm{TVOC}_{\mathrm{SERa}}$ is higher the higher the relative humidity of the storing conditions at 1 day. This applies also at 14 days irrespective of the sample collection method.

Table 46. The $\mathrm{TVOC}_{\mathrm{SERa}}$ and the SER_a of the most abundant compounds emitted from adhesive A applied onto plaster C applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 80±5 %, 90±5 %, and 95±3 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values were 50±5 %, 75±5 % and 90±5 % at 7 days and 35±5 %, 65±5 %, and 85±5 %at 14 days.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
$\mathrm{TVOC}_{\mathrm{SERa}}$	50	-	95			
acetone	15	-	20			
2-propanol	8	-	15			
acetic acid	0	-	25			
7 days						
$\mathrm{TVOC}_{\mathrm{SERa}}$	3	-	-			
all compounds	≤ 4	-	-			
14 days						
$\mathrm{TVOC}_{\mathrm{SERa}}$	0	0	20	9	10	20
organic Si-comp.	5	8	8	2	5	6
acetic acid	0	1	1	10	7	2
2-propanol	1	1	1	21	2	2
all other compounds	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2	≤ 2

Besides the three single compounds emitted at 1 day presented in Table 46, also different aldehydes (especially benzaldehyde, nonanal, and decanal) were quite abundant at that point of time. The origin of 2-propanol is unknown to the author while the other compounds stem from both the adhesive and the plaster.

When comparing the results of the two sample collection methods with each other, it can be observed that acetic acid and 2-propanol are quite abundant in the samples collected using the FLEC-cell, while their SER_a-values are ≤ 1 when samples are collected from the test chambers. The origin of the organic Si-compound is unknown to the author. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C98 to C100, and the detailed results of the samples collected using the FLEC-cell are presented in Table C158.

7.7.4.11 Adhesive B applied onto the combination of filler B and plaster B applied onto CSB

The $TVOC_{SERa}$ and the SER_a of the most abundant compounds are presented in Table 47. The $TVOC_{SERa}$ is higher at RH 20 % than at RH 80 % target relative humidities at 1 day, while the result is the opposite at 14 days for samples collected from the test chambers.

The SER_a of 2-(2-butoxyethoxy)ethanol and the nitrogen containing compounds is higher for the samples stored in the RH 20 % target relative humidity chamber than for samples stored in the RH 80 % target relative humidity chamber, as was the case for $TVOC_{SERa}$. The order of magnitude is the opposite for e.g. 2-ethyl-1-hexanol, acetic acid, ketones and esters. Of the five most abundant single compounds emitted at 1 day 2-(2-butoxyethoxy)ethanol stems mainly from the adhesive, acetic acid from both the adhesive and the combination of filler and plaster, and the other three compounds from the combination of filler and plaster. 2-(2ethoxyethoxy)ethanol that is quite abundant especially at 7 and 14 days stems also from the combination of filler and plaster.

When comparing the results from the two sample collection methods with each other, it can be observed that the results are quite similar. The main difference is that the SER_a of 2-(2-butoxyethoxy)ethanol is almost three times higher when collected using the FLEC-cell compared with the sample collected from the test chamber for samples stored at the RH 20 % target relative humidity. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C102 to C104, and the detailed results of the samples collected using the FLEC-cell are presented in Table C160.

Table 47. The TVOC$_{SERa}$ and the SER$_a$ of the most abundant compounds emitted from adhesive B applied onto the combination of filler B and plaster B applied onto CSB (µg/m^2·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 90±5 %, 95±3 %, and 95±3 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values were 45±5 %, 70±5 % and 85±5 % at 7 days and 35±5 %, 65±5 %, and 85±5 %at 14 days.

Compound	**Test chamber**			**FLEC-cell**		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
TVOC$_{SERa}$	5100	-	3600			
4,4-dimethyl-1,3-oxazolidine	2350	-	1750			
2-(2-butoxyethoxy)ethanol	2500	-	1700			
2-ethyl-1-hexanol	360	-	600			
dimethyl perhydro-1,3-oxazine	340	-	140			
acetic acid	0	-	110			
7 days						
TVOC$_{SERa}$	-	1050	-			
4,4-dimethyl-1,3-oxazolidine	-	200	-			
2-(2-butoxyethoxy)ethanol	-	1600	-			
2-ethyl-1-hexanol	-	50	-			
2-(2-ethoxyethoxy)ethanol	-	100	-			
14 days						
TVOC$_{SERa}$	380	-	1150	850	-	1300
4,4-dimethyl-1,3-oxazolidine	75	-	280	85	-	330
2-(2-butoxyethoxy)ethanol	560	-	1500	1450	-	1700
2-ethyl-1-hexanol	30	-	50	45	-	40
2-(2-ethoxyethoxy)ethanol	20	-	60	60	-	75

7.7.4.12 Adhesive B applied onto plaster C applied onto CSB

The TVOC$_{SERa}$ and the SER$_a$ of the most abundant compounds are presented in Table 48. The TVOC$_{SERa}$ is higher at RH 20 % than at RH 50 % target relative humidities at 1 day, while the trend is the opposite at 14 days for samples collected from the test chambers. This applies also to the most abundant single compounds.

The by far most abundant single compound is 2-(2-butoxyethoxy)ethanol, which stems from the adhesive. At 1 day are also aldehydes, acetone, and acetic acid quite abundant. Aldehydes and acetone stem mainly from the plaster, while acetic acid stem from both products.

Table 48. The $TVOC_{SERa}$ and the SER_a of the most abundant compounds emitted from adhesive B applied onto plaster C applied onto CSB (µg/m²·h). The relative humidity values indicate the target values of the test chambers. The measured relative humidities were 85±5 %, 95±3 %, and 98±3 % at 1 day at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively. The corresponding values were 55±5 %, 75±5 % and 90±5 % at 7 days and 40±5 %, 75±5 %, and 85±5 %at 14 days.

Compound	Test chamber			FLEC-cell		
	20 %	50 %	80 %	20 %	50 %	80 %
1 day						
$TVOC_{SERa}$	3300	2400	-			
2-(2-butoxyethoxy)ethanol	7800	5900	-			
acetic acid	110	35	-			
7 days						
$TVOC_{SERa}$	-	-	850			
2-(2-butoxyethoxy)ethanol	-	-	2150			
14 days						
$TVOC_{SERa}$	35	-	300	100	-	350
2-(2-butoxyethoxy)ethanol	85	-	490	200	-	590
organic Si-comp.	3	-	7	2		12
all other compounds	≤ 2	-	≤ 3	≤ 2	-	≤ 4

When comparing the results of the two sample collection methods with each other, it can be observed that the results are quite similar. The main difference is that the SER_a of 2-(2-butoxyethoxy)ethanol is almost three times higher when collected using the FLEC-cell compared with the sample collected from the test chamber for samples stored at the RH 20 % target relative humidity, which is also reflected in the $TVOC_{SERa}$-values. The detailed results of the samples collected from the test chambers are presented in Appendix C, Tables C106 to C108, and the detailed results of the samples collected using the FLEC-cell are presented in Table C162.

7.7.5 The influence of substrate on VOC-emissions from selected materials and material combinations

The VOC-emissions from selected material combinations will be analysed more thoroughly in the following chapters. This is done to demonstrate the joint influence of the relative humidity of the surrounding air and the different substrates on the emission patterns. FLEC-results are not dealt with here, since they were shown to be quite similar to the test chamber results in the preceding chapters.

7.7.5.1 Paint A and the combination of primer A and paint A spread onto a glass plate

The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from paint A and the combination of primer A and paint A spread onto glass plates at 1 and 14 days are presented in Table 49. When comparing the results of paint A with those of the combination of primer A and paint A, it is observed that the trend of a higher $TVOC_{SERa}$-value at a higher relative humidity applies for all other cases except for the combination of primer and paint at day one. The most abundant species are also roughly the same as regards emitted single compounds and chemical groups at 1 day, but the scatter is bigger at 14 days. The main difference is in the SER_a-values, which are one to two orders of magnitude higher for the combination of primer and paint compared to the single paint layer even though both the primer and paint have been classified as low-emitting according to the Finnish classification of indoor climate (CIC 2001).

Table 49. The major emissions from paint A and the combination of primer A and paint A spread onto glass plates, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured values for paint A were 20±5 %, 50±5 %, and 85±2 % at 1 day and at 14 days they were the same as the target relative humidities ±5% RH. The corresponding values for the combination of primer A and paint A were 20±5 %, 55±5 %, and 90±5 % at 1 day and the same as the target relative humidities ±5% RH at 14 days.

		Relative humidity (%)		
Material	**Compound**	20	50	80
Paint A	TVOC	600	850	940
1 day	1-dodecene	80	110	210
	hydrocarbarbon mixture	260	300	390
	1,2-propanediol	570	800	560
	2-(2-ethoxyethoxy)ethanol	130	200	200
	texanol	13	14	19
Paint A	TVOC	15	20	30
14 days	1,2-propanediol	14	2	2
	1-dodecene	4	5	5
	texanol	3	4	4
Primer and paint A	TVOC	6470	10400	6730
1 day	1-dodecene	75	110	190
	hydrocarbarbon mixture	-	-	-
	1,2-propanediol	3650	5500	2770
	2-(2-ethoxyethoxy)ethanol	65	115	60
	2-(2-butoxyethoxy)ethanol	11	165	200
	texanol	1680	1800	2020
Primer and paint A	TVOC	1040	1180	1600
14 days	1,2-propanediol	295	230	630
	1-dodecene	5	5	4
	texanol	930	1020	1030

The hydrocarbon mixture is not present with the combination of primer and paint while 2-(2-butoxyethoxy)ethanol is only present for the combination, so its origin is the primer. The two most abundant compounds, 1,2-propanediol and texanol, are the same in both cases and their SER_a regarding relative humidity also behave similarly. However, the SER_a of texanol is distinctly higher than that of 1,2-propanediol at 14 days compared with 1 day for the combination of primer and paint, which is not the case for the single layer of paint. The general trend is that the SER_a of single compounds decrease with time, but different compounds are observed at different points of time. The detailed results are presented in Appendix C, Tables C2 and C3 (paint A), and C34 and C36 (primer A and paint A).

7.7.5.2 Paint C, the combination of primer A and paint C and the combination of primer C and paint C spread onto a glass plate

The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from paint C, the combination of primer A and paint C, and the combination of primer C and paint C at 1 and 14 days are presented in Table 50.

Their $TVOC_{SERa}$-values are roughly of equal size the biggest differences occurring between paint C and the two combinations of primer and paint at RH 20 % at 14 days (Table 50). It can also be observed that the $TVOC_{SERa}$ of the two combinations of primer and paint is higher the higher the relative humidity of the storing conditions, irrespective of age.

However, the most abundant single compounds differ between the different samples. 2-ethylhexanoic acid is not observable for the combination of primer A and paint C at 1 day, but it is present at 14 days and its SER_a is of about the same order of magnitude as for the other two samples. 1,2-propanediol and texanol are only present for the combination of primer A and paint C stemming, thus, from the primer. 2-(2-butoxyethoxy)ethanol that was observed for the combination of primer A and paint A, but not paint A (Table 49) is not observed. On the other hand, paint C emitted 2-(2-etoxyethoxy)ethanol at especially 1 day, but this compound is not observed for the combinations of primer A and paint C or primer C and paint C. Paint C emitted also 2-butanone oxime especially at 1 day and this compound is also observed for the combination of primer A and paint C, but not for the combination of primer C and paint C. Acetic acid and especially propanoic acid have elevated SER_a-values for the combination of primer C and paint C. The single layer of paint C and the combination of primer A and paint C also emit them, but the SER_a-values are lower.

Table 50. The major emissions from paint C, the combination of primer A and paint C, and the combination of primer C and paint C spread onto glass plates, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured values were the same as the target values ±5% RH.

Material	**Compound**	**Relative humidity (%)**		
		20	50	80
Paint C	TVOC	20500	26500	17400
1 day	pentane	410	430	370
	hydrocarbon mixture	16800	21700	12100
	pentanal	440	530	580
	hexanal	1320	1480	1520
	hexanoic acid	370	360	460
	2-ethylhexanoic acid	820	890	760
Paint C	TVOC	810	1010	830
14 days	pentane	1	3	2
	hydrocarbon mixture	310	290	260
	pentanal	20	35	25
	hexanal	80	100	80
	hexanoic acid	170	280	240
	2-ethylhexanoic acid	160	170	120
Primer A and paint C	TVOC	19300	20300	20800
1 day	pentane	270	280	240
	hydrocarbon mixture	8100	8700	8500
	pentanal	370	430	560
	hexanal	1750	2000	2500
	hexanoic acid	780	1030	910
	2-ethylhexanoic acid	-	-	-
	1,2-propanediol	7350	7600	7200
	texanol	2500	2600	2550
Primer A and paint C	TVOC	410	930	1180
14 days	pentane	-	-	-
	hydrocarbon mixture	130	130	140
	pentanal	20	25	20
	hexanal	70	80	80
	hexanoic acid	180	250	225
	2-ethylhexanoic acid	40	70	100
	1,2-propanediol	470	450	560
	texanol	210	320	530
Primer C and paint C	TVOC	13700	15400	18400
1 day	pentane	270	290	275
	hydrocarbarbon mixture	7500	8400	10300
	pentanal	290	310	420
	hexanal	1300	1600	2400
	hexanoic acid	990	1050	780
	2-ethylhexanoic acid	1000	1020	810
	acetic acid	60	250	360
	propanoic acid	270	380	520
Primer C and paint C	TVOC	540	840	880
14 days	pentane	20	15	0
	hydrocarbarbon mixture	180	250	330
	pentanal	20	25	40
	hexanal	50	90	150
	hexanoic acid	310	430	410
	2-ethylhexanoic acid	65	120	150
	acetic acid	60	20	20
	propanoic acid	60	65	45

Pentanal and hexanal are the only compounds occurring in all samples having higher SER_a-values the higher the relative humidity of the storing conditions, except for paint C at 14 days. The same trend is observed also for texanol at 14 days as regards relative humidity. Other phenomena that can be observed are that even though the SER_a of the hydrocarbon mixture of the material combinations are lower than that of paint C, they still contain many higher boiling (≥ decane) aliphatic hydrocarbons with high SER_a-values. It can also be observed that the amount of higher boiling aldehydes increases with age especially for the combined products. The highest boiling aldehyde at 1 day is octanal and 2-octenal, while nonanal and higher boiling aldehydes occur at 7 and 14 days. The general trend is that the SER_a-values of the single compounds decrease with age and the same compounds are observed at different ages, contrary to what was observed for the combination of primer A and paint A. The detailed results are presented in Appendix C, Tables C6 and C7 (paint A), C42 and C44 (primer A and paint C), and C46 and C48 (primer C and paint C).

7.7.5.3 Adhesives A and B applied onto a glass plate

The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from adhesives A and B applied onto glass plates at 1 and 14 days are presented in Table 51. The $TVOC_{SERa}$ of adhesive A is of equal size irrespective of the relative humidity of the storing conditions or the point of sample collection. The most abundant single compound is acetic acid. Its SER_a is higher the higher the relative humidity of the storing conditions at 14 days, but does not show any distinct trend at 1 day. Another abundant compound at 1 day is propyl benzoate.

The $TVOC_{SERa}$ of adhesive B spread onto glass plates is higher the lower the relative humidity of the storing conditions at 1 day and higher the higher the relative humidity at 14 days. This same trend can also be observed for, by far, the most abundant single compound, 2-(2-butoxyethoxy)ethanol. The SER_a of acetic acid is higher at 7 days than at 1 day, but is depleted by 14 days.

Even though both adhesives are water-borne PVAc-dispersion products, their emission patterns are quite different. The general trend is that the SER_a-values of the single compounds decrease with age, except for acetic acid (see above), and different compounds are being emitted at different ages and relative humidities. This applies to both adhesives, but what is noteworthy is that the SER_a-values of the other occurring compounds, are generally ≤ 3 $\mu g/m^2 \cdot h$. The detailed results are presented in Appendix C, Tables C10 and C11 (adhesive A), and C30 and C32 (adhesive B).

Table 51. The major emissions from adhesives A and B applied onto glass plates, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured relative humidities were 95±5 %, 97±5 %, and 99±2 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively, at 1 day for adhesive A. The corresponding values for adhesive B were 95±3 %, 95±3 %, 99±3 %. At 14 days the measured values were the same as the target values ±5 % RH for both adhesives.

		Relative humidity (%)		
Material	**Compound**	20	50	80
Adhesive A	TVOC	60	55	55
1 day	acetic acid	115	70	75
	propyl benzoate	25	25	30
Adhesive A	TVOC	45	50	50
14 days	acetic acid	10	20	70
Adhesive B	TVOC	2570	1640	1050
1 day	acetic acid	40	10	0
	2-(2-butoxyethoxy)ethanol	2850	1985	1350
Adhesive B	TVOC	240	545	1645
14 days	acetic acid	-	-	-
	2-(2-butoxyethoxy)ethanol	385	940	2450

7.7.5.4 Filler and plaster B, plaster C, and gypsum board applied onto a glass plate

The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from the combination of filler and plaster B, a 6 mm layer of plaster C, and the gypsum board applied onto glass plates at 1 and 14 days are presented in Table 52. The $TVOC_{SERa}$ of the combination of filler B and plaster B is higher the lower the relative humidity of the storing conditions irrespective of the point of sample collection. The SER_a of the most abundant compounds is also higher the lower the relative humidity, except for 2-ethylhexyl acetate. Its SER_a is of equal size irrespective of the relative humidity. 2-methyl-2-propanol is depleted during the first week, but texanol, 2-(2-ethoxyethoxy)ethanol, and 2-(2-butoxyethoxy)ethanol have elevated SER_a-values at 14 days even though they did not occur at 1 day. The SER_a of 2-(2-ethoxyethoxy)ethanol, and 2-(2-butoxyethoxy)-ethanol is actually higher at 14 days than at 7 days, while the SER_a of texanol is of equal size at 7 and 14 days for samples stored at the RH 50 % and RH 80 % target relative humidities. It had decreased by half the value at the RH 20 % target relative humidity between 7 and 14 days. In general the $TVOC_{SERa}$ decreases with time, but the SER_a- values of single compounds vary with time and relative humidity. Especially at 7 days there are many compounds present that do not occur at 1 or 14 days. The emissions from the combination of filler B and plaster B are, thus, strongly dependent of the drying conditions.

Table 52. The major emissions from the filler and plaster B, the 6 mm layer of plaster C, and the gypsum board applied onto glass plates, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured relative humidities were 95±3 %, 98±3 %, and 99±3 % at the target relative humidities of RH 20 %, RH 50 %, and RH 80 %, respectively, at 1 day for the combination of filler B and plaster B. The corresponding values at 14 days were 20±5%, 98±3%, and 99±3%. The corresponding values for the 6 mm layer of plaster C were 99±3 % at all three different target relative humidities at 1 day and 95±3 %, 99±3 %, and 99±3 % at 14 days while the gypsum board had the same values as the target relative humidities ±5% RH at both points of time.

		Relative humidity (%)		
Material	**Compound**	20	50	80
Filler B and plaster B	TVOC	2125	2095	2075
1 day	2-ethyl-1-hexanol	1270	1230	1210
	4,4-dimethyl-1,3-oxazolidine	535	520	515
	2-methyl-2-propanol	255	215	205
	2-ethylhexyl acetate	150	145	145
Filler B and plaster B	TVOC	1525	1335	760
14 days	2-ethyl-1-hexanol	105	145	150
	4,4-dimethyl-1,3-oxazolidine	580	580	300
	2-methyl-2-propanol	-	-	-
	2-ethylhexyl acetate	145	85	45
	texanol	65	150	175
	2-(2-ethoxyethoxy)ethanol	225	35	9
	2-(2-butoxyethoxy)ethanol	215	140	7
Plaster C	TVOC	35	20	20
1 day	acetic acid	40	40	45
	acetone	15	10	15
Plaster C	TVOC	70	70	20
14 days	acetic acid	-	-	-
	acetone	1	1	1
	hydrocarbon mixture	50	55	0
Gypsum board	TVOC	9	25	35
1 day	hexanal	2	6	8
	1-chlorodecane	2	7	7
Gypsum board	TVOC	3	0	0
14 days	hexanal	2	1	1
	1-chlorodecane	0.9	0.4	0.1

The $TVOC_{SERa}$ of plaster C is in general low, but higher at 14 days than at 1 day. This result depends mainly on the mixture of hydrocarbons that is emitted at 14 days and seems to be affected by the humidity conditions. Acetic acid is depleted during the first week, while the SER_a of acetone is also very low, approximately 2 µg/m²·h at 7 days. The number of compounds emitted increases with age, but their SER_a is very low. It should be noted that there is a marked difference in the emission results between the combination of filler and plaster B and a 6 mm layer of plaster C even though all three products have been classified as low-emitting according to CIC (2001).

The $\mathrm{TVOC}_{\mathrm{SERa}}$ of the gypsum board is also very low. It is higher the higher the relative humidity of the storing conditions at 1 day, but on the whole it is of equal size compared with plaster C. The gypsum board adsorbed moisture from the surroundings at RH 80 %, but this did not seem to affect its emissions. The compounds emitted at different points of time and at different relative humidities vary slightly, but their SER_a-values are very low. The detailed results are presented in Appendix C, Tables C54 and C56 (filler B and plaster B), C58 and C60 (plaster C), and C26 and C27 (gypsum board).

7.7.5.5 Primer and paint A and primer and paint B spread onto glass and gypsum board

The measured relative humidity values of the combinations of primer and paint A and primer and paint B spread onto glass plate and gypsum board are presented in Table 53. The measured relative humidities when the gypsum board was stored at the different target relative humidities were the same as target relative humidities ±5 % RH. The $\mathrm{TVOC}_{\mathrm{SERa}}$-values and the SER_a of the most abundant compounds emitted from the combinations of primer A and paint A and primer B and paint B applied onto glass and gypsum board at 1 and 14 days are presented in Table 54. The $\mathrm{TVOC}_{\mathrm{SERa}}$ of the combination of primer and paint A is lower when spread onto gypsum board than it is when it was spread onto a glass plate, irrespective of age or the relative humidity of the storing conditions. The difference is approximately 5-10 -fold. The most abundant compounds, 1,2-propanediol and texanol, are the same irrespective of substrate. There are, however, more chemical groups present when the substrate is gypsum board even though their SER_a are in general quite low.

Table 53. The measured relative humidities when the combinations of primer and paint A and primer and paint B were spread onto glass and gypsum board.

Material	Time	Target relative humidity (%)		
		20	50	80
Primer and paint A	1 day	20±5 %	55±5 %	90±5 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Primer and paint A	1 day	30±5 %	60±5 %	85±3 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %
Primer and paint B	1 day	20±5 %	50±5 %	95±5 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Primer and paint B	1 day	35±5 %	60±5 %	80±5 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %

The $\mathrm{TVOC}_{\mathrm{SERa}}$ of the combination of primer and paint B is also lower when spread onto gypsum board than it is when it was spread onto a glass plate, irrespective of age or relative humidity. The difference is approximately 10-30 -fold. The most abundant compounds, 1,2-propanediol and 2-(2-butoxyethoxy)ethanol, are the same irrespective of substrate. 2-

propanol is not observed when the paint is spread onto a glass plate. The occurrence of acetic acid at later ages, especially at 14 days, also applies to both substrates.

Table 54. The major emissions from gypsum board, and primer A and paint A and primer B and paint B spread onto glass and gypsum board, (µg/m²·h).

Material	Compound	Relative humidity (%)		
		20	50	80
Gypsum board	TVOC	9	25	35
1 day	hexanal	2	6	8
Gypsum board	TVOC	3	0	0
14 days	hexanal	2	1	1
Primer and paint A	TVOC	6470	10400	6730
1 day on glass	1,2-propanediol	3650	5500	2770
	texanol	1680	1800	2020
Primer and paint A	TVOC	1040	1180	1600
14 days on glass	1,2-propanediol	300	230	630
	texanol	930	1020	1030
Primer and paint A	TVOC	730	970	820
1 day on gypsum board	1,2-propanediol	1550	1680	1150
	texanol	560	670	870
Primer and paint A	TVOC	300	290	420
14 days on gypsum board	1,2-propanediol	75	160	320
	texanol	350	310	350
Primer and paint B	TVOC	120	280	170
1 day on glass	1,2-propanediol	150	620	110
	2-(2-butoxyethoxy)ethanol	20	140	130
Primer and paint B	TVOC	20	25	15
14 days on glass	1,2-propanediol	25	30	35
	acetic acid	30	55	50
Primer and paint B	TVOC	4	9	30
1 day on gypsum board	1,2-propanediol	0	50	70
	2-(2-butoxyethoxy)ethanol	0	0	100
Primer and paint B	TVOC	11	10	15
14 days on gypsum board	1,2-propanediol	0	0	5
	acetic acid	0.5	8	5

The $TVOC_{SERa}$ is higher the higher the relative humidity of the storing conditions only for the combination of primer and paint A spread onto glass at 14 days and the combination of primer and paint B spread onto gypsum board at 1 day. In the other cases it is highest at RH 50 % target relative humidity, except for both combinations of primer and paint spread onto gypsum board at 14 days when it is lowest at RH 50 %. Even though the $TVOC_{SERa}$-values and the SER_a-values of the most abundant compounds are lower when emitted from the gypsum board compared with the glass plate at a specific age there are some differences in the SER_a-values regarding relative humidity. For instance, the SER_a of 2-(2-

butoxyethoxy)ethanol emitted from paint B is at 1 day highest at RH 80 % when emitted from the gypsum board, but highest at RH 50 % when emitted from the glass plate. Thus, relative humidity does not have a clear effect on the VOC-emissions from the combinations of primer and paint as far as TVOC and the emission of the most abundant compounds is concerned, but a substrate effect is obvious.

The detailed results are presented in Appendix C, Tables C26 and C27 (gypsum board), C34 and C36 (primer and paint A on glass), C62 and C64 (primer and paint A on gypsum board), C38 and C40 (primer and paint B on glass), and C66 and C68 (primer and paint B on gypsum board).

7.7.5.6 Adhesives A and B applied onto glass and gypsum board

The measured relative humidity values of adhesives A and B applied onto glass plate and gypsum board are presented in Table 55. The measured relative humidities when the gypsum board was stored at the different target relative humidities were the same as target relative humidities ±5 % RH. The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from adhesives A and B applied onto glass and gypsum board at 1 and 14 days are presented in Table 56.

Table 55. The measured relative humidities when adhesives A and B were applied onto glass and gypsum board.

		Target relative humidity (%)		
Material	**Time**	20	50	80
Adhesive A	1 day	95±5 %	97±3 %	99±2 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Adhesive A	1 day	80±5 %	90±5 %	95±3 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %
Adhesive B	1 day	95±5 %	95±5 %	99±2 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Adhesive B	1 day	85±5 %	95±5 %	98±3 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %

The $TVOC_{SERa}$ is of very equal size, irrespective of the relative humidity of the storing conditions at the respective point of sample collection when adhesive A was applied onto a glass plate and the same trend is roughly maintained when the adhesive is applied onto gypsum board. In general, the $TVOC_{SERa}$ is distinctly lower when the substrate is gypsum board compared with the glass plate. The most abundant single compound is acetic acid in both cases irrespective of the point of sample collection. Its SER_a-value, especially at 7 and 14 days, is higher the higher the relative humidity of the storing conditions when the adhesive is applied onto a glass plate while the trend is the opposite with the gypsum board as substrate. Other abundant compounds emitted when adhesive A is applied onto glass or gypsum board are propyl benzoate and 2-methyl-2-propanol, respectively. Since propyl benzoate emits from the adhesive when it is spread onto a glass plate, it can be deduced to be characteristic for the adhesive. The origin of 2-methyl-2-propanol is, however, unknown. A fourth compound emitted from adhesive A with an elevated SER_a-value, i.e. > 5 µg/m²·h, at 1 day is hexanal. It was not observed when the adhesive was applied onto a glass plate and stems, thus, from the gypsum board.

Table 56. The major emissions from gypsum board, and adhesives A and B applied onto glass and gypsum board, (µg/m²·h).

		Relative humidity (%)		
Material	**Compound**	20	50	80
Gypsum board	TVOC	9	25	35
1 day	hexanal	2	6	8
Gypsum board	TVOC	3	0	0
14 days	hexanal	2	1	1
Adhesive A	TVOC	60	55	55
1 day on glass	acetic acid	120	70	75
	propyl benzoate	25	25	30
Adhesive A	TVOC	45	50	50
14 days on glass	acetic acid	10	20	70
	propyl benzoate	-	-	-
Adhesive A	TVOC	15	10	25
1 day on gypsum board	acetic acid	15	8	15
	2-methyl-2-propanol	6	7	10
Adhesive A	TVOC	1	3	2
14 days on gypsum board	acetic acid	4	9	16
	2-methyl-2-propanol	-	-	-
Adhesive B	TVOC	2570	1640	1050
1 day on glass	acetic acid	40	10	0
	2-(2-butoxyethoxy)ethanol	2850	1990	1350
Adhesive B	TVOC	240	540	1640
14 days on glass	acetic acid	-	-	-
	2-(2-butoxyethoxy)ethanol	380	940	2450
Adhesive B	TVOC	240	250	220
1 day on gypsum board	acetic acid	15	45	15
	2-(2-butoxyethoxy)ethanol	350	340	290
Adhesive B	TVOC	0	0	50
14 days on gypsum board	acetic acid	5	5	10
	2-(2-butoxyethoxy)ethanol	0	5	65

The $TVOC_{SERa}$ of adhesive B applied onto glass is lower the higher the relative humidity of the storing conditions at 1 day, while it is higher the higher the relative at 14 days. There is only one result > 0 µg/m²·h when the adhesive is applied onto gypsum board at 14 days, i.e. at the RH 80 % target relative humidity. The $TVOC_{SERa}$-values are lower on the gypsum board compared with the glass plate at a specific point of time, but there are some differences in the SER_a-values and the most abundant compounds.

The SER_a of 2-(2-butoxyethoxy)ethanol emitted from adhesive B is higher the lower the relative humidity of the storing conditions at 1 day and higher the higher the relative humidity at 14 days, irrespective of substrate. It can be concluded that the relative humidity does not have a clear effect on the VOC-emissions from adhesives applied onto glass or gypsum board as far as TVOC is concerned, but it seems to affect the emissions of the most abundant single compounds and a substrate effect is also obvious.

The detailed results are presented in Appendix C, Tables C26 and C27 (gypsum board), C10 and C11 (adhesive A on glass), C70 and C72 (adhesive A on gypsum board), C30 and C32 (adhesive B on glass), and C74 and C76 (primer and paint B on gypsum board).

7.7.5.7 The combination of primer and paint A spread onto different substrates

The measured relative humidity values of the combination of primer and paint A spread onto glass plate, gypsum board, the combination of filler and plaster B, and plaster C are presented in Table 57. The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from primer and paint A spread onto different substrates and the emissions from the combination of filler and plaster B and plaster C at 1 and 14 days are presented in Table 58. The dependence of $TVOC_{SERa}$ on the relative humidity of the storing conditions is difficult to deduce from Table 56 partly because of the factorial design that was applied, but there seems to be no clear trend of the $TVOC_{SERa}$ of primer and paint A regarding relative humidity.

Table 57. The measured relative humidities when the combination of primer and paint A was spread onto different substrates.

		Target relative humidity (%)		
Material	**Time**	20	50	80
Primer and paint A	1 day	20±5 %	55±5 %	90±5 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Primer and paint A	1 day	30±5 %	60±5 %	85±3 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %
Primer and paint A	1 day	80±5 %	85±5 %	90±5 %
on filler and plaster B	14 days	45±5 %	65±5 %	85±5 %
Primer and paint A	1 day	50±5 %	75±5 %	85±5 %
on plaster C	14 days	30±5 %	60±5 %	80±5 %

Table 58. The major emissions from primer and paint A spread onto different substrates and the emissions from the combination of filler B and plaster B, and plaster C, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured relative humidities were presented in Table 55.

Material	Compound	Relative humidity (%) 20	50	80
Primer and paint A	TVOC	6500	10400	6700
1 day on glass	1,2-propanediol	3660	5500	2770
	texanol	1680	1800	2020
Primer and paint A	TVOC	1040	1180	1600
14 days on glass	1,2-propanediol	295	230	630
	texanol	930	1020	1030
Primer and paint A	TVOC	730	970	820
1 day on gypsum board	1,2-propanediol	1550	1680	1150
	texanol	560	670	870
Primer and paint A	TVOC	300	290	420
14 days on gypsum board	1,2-propanediol	75	150	320
	texanol	350	310	350
Primer and paint A	TVOC	3750	-	4830
1 day on plaster B	1,2-propanediol	2360	-	1750
	texanol	1630	-	1910
Primer and paint A	TVOC	540	-	1140
14 days on plaster B	1,2-propanediol	370	-	510
	texanol	280	-	460
Primer and paint A	TVOC	-	2620	3120
1 day on plaster C	1,2-propanediol	-	2760	2450
	texanol	-	1070	1360
Primer and paint A	TVOC	450	-	380
14 days on plaster C	1,2-propanediol	140	-	260
	texanol	300	-	240
Filler and plaster B	TVOC	2130	2100	2080
1 day	2-ethyl-1-hexanol	1270	1230	1210
	4,4-dimethyl-1,3-oxazolidine	530	520	515
Filler and plaster B	TVOC	1530	1340	760
14 days	2-ethyl-1-hexanol	100	140	150
	4,4-dimethyl-1,3-oxazolidine	580	580	300
Plaster C	TVOC	35	20	20
1 day	acetic acid	40	40	45
	acetone	15	10	15
Plaster C 14 days	TVOC	70	70	20
	acetic acid	-	-	-
	acetone	1	1	1

However, what can be deduced is that the $TVOC_{SERa}$ depends on the substrate and increases in the following order: gypsum board < plaster C < filler and plaster B < glass plate, irrespective of time. The only exception is that the $TVOC_{SERa}$ is of approximately equal size when the combination of primer and paint is spread onto gypsum board or plaster C at 14 days. Another noteworthy observation is that 1,2-propanediol and texanol are the two most abundant compounds emitted from the combination of primer and paint, irrespective of the substrate. Thus, the substrate contributes mainly to the $TVOC_{SERa}$-value. It can additionally be noticed that the SER_a of 1,2-propanediol is higher the higher the relative humidity of the storing conditions at 14 days irrespective of the substrate while the SER_a of texanol is higher the higher the relative humidity of the storing conditions at 1 day irrespective of the substrate. The detailed results are presented in Appendix C, Tables C34 and C36 (primer and paint A on glass), C62 and C64 (primer and paint A on gypsum board), C78 and C80 (primer and paint A on filler and plaster B), and C82 and C84 (primer and paint A on plaster C). The detailed results of the emissions from gypsum board are presented in Appendix C, Tables 26 and 27, filler and plaster B in Tables C54 and C56 and of plaster C in Tables C58 and C60.

7.7.5.8 The combination of primer and paint B spread onto different substrates

The measured relative humidity values of the combination of primer and paint B spread onto glass plate, gypsum board, the combination of filler and plaster B, and plaster C are presented in Table 59. The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from primer and paint B spread onto different substrates and the emissions from the combination of filler and plaster B and plaster C at 1 and 14 days are presented in Table 60.

Table 59. The measured relative humidities when the combination of primer and paint B was spread onto different substrates.

Material	Time	Target relative humidity (%)		
		20	50	80
Primer and paint B	1 day	20±5 %	50±5 %	95±5 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Primer and paint B	1 day	35±5 %	60±5 %	80±3 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %
Primer and paint B	1 day	55±5 %	70±5 %	85±5 %
on filler and plaster B	14 days	30±5 %	60±5 %	80±5 %
Primer and paint B	1 day	65±5 %	80±5 %	90±5 %
on plaster C	14 days	40±5 %	65±5 %	85±5 %

Table 60. The major emissions from primer and paint B spread onto different substrates and the emissions from the combination of filler B and plaster B, and plaster C, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured relative humidities were presented in Table 57.

Material	Compound	Relative humidity (%)		
		20	50	80
Primer and paint B	TVOC	125	285	170
1 day on glass	1,2-propanediol	150	620	110
	2-(2-butoxyethoxy)ethanol	20	145	130
Primer and paint B	TVOC	15	25	15
14 days on glass	1,2-propanediol	25	30	35
	acetic acid	30	55	50
Primer and paint B	TVOC	4	9	30
1 day on gypsum board	1,2-propanediol	0	50	70
	2-(2-butoxyethoxy)ethanol	0	0	100
Primer and paint B	TVOC	11	10	15
14 days on gypsum board	1,2-propanediol	0	0	5
	acetic acid	0.5	8	5
Primer and paint B	TVOC	260	400	1300
1 day on filler and	2-(2-butoxyethoxy)ethanol	260	420	430
plaster B	2-(2-ethoxyethoxy)ethanol	100	200	160
	1,2-propanediol	150	110	55
Primer and paint B	TVOC	25	-	325
14 days on filler	2-(2-butoxyethoxy)ethanol	45	-	115
plaster B	2-(2-ethoxyethoxy)ethanol	7	-	30
	1,2-propanediol	8	-	20
Primer and paint B	TVOC	55	-	105
1 day on plaster C	2-(2-butoxyethoxy)ethanol	100	-	140
	1,2-propanediol	120	-	60
Primer and paint B	TVOC	5	15	20
14 days on plaster C	2-(2-butoxyethoxy)ethanol	3	7	20
	1,2-propanediol	2	2	10
Filler and plaster B	TVOC	2130	2100	2080
1 day	2-ethyl-1-hexanol	1270	1230	1210
	4,4-dimethyl-1,3-oxazolidine	530	520	515
Filler and plaster B	TVOC	1530	1340	760
14 days	2-ethyl-1-hexanol	100	140	150
	4,4-dimethyl-1,3-oxazolidine	580	580	300
Plaster C	TVOC	35	20	20
1 day	acetic acid	40	40	45
	acetone	15	10	15
Plaster C	TVOC	70	70	20
14 days	acetic acid	-	-	-
	acetone	1	1	1

The dependence of $\mathrm{TVOC}_{\mathrm{SERa}}$ on relative humidity is again difficult to deduce from the table partly because of the factorial design that was applied, but some observations can still be made. The $\mathrm{TVOC}_{\mathrm{SERa}}$-values are highest at the RH 50 % target relative humidity when the combination of primer and paint is spread onto a glass plate, higher the higher the relative humidity of the storing conditions when spread onto gypsum board and the combination of filler and plaster B at 1 day and plaster C at 14 days. It can also be deduced that the $\mathrm{TVOC}_{\mathrm{SERa}}$ of primer and paint B depends on the substrate and increases in the following order: gypsum board < plaster C < glass plate < filler and plaster B irrespective of time.

Another observation that can be made is that the most abundant compounds change with substrate and age. 2-(2-butoxethoxy)ethanol and 1,2-propanediol are the two most abundant compounds emitted when the primer and paint is spread onto glass and gypsum board at 1 day and when it is spread onto the combination of filler and plaster B or plaster C irrespective of the point of time. Acetic acid replaces 2-(2-butoxethoxy)ethanol when the combination of primer and paint is spread onto glass and gypsum board at 14 days. 2-(2-ethoxyethoxy)ethanol is also very abundant when the combination of primer and paint is spread onto the combination of filler and plaster B irrespective of the point of time. 4,4-dimethyl-1,3-oxazolidine is also very abundant at the RH 80 % target relative humidity when the combination of primer and paint is spread onto the combination of filler and plaster B. Thus, it can be concluded that the substrate contributes mainly to the $\mathrm{TVOC}_{\mathrm{SERa}}$-value and that the occurrence of single compounds depends on the relative humidity.

It is also noteworthy that the $\mathrm{TVOC}_{\mathrm{SERa}}$ of the combination of primer and paint B is one to two orders of magnitude lower than that of the combination of primer and paint A irrespective of the substrate, even though all four products have been classified as low-emitting in CIC (2001).

The detailed results are presented in Appendix C, Tables C38 and C40 (primer and paint B on glass), C66 and C68 (primer and paint B on gypsum board), C86 and C88 (primer and paint B on filler and plaster B), and C90 and C92 (primer and paint B on plaster C). The detailed results of the emissions from gypsum board are presented in Appendix C, Tables 26 and 27, filler and plaster B in Tables C54 and C56 and of plaster C in Tables C58 and C60.

7.7.5.9 Adhesive A applied onto different substrates

The measured relative humidity values of adhesive A applied onto glass plate, gypsum board, the combination of filler and plaster B, and plaster C are presented in Table 61. The $\mathrm{TVOC}_{\mathrm{SERa}}$-values and the SER_a of the most abundant compounds emitted from the adhesive applied onto different substrates and the emissions from the combination of filler and plaster B and plaster C at 1 and 14 days are presented in Table 62.

Table 61. The measured relative humidities when adhesive A was spread onto different substrates.

		Target relative humidity (%)		
Material	**Time**	20	50	80
Adhesive A	1 day	95±5 %	97±5 %	99±3 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Adhesive A	1 day	80±5 %	90±5 %	95±5 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %
Adhesive A	1 day	95±5 %	95±5 %	95±5 %
on filler and plaster B	14 days	40±5 %	65±5 %	85±5 %
Adhesive A	1 day	80±5 %	90±5 %	95±5 %
on plaster C	14 days	35±5 %	65±5 %	85±5 %

The dependence of $TVOC_{SERa}$ on the relative humidity of the surrounding air is again difficult to deduce from Table 60 partly because of the factorial design that was applied, however there seems not to exist any clear trend of the $TVOC_{SERa}$ of adhesive A regarding the relative humidity of the storing conditions. On the other hand, what can be deduced is that the $TVOC_{SERa}$ depends on the substrate and increases in the following order: gypsum board < glass plate < plaster C < filler and plaster B at 1 day, and gypsum board < plaster C < glass plate < filler and plaster B at 14 days. Another noteworthy observation is that the most abundant compounds emitted from the adhesive depend strongly on the substrate.

4,4-dimethyl-1,3-oxazolidine and 2-ethyl-1-hexanol are emitted only when the adhesive is applied onto the combination of filler and plaster B. These were also the most abundant compounds emitted when the filler and plaster combination was applied onto glass plates. 2-(2-butoxehtoxy)ethanol is also quite abundant and stems from the combination of filler and plaster B. The major differences at 7 and 14 days compared with 1 day is that 2-(2-ethoxyethoxy)ethanol and texanol also become quite abundant. The same trend was observed when the combination of filler and plaster B was applied onto a glass plate.

Acetone, nonanal, and decanal are the most abundant compounds when the adhesive is applied onto plaster C. They were also emitted when the adhesive was applied onto glass plates, but their SER_a were ≤ 2 µg/m²·h at 1 day and practically 0 at 14 days. The origin of 2-propanol is unknown.

What should also be noted is that the SER_a of acetic is lower when the adhesive is applied onto gypsum board compared with the glass plate. The origin of 2-methyl-2-propanol is unknown. Thus, it can be concluded that the substrate is strongly affecting the VOC-emissions from adhesive A as far as TVOC and the most abundant compounds are concerned.

Table 62. The major emissions from adhesive A applied onto different substrates and the emissions from the combination of filler B and plaster B, and plaster C, (µg/m²·h). The relative humidity indicates the target relative humidity of the test chambers. The measured relative humidities were presented in Table 59.

Material	**Compound**	**Relative humidity (%)**		
		20	50	80
Adhesive A	TVOC	60	55	55
1 day on glass	acetic acid	120	70	75
	propyl benzoate	25	25	30
Adhesive A	TVOC	45	50	50
14 days on glass	acetic acid	10	20	70
	propyl benzoate	-	-	-
Adhesive A	TVOC	15	10	25
1 day on gypsum board	acetic acid	15	8	15
	2-methyl-2-propanol	6	7	10
Adhesive A	TVOC	1	3	2
14 days on gypsum board	acetic acid	4	9	15
	2-methyl-2-propanol	-	-	-
Adhesive A	TVOC	2770	2970	2740
1 day on filler and	4,4-dimethyl-1,3-oxazolidine	1640	1920	1750
plaster B	2-ethyl-1-hexanol	670	540	530
Adhesive A	TVOC	130	-	580
14 days on filler and	4,4-dimethyl-1,3-oxazolidine	45	-	310
plaster B	2-ethyl-1-hexanol	30	-	55
	2-(2-butoxyethoxy)ethanol	35	-	150
Adhesive A	TVOC	50	-	95
1 day on plaster C	acetone	15	-	20
	2-propanol	8	-	15
Adhesive A	TVOC	0.5	0	20
14 days on plaster C	decanal	2	2	2
	nonanal	1	1	2
Filler and plaster B	TVOC	2130	2100	2080
1 day	2-ethyl-1-hexanol	1270	1230	1210
	4,4-dimethyl-1,3-oxazolidine	530	520	515
Filler and plaster B	TVOC	1530	1340	760
14 days	2-ethyl-1-hexanol	100	140	150
	4,4-dimethyl-1,3-oxazolidine	580	580	300
Plaster C	TVOC	35	20	20
1 day	acetic acid	40	40	45
	acetone	15	10	15
Plaster C 14 days	TVOC	70	70	20
	acetic acid	-	-	-
	acetone	1	1	1

The detailed results are presented in Appendix C, Tables C10 and C11 (adhesive A on glass), C70 and C72 (adhesive A on gypsum board), C94 and C96 (adhesive A on filler and plaster B), and C98 and C100 (adhesive A on plaster C). The detailed results of the emissions from gypsum board are presented in Appendix C, Tables 26 and 27, filler and plaster B in Tables C54 and C56 and of plaster C in Tables C58 and C60.

7.7.5.10 Adhesive B applied onto different substrates

The measured relative humidity values of adhesive B applied onto glass plate, gypsum board, the combination of filler and plaster B, and plaster C are presented in Table 63.

Table 63. The measured relative humidities when adhesive B was spread onto different substrates.

Material	**Time**	**Target relative humidity (%)**		
		20	50	80
Adhesive A	1 day	95±5 %	95±5 %	99±3 %
on glass	14 days	20±5 %	50±5 %	80±5 %
Adhesive A	1 day	85±5 %	95±5 %	98±3 %
on gypsum board	14 days	20±5 %	50±5 %	80±5 %
Adhesive A	1 day	90±5 %	95±5 %	95±5 %
on filler and plaster B	14 days	35±5 %	65±5 %	85±5 %
Adhesive A	1 day	85±5 %	95±5 %	98±3 %
on plaster C	14 days	40±5 %	75±5 %	85±5 %

The $TVOC_{SERa}$-values and the SER_a of the most abundant compounds emitted from the adhesive applied onto different substrates and the emissions from the combination of filler and plaster B and plaster C at 1 and 14 days are presented in Table 64. The dependence of $TVOC_{SERa}$ on the relative humidity of the surrounding air is difficult to deduce from the table partly because of the factorial design that was applied, however there seems not to exist any clear trend of the $TVOC_{SERa}$ of adhesive B regarding the relative humidity of the storing conditions. What, however, can be deduced is that the $TVOC_{SERa}$ depends on the substrate and increases in the following order: gypsum board < glass plate < plaster C < filler and plaster B at the age of 1 day, and gypsum board < plaster C < glass plate and filler and plaster B, which are difficult to separate, at the age of 14 days. The $TVOC_{SERa}$ of adhesive B spread onto the combination of filler and plaster B applied onto CSB is higher at RH 20 % than at RH 80 % target relative humidities at 1 day, while the result is the oppposite at 14 days. This result is consistent with the case when the adhesive was spread onto a glass plate. The $TVOC_{SERa}$-value at 1 day is approximately 2-times higher when the adhesive is spread onto the combination of filler and plaster B than onto a glass plate, irrespective of relative humidity of the storing conditions, but the difference evens out during the first seven days.

Table 64. The major emissions from adhesive B spread onto different substrates and the emissions from the combination of filler and plaster B, and plaster C, (µg/m²·h).

Material	**Compound**	**Relative humidity (%)**		
		20	50	80
Adhesive B	TVOC	2570	1640	1050
1 day on glass	2-(2-butoxyethoxy)ethanol	2860	1990	1350
	acetic acid	40	10	0
Adhesive B	TVOC	240	540	1640
14 days on glass	2-(2-butoxyethoxy)ethanol	380	940	2450
	acetic acid	-	-	-
Adhesive B	TVOC	240	250	220
1 day on gypsum board	2-(2-butoxyethoxy)ethanol	350	340	290
	acetic acid	15	45	15
Adhesive B	TVOC	0	0	50
14 days on gypsum board	2-(2-butoxyethoxy)ethanol	0	5	65
	acetic acid	5	5	10
Adhesive B	TVOC	5060	-	3630
1 day on plaster B	2-(2-butoxyethoxy)ethanol	2480	-	1720
	4,4-dimethyl-1,3-oxazolidine	2360	-	1730
Adhesive B	TVOC	380	-	1150
14 days on plaster B	2-(2-butoxyethoxy)ethanol	580	-	1500
	4,4-dimethyl-1,3-oxazolidine	75	-	280
Adhesive B	TVOC	3270	2380	-
1 day on plaster C	2-(2-butoxyethoxy)ethanol	7840	5860	-
	acetic acid	110	35	-
Adhesive B	TVOC	100	-	510
14 days on plaster C	2-(2-butoxyethoxy)ethanol	85	-	490
	decanal	2	-	3
Filler and plaster B	TVOC	2130	2100	2080
1 day	2-ethyl-1-hexanol	1270	1230	1210
	4,4-dimethyl-1,3-oxazolidine	530	520	515
Filler and plaster B	TVOC	1530	1340	760
14 days	2-ethyl-1-hexanol	100	140	150
	4,4-dimethyl-1,3-oxazolidine	580	580	300
Plaster C	TVOC	35	20	20
1 day	acetic acid	40	40	45
	acetone	15	10	15
Plaster C 14 days	TVOC	70	70	20
	acetic acid	-	-	-
	acetone	1	1	1

The most abundant compounds when the adhesive is applied onto the combination of filler and plaster B are 2-(2-butoxyethoxy)ethanol, 2-ethyl-1-hexanol and two nitrogen containing compounds, the same as when adhesive A was applied onto the combination of filler and plaster B. The aforementioned compounds stem from the combination of filler and plaster. The SER_a of 2-(2-butoxyethoxy)ethanol is, however, much higher in the case for adhesive B than for adhesive A. The difference is caused by adhesive B, which emits mainly 2-(2-butoxyethoxy)ethanol based on the emission results when it was spread onto glass.

When adhesive B is spread onto plaster C the $TVOC_{SERa}$-level is distinctly lower than was the case with the combination of filler and plaster B as substrate. It is still higher than with the glass as substrate at 1 day at RH 20 % and RH 50 % target relative humidities, but after that it is intermediate compared with glass and gypsum board as substrates. Of the three most abundant compounds are acetic acid, and especially decanal, also emitted from the plaster.

What should also be noted is that the SER_a of acetic acid is higher especially at 14 days when the adhesive is applied onto gypsum board compared with the glass plate. This result is opposite to what was observed for adhesive A applied onto gypsum board.

The detailed results are presented in Appendix C, Tables C30 and C32 (adhesive B on glass), C74 and C76 (adhesive B on gypsum board), C102 and C104 (adhesive B on filler and plaster B), and C106 and C108 (adhesive B on plaster C). The detailed results of the emissions from gypsum board are presented in Appendix C, Tables 26 and 27, filler and plaster B in Tables C54 and C56 and of plaster C in Tables C58 and C60.

7.7.6 Statistical analysis

The influence of the relative humidity of the surrounding air on the emission of single compounds separated according to the chemical group they belong to and the conformity of the two sample collection methods were studied using a STATGRAPHICS software program. For the study on the influence of relative humidity a condition that the measured relative humidity of the test chamber air should have reached the target level at least five days prior to sample collection for a result to be included was introduced. This was done in an attempt to minimise the influence of the drying process on the analysis results.

7.7.6.1 Statistical analysis of Part I. VOC emissions from single material layers on a glass substrate

A Kruskal-Wallis test at a 95 % confidence interval indicated that the relative humidity of the surrounding air did not influence the emission rate of single compounds separated according to chemical groups or the $TVOC_{SERa}$-values for samples collected from the test chambers. This applies also to acetic acid, which was tested separately. Adhesive B was included in the analysis, since it was also applied onto a glass plate as a single material layer.

Furthermore, the same test indicated that there was no statistical difference in the two different sample collection methods when the emission rates of single compounds separated according to chemical groups or the $TVOC_{SERa}$-values were compared.

7.7.6.2 Statistical analysis of Part II. VOC emissions from material combinations on a glass substrate

A Kruskal-Wallis test at a 95 % confidence interval indicated that the relative humidity of the surrounding air did not influence influenced the $TVOC_{SERa}$-values for samples collected from the test chambers. However, it did influence the emission rate of aldehydes when their SER_a was < 200 µg/m²·h. A Mann-Whitney u Test indicates that the difference was significant between samples stored at RH 20 % and RH 80 % target relative humidities. A Box-and-Whisker plot, Figure 64, shows that the SER_a were higher for the latter storing conditions. The plot also asserts the result from the Mann-Whitney u Test, since the notches in the boxes do not overlap each other.

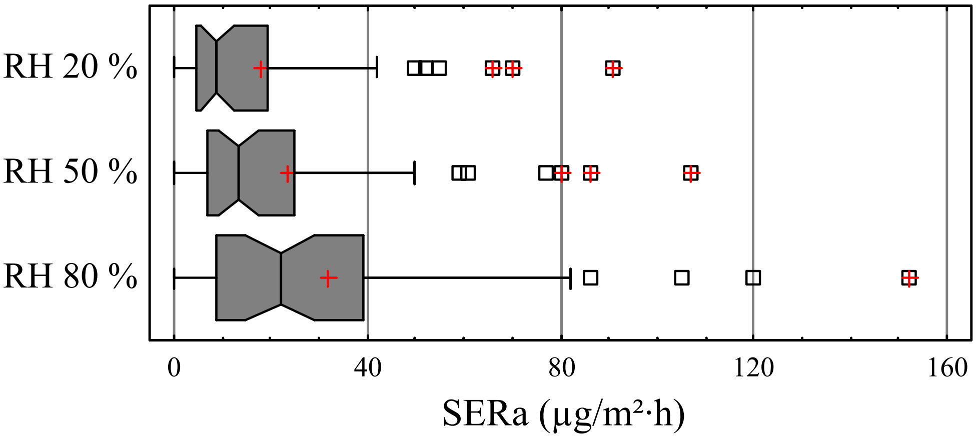

Figure 64. A Box-and-Whisker of the SER_a of aldehydes. The relative humidity values indicate the measured relative humidity of the different test chambers ±5 % RH.

Furthermore, the Kruskal-Wallis test indicated that there was no statistical difference in the two different sample collection methods when the emission rates of single compounds separated according to chemical groups or the $TVOC_{SERa}$-values were compared.

7.7.6.3 Statistical analysis of Part III. VOC emissions from material combinations on gypsum board and CSB

Factorial design was applied in order to optimise the amount of samples collected when primer A and paint A or primer B and paint B was spread onto filler B and plaster B or a 6 mm layer of plaster C which was applied onto calcium silicate brick (CSB). A statistical analysis of the test results, which has been done by using a software program, MODDE, which was also used to design the experiments by D-Optimal design, is presented in the following paragraphs. The $TVOC_{SERa}$-values used in the calculations were presented in Tables 41-44.

A multiple linear regression (MLR) analysis performed using MODDE gave the following results presented in Table 65 regarding the combinations of primer and paint applied onto the combination of filler and plaster B or a single layer of plaster C. Partial Least Squares (PLS) - coefficients with confidence intervals and an interaction plot for the influence of the point of sample collection and the relative humidity of the storing conditions on $TVOC_{SERa}$-values are presented in Figures 65 and 66.

Table 65. ANOVA-table (MLR) of the tests with the combination of primers and paints A or B spread onto the combination of filler and plaster B or a single layer of plaster C applied onto CSB.

TVOC	DF	SS	MS	F	p	SD
Total	22	6.2×10^7	2.8×10^6			
Constant	1	2.3×10^7	2.3×10^7			
Total corrected	21	3.9×10^7	1.8×10^6			1357
Regression	10	3.7×10^7	3.7×10^6	21.8	0.00	1919
Residual	11	1.8×10^6	168600			410
	$R^2 = 0.952$ and $Q^2 = 0.591$. Condition number = 1.360					

By default the PLS-coefficient plot is centred and scaled. The scaling of the data makes the coefficients comparable. The size of the coefficient represents the change in the response when a factor varies from 0 to 1, in coded units, while the other factors are kept at their averages. A PLS-coefficient is significant, i.e. different from the noise, when the confidence interval does not cross zero. It can be observed that the combination of primer and paint, point of time of sample collection, and the combination of filler and plaster, respectively, are three significant factors affecting the $TVOC_{SERa}$-values. The relative humidity of the surrounding air by itself is insignificant regarding $TVOC_{SERa}$, but there is a strong interaction of relative humidity and the combination of filler plaster affecting the $TVOC_{SERa}$.

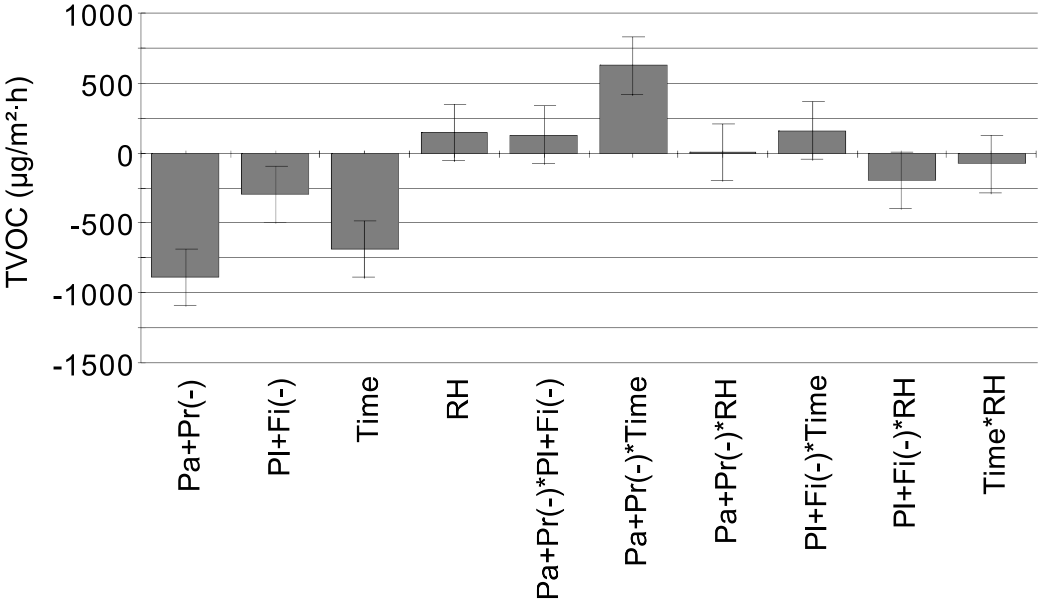

Figure 65. PLS-coefficients with confidence intervals showing the influence of different factors on TVOC$_{SERa}$. Pa denotes paint, Pr denotes primer, Pl denotes plaster, Fi denotes filler, and Time denotes the point of sample collection.

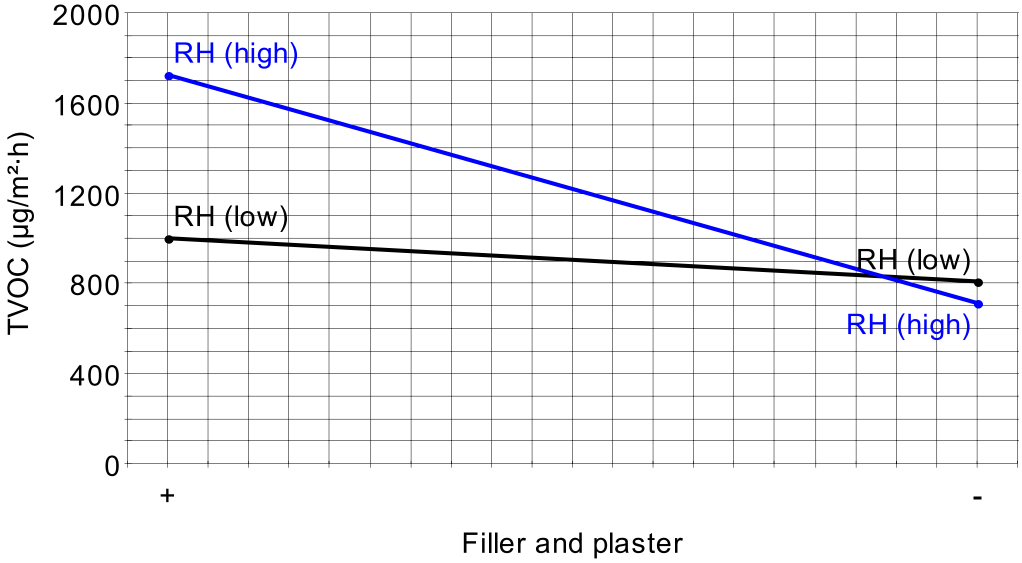

Figure 66. The interaction of relative humidity (at its low and high level) and the combination of filler and plaster and their effect on TVOC$_{SERa}$. "+" and "-" indicates whether the combination of filler and plaster or a single layer of plaster is high emitting (+) or low emitting (-). The interaction is strong, since the two lines cross each other.

Figure 67 presents a response prediction plot of the effect that relative humidity has on the TVOC$_{SERa}$. It can be observed that TVOC$_{SERa}$ tends to increase when the elative humidity of the surrounding air increases.

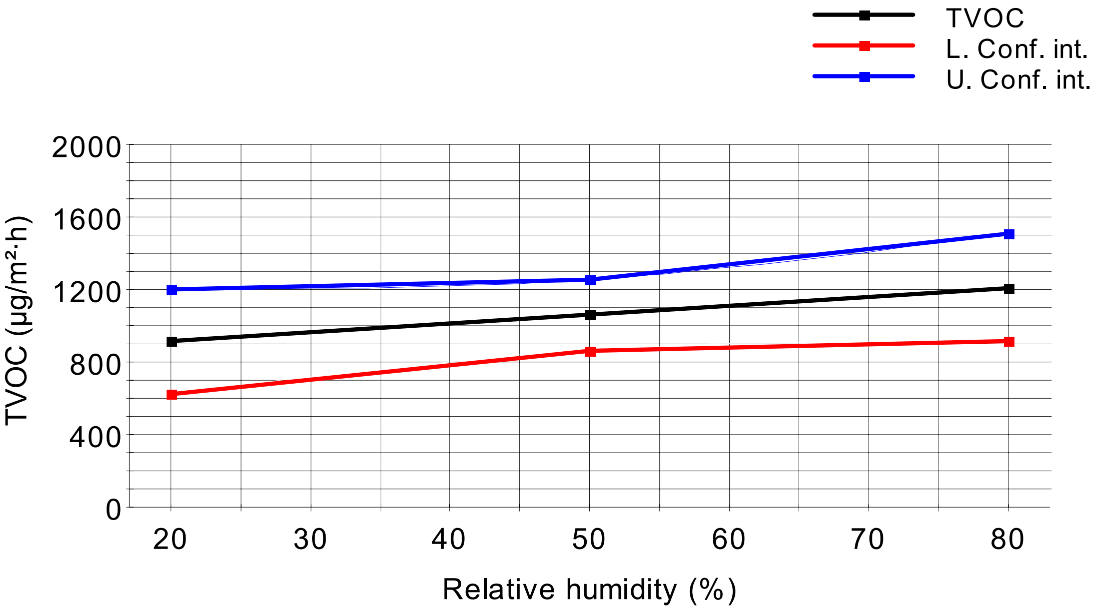

Figure 67. A response prediction plot of the effect of relative humidity on $\mathrm{TVOC}_{\mathrm{SERa}}$.

Factorial design was also applied in order to optimise the amount of samples collected when adhesive A or adhesive B was applied onto the combination of filler B and plaster B or a 6 mm layer of plaster C which was applied onto calcium silicate brick (CSB). A statistical analysis of the test results is presented in the following paragraphs. The $\mathrm{TVOC}_{\mathrm{SERa}}$-values were presented in Tables 45-48.

A multiple linear regression (MLR) analysis done using MODDE gave the result presented in Table 66. PLS-coefficients with confidence intervals and an interaction plot for the influence of time and relative humidity on $\mathrm{TVOC}_{\mathrm{SERa}}$ are presented in Figures 68 and 69.

Table 66. ANOVA-table (MLR) of the tests with adhesives A and B spread onto the combination of filler and plaster B or a single layer of plaster C applied onto CSB.

TVOC	DF	SS	MS	F	p	SD
Total	22	8.4×10^7	3.8×10^6			
Constant	1	3.7×10^7	3.7×10^7			
Total corrected	21	4.7×10^7	2.2×10^6			1497
Regression	10	4.3×10^7	4.3×10^6	11.8	0.00	2076
Residual	11	4.0×10^6	364000			603
	$R^2 = 0.915$ and $Q^2 = 0.700$. Condition number = 1.552					

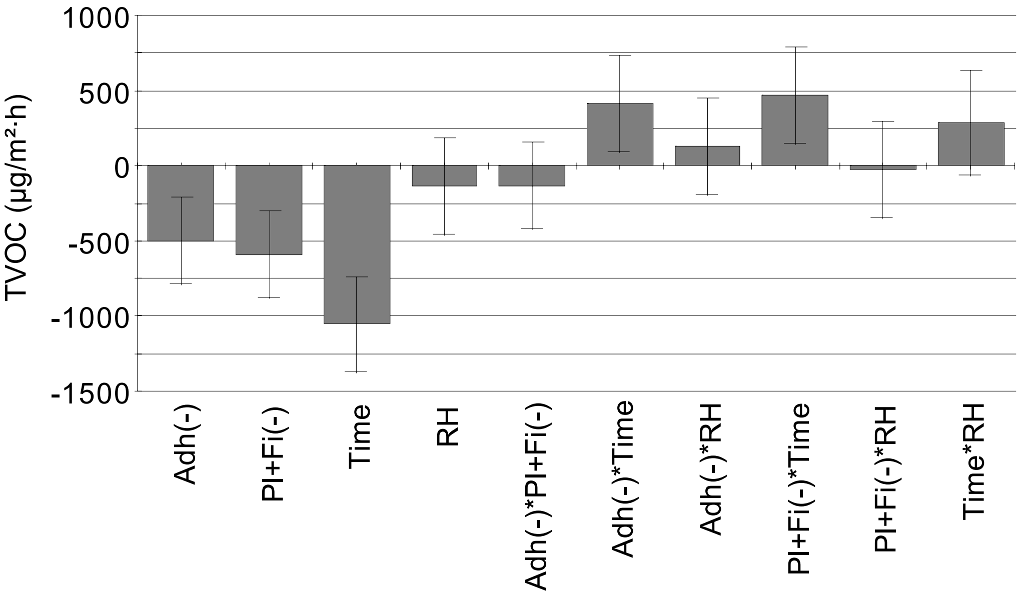

Figure 68. PLS-coefficients with confidence intervals showing the influence of different factors on TVOC$_{SERa}$. Adh denotes adhesive, Pl denotes plaster, Fi denotes filler, and Time denotes the point of sample collection.

It can be observed that the point of time of sample collection, the combination of filler and plaster, and the adhesive, respectively, are the three most significant factors affecting the TVOC$_{SERa}$-values when an adhesive is applied onto a combination of filler and plaster applied onto CSB. The relative humidity by itself is insignificant regarding TVOC$_{SERa}$, but there is a strong interaction of relative humidity and the point of time of sample collection affecting TVOC$_{SERa}$.

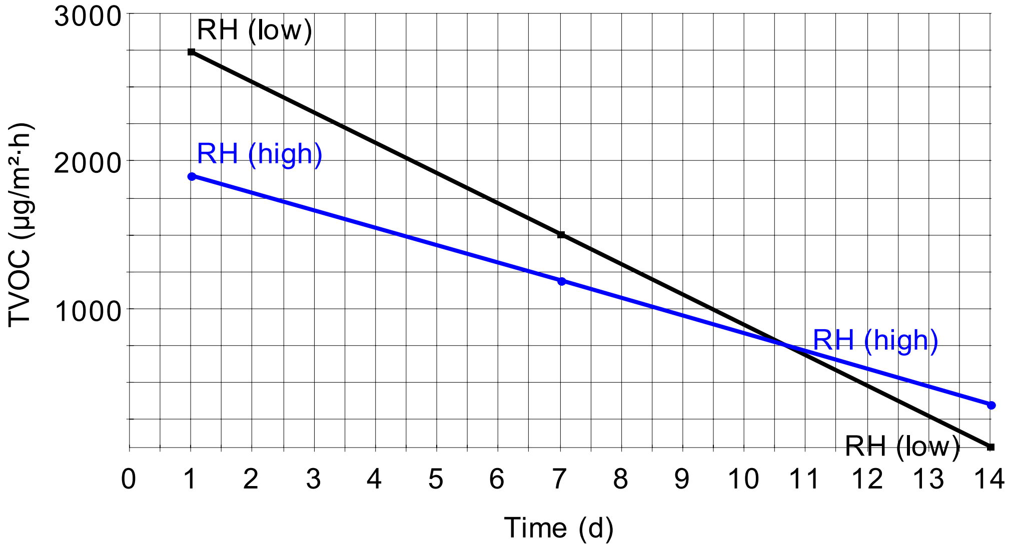

Figure 69. The interaction of relative humidity (at its low and high level) and the point of time of sample collection and their effect on TVOC$_{SERa}$. The interaction is strong, since the two lines cross each other.

Figure 70 presents a response prediction plot of the effect that relative humidity has on the $TVOC_{SERa}$. It can be observed that $TVOC_{SERa}$ tends to decrease when the relative humidity of the surrounding air increases, contrary to what was observed for paints.

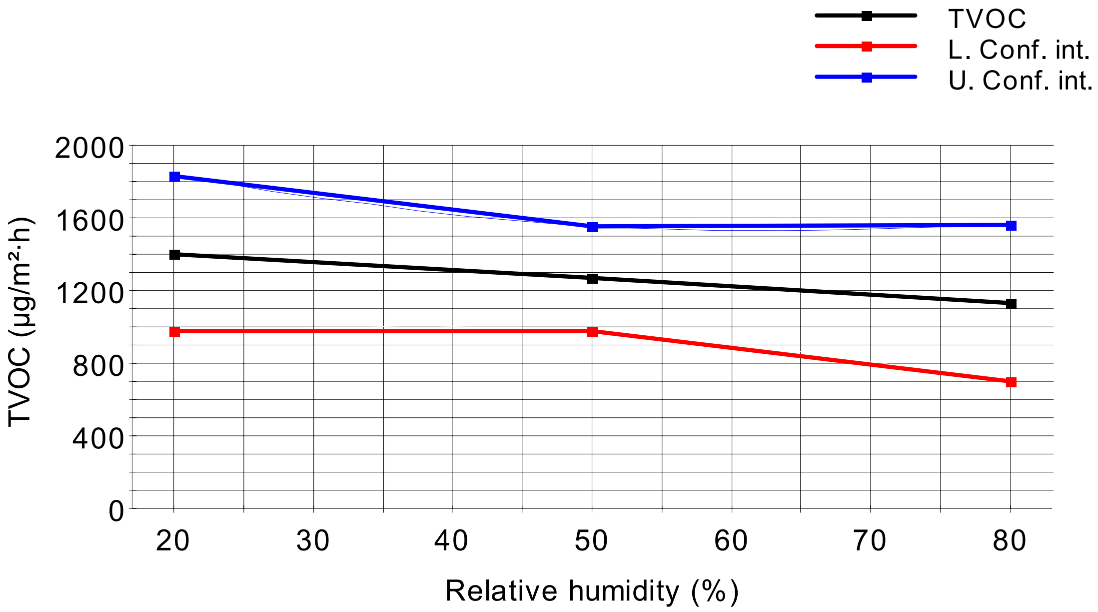

Figure 70. A response prediction plot of the effect of relative humidity on $TVOC_{SERa}$.

A Kruskal-Wallis test at a 95 % confidence interval performed with the STATGRAPHICS software program indicated that there was no difference in the $TVOC_{SERa}$-values when the two different sample collection methods were compared with each other. However, the same test indicated that sample collection methods caused a difference in the SER_a of ketones when the combination of primers and paints, or adhesives, was applied onto gypsum board. A Mann-Whitney u Test indicated that the difference was significant between samples stored at RH 20 % target relative humidity. A Box-and-Whisker plot showed that the SER_a were higher for samples collected using the FLEC-cell than for samples collected from the test chamber. The same conclusion could be drawn for both aldehydes and ketones when the combination of primers and paints, or adhesives, were applied onto the combination of filler B and plaster B or a single layer of plaster C applied onto CSB and stored in the RH 20 % target relative humidity. This behaviour could be a consequence of the fact that the air introduced into the FLEC-cell had a relative humidity of 50±5 %.

7.7.6.4 A comparison of glass and gypsum board as substrates

A statistical analysis was performed to compare the emissions from the combinations of primer and paint A and B and adhesives A and B applied onto glass plate and gypsum board after the samples had reached moisture equilibrium with their surroundings. A Kruskal-Wallis test at a 95 % confidence interval indicated that there was a statistically significant difference in the emission rates of alcohol and phenol ethers emitted from the paint combinations for samples collected from the test chambers. A Mann-Whitney u Test indicated that the difference was significant between samples stored at the RH 20 % target relative humidity and a Box-and-Whisker plot showed that the SER_a were higher for samples spread onto glass plates than gypsum board. The same analysis procedure also indicated that the emission rate of aromatic hydrocarbons emitted from the adhesives was higher when they were applied onto glass plates than onto gypsum board both at the RH 20 % and RH 50 % target relative humidities when samples were collected from the test chambers.

Furthermore, there was a statistically significant difference between the emission rates of aliphatic and alicyclic compounds emitted from the combinations of primer and paint A and B spread onto glass plate and gypsum board for samples stored at the RH 80 % target relative humidity when samples were collected using the FLEC-cell. The emission rates were again higher from the glass plate. Adhesives could not be analysed, since there was not enough data.

7.8 OLFACTORY EVALUATION

The average strength of olfaction of the materials studied in Parts I-III of this study is presented in Tables 67-69, respectively. It was rather difficult to observe any differences between samples stored at different relative humidities. At least during the first 2-3 days the odour seemed to be stronger at higher relative humidity, but this shifted later on, and no definite pattern could be observed. Regarding the end of a testing period when the chamber lid was opened, a more distinct pattern could be observed. Then the olfactory evaluation showed increasing sensation with an increase in the relative humidity of the storing conditions. The difference between the relative humidities was approximately one step on the olfactory scale irrespective of the sample evaluated. This finding is consistent with the results reported by FANG ET AL. (1998), who concluded that the air was perceived as less acceptable with increasing humidity. They used five different building materials, i.e. a PVC flooring, a loomed polyamide carpet, a water-borne floor varnish, a water-borne wall paint, and an acrylic sealant, and a humidity range of 30 % to 70 % RH in their study.

The odours observed were characteristic to the samples in Parts I and II, i.e. paints had a characteristic smell of wet paint with regard to the solvent and adhesives had a characteristic adhesive-like smell. Fillers and plasters A and B had a hint of the characteristic smell of adhesives while plaster C was mainly odourless. When paints and adhesives were spread onto gypsum board the smell could be characterised by a mix of paint or adhesive and the rather tangy smell of the gypsum board. Filler and plaster B as a substrate gave a mix of the adhesive-like smell of the substrate and the surface material, while plaster C did not contribute to the odour sensation of the surface material.

Table 67. Average olfactory strength of single materials spread onto glass plate.

Sample	Age (day)												
	1	2	3	4	5	6	7	11	12	16	17	28	Open
Paint A	4	3	3	2	1	0	0	0	0	0	0	0	1
Paint C	5	4	4	4	3	3	3	3	2	2	1	1	4
Adhesive A	1	1	1	0	0	0	0	0	0	0	0	0	2
Adhesive C	1	1	1	1	1	0	0	0	0	0	0	0	3
Plaster A (3 mm)	1	0	0	0	0	0	0	0	0	0	0	0	1
Plaster C (3 mm)	0	0	0	0	0	0	0	0	0	0	0	0	1
GB[1)]	3	2	2	1	1	0	0	0	0	0	0	0	2

[1)] GB is gypsum board

Table 68. Average olfactory strength of adhesive B and material combinations spread onto glass plate.

Sample	Age (day)										
	1	2	3	4	5	8	9	11	12	14	Open
Adhesive B	1	0	0	0	0	0	0	0	0	0	2
Primer A and paint A	1	0	0	0	0	0	0	0	0	0	2
Primer B and paint B	0	0	0	0	0	0	0	0	0	0	2
Primer A and paint C	4	4	4	4	3	3	2	2	1	1	3
Primer C and paint C	4	3	3	3	2	2	1	1	1	1	3
Filler A and plaster A[2)]	2	2	1	1	0	0	0	0	0	0	2
Filler B and plaster B[2)]	1	1	0	0	0	0	0	0	0	0	3
Plaster C (6 mm)	0	0	0	0	0	0	0	0	0	0	1

[2)] The thickness of the layers of fillers A and B and plasters A and B was 3 mm

Table 69. Average olfactory strength of material combinations spread onto gypsum board or CSB.

Sample	Age (day)										
	1	2	3	4	5	6	7	8	9	14	Open
GB and primer and paint A[3)]	2	1	1	1	1	1	0	0	0	0	2
GB and primer and paint B[3)]	1	1	1	0	0	0	0	0	0	0	1
GB and adhesive A[3)]	3	3	2	2	2	1	1	1	0	0	2
GB and adhesive B[3)]	3	2	1	1	1	0	0	0	0	0	2
CSB, fi + pl B, and pr + pa A[4),5)]	0	0	0	0	0	0	0	0	0	0	2
CSB, fi + pl B and pr + pa B[4),5)]	0	0	0	0	0	0	0	0	0	0	3
CSB, pl C and pr + pa A[4),5)]	0	0	0	0	0	0	0	0	0	0	2
CSB, pl C and pr + pa B[4),5)]	1	0	0	0	0	0	0	0	0	0	1
CSB, fi + pl B and adhes. A[4),5)]	2	1	0	0	0	0	0	0	0	0	3
CSB, fi + pl B and adhes. B[4),5)]	0	0	0	0	0	0	0	0	0	0	2
CSB, pl C, and adhesive A[4),5)]	1	0	0	0	0	0	0	0	0	0	0
CSB, pl C, and adhesive B[4),5)]	1	0	0	0	0	0	0	0	0	0	2

[3)] GB denotes gypsum board

[4)] CSB denotes calcium silicate brick

[5)] fi denotes filler, pl denotes plaster, pr denotes primer and pa denotes paint

The emissions from materials and material combinations were obviously related to the sensation of smell, even though there were some major exceptions. The combination of primer and paint A had higher TVOC-values than paint C spread onto primer A or primer C even though it did not smell as strongly. The gypsum board also smelled quite strongly, but its emissions were, on the other hand, very low. The fact that the chambers had a stronger smell at higher relative humidities at the end of a testing period when the chamber lids were opened is possibly related to sink effects caused by the high relative humidity in the chambers and consequently of adsorption of water molecules and, hence, VOCs on the inner surfaces of the chambers.

8 DISCUSSION

8.1 PROPERTIES OF THE TESTED MATERIALS AND THEIR BEHAVIOUR AT DIFFERENT MOISTURE CONDITIONS

The FTIR-analyses of all three primers and paints demonstrated that they contain $CaCO_3$, which is used as filler. They also have strong bands assigning C=O stretching in ester and C–O–C stretching in ether or carboxylic ester. One major difference in the absorption bands of the water-borne primers and paints A and B was that primer and paint A had a strong band at 1160 cm^{-1}, while primer and paint B had a strong band at 1110 cm^{-1} instead. Even though both bands assign asymmetric and symmetric C–O–C stretching in ether and carboxylic ester the products have probably some differences in their film formers. This could be one reason for their different VOC-emissions. They emit partly different compounds when spread onto glass, e.g. ethers and nitrogen containing compounds are emitted only from primer and paint A while 2-ethyl-1-hexanol and acids are emitted only from primer and paint B. Furthermore, their common compounds, e.g. 1,2-propanediol and texanol, have quite different emission rates being higher for primer and paint A.

The water-borne primers and paints differ from the alkyd primer and paint especially in the wavenumber region 1500 cm^{-1} to 1000 cm^{-1}. The main absorption bands assign the same chemical compounds in that region, but the bands occur at somewhat different wavenumbers indicating that the film formers differ somewhat from each other. There is also a marked difference in the VOC-emissions from water-borne and alkyd paints, since, besides differences in the film formers the products have also different solvents and means of film formation.

The FTIR-spectra of the different adhesives differ mainly in the wavenumber region 1640 cm^{-1} to 1600 cm^{-1} and 1160 cm^{-1} to 1110 cm^{-1}. The first absorption band region assigns C=C stretching vibration and the latter assigns C–O–C stretching characteristic of ethers and carboxylic esters. Adhesives A and C have bands at 1640 cm^{-1} and 1160 cm^{-1}, while adhesive B have bands at 1600 cm^{-1} and 1110 cm^{-1}. Adhesives A and C also emit roughly the same compounds when applied onto glass and the emission rates are also similar, 1,2-propanediol emitted from adhesive C being the major exception. Adhesive B emits mainly 2-(2-butoxyethoxyethanol), which adhesives A and C emit only at 28 days and the emission rate is low, <0.5 $\mu g/m^2 \cdot h$.

The FTIR-spectra of fillers and plasters with polymer binder were also quite similar. They had absorption bands assigning water (or alcohol), $CaCO_3$, C=O stretching in ester, and C–O–C stretching characteristic of ether and carboxylic ester. However, the spectral band positions were somewhat different as was the emission rates of their common compounds.

Furthermore, only the combination of filler and plaster A emitted 1,2-propanediol whereas only the combination of filler and plaster B emitted nitrogen containing compounds.

The absorption bands of plaster C, a gypsum-based product, assigned gypsum along with $CaCO_3$ and C=O stretching vibration in ester. It was noted in its operational safety sheet that the product contains a copolymer acetate of vinyl acetate. The core of the gypsum board is rather pure gypsum according to its FTIR-spectra.

The element analysis of primers and paints indicated that they contain TiO_2 that is used as pigment in the products. TiO_2 was also observed in the ESEM-images as small particles evenly distributed in the samples. The element analysis further indicated the presence of $CaCO_3$, a filler used in paints that was observed in the images as coarser particles. The presence of $CaCO_3$ is also in concordance with the FTIR-spectra. The ESEM-images revealed also the coarser structure of primers compared with paints. Furthermore, the element analysis indicated the presence of oxygen in the water-borne primers and paints, but not in the alkyd primer and paint, as expected.

The element analysis of adhesive A indicated the presence of Cl^- and Na^+. Cl^- could derive from the adhesive binder, which according to the manufacturer is a PVAc -copolymer and, thus, probably a vinyl acetate - vinyl chloride copolymer, while Na^+ may derive, for instance, from a plasticiser.

Storing the different plasters at different relative humidities caused only minor changes in their porosity characteristics, as either a shift in the pore size distribution curve or as higher peak values. However, the major differences between the different plasters studied were in their specific surface areas. This could be a key factor affecting adsorption and absorption phenomena of VOCs, but was not further investigated in this study.

The pH-measurements indicated that the surface of the samples stored at RH 80 % was covered with a layer of water molecules, since their pH was approximately 7 and it decreased when the samples were allowed to dry. Thus, the moisture content of the surrounding air rather than the pH of the plasters affected the pH of the top layers. The reason for the low pH of the gypsum board compared with that reported in its operational safety sheet could be caused by the fact that the colour of the surface of the gypsum board made the determination of the pH difficult.

The weight change of the water-borne primers and paints, the adhesives and the gypsum-based plaster spread onto a glass plate was smaller the higher the relative humidity of the storing conditions. This result is consistent with the finding reported by KORNUM (1980), who concluded that the influence of relative humidity on the evaporation of water can be considered to be linear at isothermal conditions, since the products emitted, based on their emission and weight change results, mainly water.

The weight change of adhesives was higher than that of the water-borne paint A and they also caused a more pronounced change in the relative humidity of the chamber air when applied onto glass plates. Thus, the water to solid -ratio of adhesives is higher than that of the paint, and probably also of other water-borne paints, but their area specific emission rates were lower especially at one day compared with paint A. The weight change of the alkyd paint spread onto a glass plate was rather unaffected by the relative humidity. This also holds true for the water-mixable plaster with a polymer binder. The gypsum board, which had been stored at approximately RH 30 % before the start of the testing adsorbed moisture from the surroundings when stored at RH 80 %.

The weight change of the combinations of water-borne primer and paint or adhesives applied onto gypsum board was smaller than when the products were applied onto a glass plate. This holds true also for the VOC-emissions. The differences in the relative weight changes were also bigger between the different relative humidities. The cause of this is that the gypsum board had adsorbed some of the water in the primer, paint and adhesive during application, which was released by a rather slow process. When a water-borne primer and paint or an adhesive were spread onto the combination of filler and plaster or a single layer of plaster which were applied onto calcium silicate bricks, the effect of the moisture content of the plaster on the weight change was considerable indicating that the plaster may also influence the VOC-emissions.

The weight change of the different materials and material combinations is, at least as far as water-based products are concerned, related mainly to their drying, i.e. water evaporation from the samples. The evaporation process seems, on the other hand, to be interrelated with the emission of VOCs especially from the plasters, but this seems also to hold true for the other materials. The emissions from e.g. adhesive B was high at RH 80 % target relative humidity at 7 days, when the drying process in the climate chamber was still going on. Otherwise it is difficult to relate the weight change to the emission of VOCs. For instance, the combination of primer and paint A had a bigger relative weight change than the combination of primer and paint B, which indicates that there could be less volatile constituents left at the end of the testing period in the combination of primer and paint A, but the $TVOC_{SERa}$ at 14 days of the combination of primer and paint A was much higher than that of the combination of primer and paint B. This same trend holds true for e.g. the combination of filler and plaster B compared with the single layer of plaster C.

Adhesives applied onto glass plates and gypsum board caused a higher increase in the relative humidity than did the combination of water-borne primers and paints, which was also reflected in the relative weight changes. The water-borne primers and paints spread onto glass plates affected markedly only the relative humidity of the RH 80 % target relative humidity chamber, in contrast to the case when the combinations of primer and paint were spread onto gypsum board. This indicates that the increase in the relative humidity generated by the primer and paint spread onto a glass plate lasts longer in the high relative humidity compared with the RH 50 % and RH 20 % target relative humidity chambers and also that the gypsum board adsorbs some of the water in the primer, paint and adhesive which is later released. The measured relative humidities were, thus, in concordance with the weight change results. The relative humidity of primer and paint A was unfortunately recorded only for the first two hours after the introduction of the sample into the test chamber. However, it was > 95 % in all three target relative humidities during that time.

Adhesives, and especially plaster C and the combinations of filler and plaster A and B, raised the relative humidity of especially the RH 80 %, but also the RH 50 % target relative humidity chambers, to 100 % for several days. This is consistent with the observed relative weight changes as far as the adhesives are concerned. The chambers of RH 50 % and RH 80 % target relative humidities also had observable condensation on their walls and lid. The high relative humidity caused by the plasters was not reflected as distinctly in their relative weight changes because the mass of the water in relation to the mass of the solids is much smaller in plasters compared with the adhesives. The water to solids ratio for plasters A and C were 0.32 and 0.52, respectively. The average amount of constituents evaporated from adhesives A and C in relation to their initial weight were 0.76 and 0.81, respectively. The water to solids ratio of the adhesives is probably even higher, since they were not completely dry at the end of the testing period.

The relative humidity profiles of the water-borne products were also similar to what has been presented in the literature on the emission profile during evaporation (TICHENOR & GUO 1991, CHANG & GUO 1992, YU & CRUMP 1998, HUANG & HAGHIGHAT 2002, LEE ET AL. 2003), i.e. a rapid increase followed by a rapid decrease and that the peak value is achieved during the first hours of the emission process. This was valid especially for materials spread onto dry surfaces, i.e. glass or gypsum board. The humidity profiles also revealed that the higher the relative humidity of the surrounding air the longer was the drying process of water-based materials, as expected. However, this affects also the emission profiles, since the $\mathrm{TVOC}_{\mathrm{SERa}}$, of adhesive C was higher at 14 and even 28 days when stored at RH 50 % and RH 80 % target relative humidities than at RH 20 %. This also holds true for plaster A and adhesive B at 7 and 14 days.

8.2 VOC EMISSIONS

The behaviour of single material layers on substrates including glass, aluminium, stainless steel, wood products, and gypsum board has been studied extensively during the last years (JØRGENSEN ET AL. 1995, ROACHE ET AL. 1996, CHANG ET AL. 1997, SPARKS ET AL. 1999, KWOK ET AL. 2003) There have also been also quite many studies on the emissions from actual buildings, e.g. (BLUYSSEN ET AL. 1996, PEJTERSEN ET AL. 2001, TUOMAINEN ET AL. 2001, SAARELA ET AL. 2003, PARK & IKEDA 2004, RAW ET AL. 2004), but no attempts to study the behaviour of several material layers on different substrates, as is the case in actual structural components, in controlled laboratory conditions has been done so far, floors excluded.

Furthermore, only two reports where the influence of the relative humidity of the surrounding air on the emissions from structures in actual buildings have been found. FELLIN & OTSON (1994) conducted a nationwide study of indoor air in Canadian residences. They found only a weak correlation between indoor relative humidity and VOC concentration levels. The result was valid for individual VOCs also. However, the authors did not give any detailed information of the age of the residences or the materials used. The study of JÄRNSTRÖM & SAARELA (2005) on the emissions from structures in eight buildings built according to today's good practice, including humidity control of the structures and selection of low-emitting materials (CIC 2001), showed that higher emissions were measured from building structures than from individual materials tested at laboratory conditions. This was explained by the fact that a material in a real structure is affected by its surroundings, i.e. the humidity and temperature of the structure and its surrounding air.

When single material layers were applied onto glass plates in this present study, the emission pattern of TVOC and single compounds generally fluctuated quite much both with the relative humidity of the storing conditions and the point of time of sample collection and no clear trend between the $\text{TVOC}_{\text{SERa}}$ and the SER_a of single compounds could be established. This result is consistent with the findings by HAGHIGHAT & DE BELLIS (1998) and applies to all materials studied. There are, however, three trends that could be observed. First, the $\text{TVOC}_{\text{SERa}}$ of the water-borne paint, paint A, was higher the higher the relative humidity of the surrounding air irrespective of the point of time of sample collection when samples were collected from the test chamber air. Second, the $\text{TVOC}_{\text{SERa}}$ of the alkyd paint, paint C, was rather unaffected by the relative humidity of the surrounding air, even though there were fluctuations in the emission patterns of single compounds. Third, the emissions from plasters A and C were markedly affected by the condensation of water on the test chambers' inner surfaces that they generated.

CHANG & GUO (1998) found in their study on aldehyde emissions from three different alkyd paints that their main target compound hexanal, as well as other odorous aldehydes, is formed after painting during the air-drying period. The existence of this phenomenon was confirmed based on the results from the bulk analysis of the paints where no hexanal was detected. The emitted amount of hexanal was more than 2 mg/g. They also noticed that each paint studied had a different set of values for the first order reaction rate constants modelling the hexanal formation. Hexanal was not the only aldehyde emitted, as was mentioned. Other aldehyde emissions such as pentanal and propanal were also detected. These compounds have very low odour threshold values. The combination of those aldehydes and indoor sink effects can result in strong and irritating odour that lasts for weeks. This is consistent with the findings in this present study and hexanal was, indeed, the most abundant aldehyde emitted from the alkyd paint.

A statistical analysis confirmed that the emission results of the two sample collection methods, samples collected from the test chamber air and samples collected using the FLEC-cell, did not differ from each other. This applies both to $\mathrm{TVOC}_{\mathrm{SERa}}$-values and to single compounds, which were separated according to chemical groups in the analysis. The result implies that the test chambers did not act as significant sinks.

When material combinations were applied onto glass plates, the emission pattern of TVOC and single compounds still fluctuated quite much both with the relative humidity of the storing conditions and the point of time of sample collection, and no clear trend between the $\mathrm{TVOC}_{\mathrm{SERa}}$ and the SER_a of single compounds could be established. There are, however, two results that need special attention. The $\mathrm{TVOC}_{\mathrm{SERa}}$ of the combination of primer and paint A and the combination of filler and plaster B was markedly elevated still at 14 days, even though the materials have been classified as low-emitting. It can, however, only be speculated what their emission level would be at 28 days, which is the classification time. Nevertheless, the $\mathrm{TVOC}_{\mathrm{SERa}}$ of paint A spread onto glass plate was 20 µg/m²·h and 15 µg/m²·h at 14 and 28 days for the sample stored at the RH 50 % target relative humidity, while the corresponding value at 14 days for the combination of primer and paint A was 1200 µg/m²·h for samples collected from the test chamber. The $\mathrm{TVOC}_{\mathrm{SERa}}$ of the combination of primer and paint B was 26 µg/m²·h at 14 days at the RH 50 % target relative humidity, which is approximately equal to the value of paint A. For comparison, the $\mathrm{TVOC}_{\mathrm{SERa}}$ of the combination of filler and plaster B at the RH 50 % target relative humidity at 14 days was 1335 µg/m²·h, when the corresponding values for the combination of filler and plaster A and a single layer of plaster C were 275 and 72 µg/m²·h , respectively. It is, however, to be noted that the measured relative humidities were 98±3 %, 55±5 %, and 99±3 %, respectively, i.e. in two cases quite different from the target relative humidity of 50±5 %. Another interesting result is that the emissions from the combination of primer A and paint C include compounds that are typical for both the water-borne primer and the alkyd paint. It can also be noted that the $\mathrm{TVOC}_{\mathrm{SERa}}$-value is higher the higher the relative humidity of the storing conditions irrespective of the point of time of sample collection for samples collected from the test chambers.

A statistical analysis indicated that the emission rate of aldehydes was higher for samples stored at the RH 80 % target relative humidity than for samples stored at the RH 20 % target relative humidity. This result was valid only for samples collected from the test chambers. There was no statistical difference in the $\mathrm{TVOC}_{\mathrm{SERa}}$-values or the SER_a of single compounds separated according to chemical groups of the two sample collection methods. The result implies that the test chambers did not act as significant sinks.

When the combinations of primer and paint A or B or adhesives A or B were applied onto gypsum board, the emissions were lower than when they were spread onto glass plates. What is, however, noteworthy is that the emissions from the paints spread onto gypsum board were higher at 14 days than at 7 days. This was not the case for the adhesives. The emission pattern concerning the emissions from paints have been studied by CHANG ET AL. (1997), JØRGENSEN

ET AL. (1995), and SPARKS ET AL. (1999) among others. Their results also showed that the emissions from an inert substrate, stainless steel and aluminium, were initially higher, but at later ages, i.e. over 30 days, the emissions from the gypsum board could still be significant, or at least higher, than from the inert substrate. Furthermore, CHANG ET AL. (1997) reported that the composition of VOCs emitted were dramatically different on the two substrates studied, i.e. stainless steel and gypsum board. Ethylene glycol dominated the VOC emissions for the first 100 h and Texanol was the dominant VOC thereafter when stainless steel was the substrate. The trend was reversed when gypsum board was the substrate. This trend is, however, not observed in this present study.

A statistical analysis indicated that there was no significant difference in the $TVOC_{SERa}$-values of the samples collected with the two different sample collection methods. However, the same test indicated there was a difference in the SER_a of ketones being higher for samples collected using the FLEC-cell than for samples collected from the test chambers, when they were stored at the RH 20 % target relative humidity.

When the combinations of primer and paint A or B or adhesives A or B were applied onto the combination of filler and plaster B or a single layer of plaster C, which were applied onto calcium silicate bricks, the emissions were higher when applied onto the combination of filler and plaster B than when applied onto plaster C. Furthermore, the emissions were higher when the combinations of primer and paint or adhesives were applied onto plaster C then when applied onto gypsum board. How much the results are affected by the different retention capacities of the substrates, their porosity characteristics, specific emissions, and moisture conditions is difficult to deduce. WESCHLER & SHIELDS (1997) reported that the relative humidity determines both the gas phase concentration of water and the absence, presence, and thickness of aqueous surface films. The former influences homogenous (gas phase) hydrolysis reactions while the latter influences the surface removal rates of numerous hydrophilic chemicals in the air. They reported further that homogenous processes are influenced by the nature of the surface, i.e. polar surfaces attract polar VOCs and water while non-polar surfaces attract non-polar VOCs and repel water. The emission results from this present study show that the high relative humidity of the surrounding air affects the emission rates, the emission profile of a sample quite often change with time in relation to the measured relative humidity of the test chamber air. However, the polarity of the material surfaces studied and hydrolysis reactions have not been clarified in this project. On the other hand, WON ET AL. (2001) reported that virgin gypsum board was observed to be a significant sink for highly polar VOCs and would, thus, be highly polar itself. This finding is consistent with the results obtained by GEHRIG ET AL. (1993) and CHANG ET AL. (1997) who noticed that compounds with more polar oxygen containing functional groups show lower emissions from gypsum board and wood chip wall paper than from glass or stainless steel. A statistical analysis of the emission results from this present study indicated that the emission rate of alcohol and phenol ethers emitted from the combinations of primer and paint A and B was higher from the glass plate than from the gypsum board for samples stored at RH 20 % target relative humidity. On the other hand, the emission rate of aromatic hydrocarbons emitted from adhesives A and B was higher when they were applied onto glass plate than onto gypsum board both at the RH 20 % and RH 50 % target relative humidities for samples collected from the test chambers.

The emissions were, especially regarding adhesives, also influenced by the emissions from the substrate, all three substrates, i.e. the combination of filler and plaster B, plaster C, and gypsum board, included. A statistical analysis indicated that there was a strong interaction of filler and plaster and the relative humidity of the surrounding air influencing the $\mathrm{TVOC}_{\mathrm{SERa}}$ of the structures when the combinations of primer and paint A or B were spread onto the combination of filler and plaster B or a single layer of plaster C that was applied onto calcium silicate brick. A response prediction plot indicated further that the $\mathrm{TVOC}_{\mathrm{SERa}}$ increases with increasing relative humidity of the surrounding air. The analysis indicated further that there was a strong interaction of relative humidity and the point of time of sample collection on the $\mathrm{TVOC}_{\mathrm{SERa}}$ of the structures when adhesives A or B were applied onto the combination of filler and plaster B or a single layer of plaster C that was applied onto calcium silicate brick. Contrary to what was observed for the combinations of primer and paint, a response prediction plot indicated that the $\mathrm{TVOC}_{\mathrm{SERa}}$ decreases with increasing relative humidity of the surrounding air.

It could also be deduced that there was no statistically significant difference between the two sample collection methods regarding $\mathrm{TVOC}_{\mathrm{SERa}}$. However, there was a difference in that sample collection methods for aldehydes and ketones being higher for samples collected using the FLEC-cell than for samples collected from the test chambers when the structures were stored at the RH 20 % target relative humidity.

The difference in the emission rates of aldehydes and ketones between the two sample collection methods could be a consequence of the higher humidity of the air introduced into the FLEC-cell compared with that of the test chambers. The measured relative humidity of the chamber was the same as the target relative humidity ±5 % RH when gypsum board was the substrate and it was between 30 % and 45 % when the combination of filler and plaster was the substrate, while the relative humidity of the air introduced into the FLEC-cell was 50±5 %. On the other hand, this does not explain why there was no statistically significant difference in the results in Parts I and II of this study, when single material layers or material combinations were applied onto glass plate. One possible explanation could be different retention capacities of the different materials.

It can be concluded about the two different sample collection methods that the emission results achieved using the FLEC-cell were in general comparable with samples collected from the environmental chamber air. This finding is consistent with the results obtained by AFSHARI ET AL. (2003) who compared the VOC emission rate of an alkyd paint from three small test chambers, i.e. a 1-m³ chamber, a CLIMPAQ, and the FLEC-cell. Also KNUDSEN ET

AL. (1999) who compared the VOC emissions from five building materials (nylon carpet, PVC flooring, floor varnish, sealant, and a water-borne wall paint) using a CLIMPAQ with the results from a study by WOLKOFF ET AL. (1998) who collected the VOCs from the same materials using a FLEC-cell reached a similar result. However, ROACHE ET AL. (1996) studied the emissions from a floor wax and a latex paint using a 53-litre test chamber and the FLEC-cell. They reached consistent results for the floor wax applied onto glass with the two different chambers, but the emission rates from the latex paint applied onto gypsum board were not comparable. The emission rate of TVOC for the FLEC was generally higher than that from the test chamber. The discrepancy could be attributed to the freshness of the painted surface and the substrate according to the authors. The tests lasted for two weeks. Nevertheless, the comparability of the test results from the two different sample collection methods in this present study indicates that the test chambers did not act as significant sinks. The only discrepancies occurred, besides to what was referred to in the preceding paragraphs about aldehydes and ketones, also at high SER_a-values of a specific compound, typically 1,2-propanediol, aldehydes, and acids. Then the SER_a were generally higher for samples collected using the FLEC-cell. This could be a result of the differences in the relative humidities being introduced into the chambers, i.e. the relative humidity during sample collection from the test chambers was the same as the measured relative humidity of the chamber air ±5 % RH, while the relative humidity introduced into the FLEC-cell was 50±5 % RH.

Thus, the finding by JÄRNSTRÖM & SAARELA (2005) who concluded that higher emissions were measured from building structures than from individual materials tested at laboratory conditions is probably a result indicated by this present study, i.e. material combinations act as entities, not as the sum of single material layers. A material in a real structure is affected by its surroundings, i.e. the humidity and temperature of the structure and its surrounding air, but also of the physical and chemical characteristics, i.e. porosity, emissions, moisture content, etc. of the materials included.

One of the objectives of the experimental part of this study was to verify if it is possible to achieve a low emission rate with different material combinations. A target value of 30 $\mu g/m^2 \cdot h$ was set. The material combinations that fulfil the target value for samples collected from the test chambers at 14 days were:

- primer and paint B spread onto gypsum board or plaster C applied onto calcium silicate brick irrespective of the storing conditions,
- primer and paint B spread onto the combination of filler and plaster B stored at RH 20 % target relative humidity,
- adhesive A applied onto gypsum board or plaster C which was applied onto calcium silicate brick irrespective of the storing conditions,
- adhesive B spread onto gypsum board and stored at RH 20 % or RH 50 % target relative humidities.

However, even though the $TVOC_{SERa}$-values were low at 14 days, it is still possible that they increase or stay at least at a significant level for a long period of time, as has been reported by e.g. CHANG ET AL. (1997), YU & CRUMP (1998), and SPARKS ET AL. (1999).

8.3 MATHEMATICAL MODELLING

The emission process of a compound is known to be affected by several factors. In the following paragraphs is presented, as an example, the emission of 2-(2-butoxyethoxy)ethanol from adhesive B applied onto different substrates at 1 day. This example is chosen because 2-(2-butoxyethoxy)ethanol is by far the most abundant compound emitting from adhesive B and the case is simple enough compared e.g. with paints, which has one additional material layer, a primer, compared with adhesives. A third reason is that the emission process at 1 day is quite certainly still, at least partly, evaporation controlled.

The calculations are based on the equations presented in Chapter 3.2. The initial amount of VOC applied is not known, but can be approximated as follows. The emission rate was highest in the RH 20 % chamber at 1 day and highest in the RH 80 % chamber at 7 and 14 days, when the adhesive was applied onto glass plates. Considering that the emission rate reaches a peak followed by a decay, the initial amount of 2-(2-butoxyethoxy)ethanol is approximated based on its maximum SER_a-values. The corresponding SER_a-values were 2855 µg/m²·h, 5886 µg/m²·h, and 2454 µg/m²·h. Thus, the amount of 2-(2-butoxyethoxy)ethanol is 2855 µg/m²·h × 24 h + 5886 µg/m²·h × 144 h + 2454 µg/m²·h × 168 h = 1328 mg/m². Considering that the emission process is still continuing, an approximation is made that the initial amount of 2-(2-butoxyethoxy)ethanol was 1400 mg/m². The partition coefficient, k_c, can be obtained from Equation 34 and the diffusivity from Equation 35. The density of air is 1.290 g/m³ and its viscosity is 65.52 g/h m. The molecular weight of air is 28.96 g/mole and its molar volume is approximately 20.1 cm³/mole. The molecular weight of 2-(2-butoxyethoxy)ethanol is 162.23 g/mole and its molar volume can be approximated according to (LYMAN ET AL. 1990). The molecular formula of 2-(2-butoxyethoxy)ethanol is $C_8H_{18}O_3$ and its molar volume is, thus, approximately 8 × 16.5 + 18 × 1.98 + 3 × 5.48 = 184.08 cm³/mole. M_r is (28.96 + 162.23)/(28.96 · 162.23) = 0.041 g/mole. The air-velocity over the source is 540 m/h and the characteristic length of the source is 0.248 m. Introducing these values into Equations 35 and 34 gives:

$$D_a = \frac{10^{-3} \cdot 294^{1.75} \cdot \sqrt{0.041}}{1 \cdot \left[20.1^{1/3} + 184.08^{1/3}\right]^2} = 0.057 \text{ m}^2/\text{h}$$

$$k_c = 0.33 \cdot 0.057 \cdot 0.248^{-(1/3)} \cdot \left(\frac{540 \cdot 1.29}{65.52}\right)^{2/3} = 0.145 \text{ m/h}$$

Assuming that the concentration at the surface of the sample is the same as its bulk concentration and assuming further, based on the conclusion by HANSEN (1974) that the loss of volatile material from, in his case water-based latex coatings, is a surface phenomenon controlled by surface resistance and not by internal diffusion at least at early age (SULLIVAN 1975), the calculations according to Equation 9 give the following results presented in Table 70.

When examining the results presented in Table 70 it can be observed that the calculated values are higher than the measured ones. At least two factors affect the result: the approximation of the initial amount of 2-(2-butoxyethoxy)ethanol in the product could be too high or the emission process is no longer evaporation controlled. At least one thing supports the latter argument, since the results are closest in size for the case when the adhesive was spread onto plaster C, which caused a higher moisture content in the environmental chamber than when the adhesive was spread onto the combination of filler and plaster B. Two other factors that might affect the result, but which have not been taken into consideration in the calculations, are the retention capacities of the substrates and the sink effects on the chamber walls. The latter one is more troublesome to evaluate, since the influence of adsorbed moisture on the adsorption of 2-(2-butoxyethoxy)ethanol should be clarified first, and is, as such, outside the scope of this study. Partition coefficients based on the studies by Meininghaus for some VOCs were presented in Table 6. The partition coefficients for *m*-xylene, *n*-octane, and ethyl acetate emitted from gypsum board varied from 0.010 to 0.133, respectively. Applying for instance the value of ethyl acetate would give the following results: 995 µg/m²·h, 989 µg/m²·h and 826 µg/m²·h at RH 20 %, RH 50 %, and RH 80 % target relative humidities, respectively. No further efforts to model the emissions are made, since there are so many different factors affecting the emission process and a full model that would take all these factors into consideration simultaneously would require a separate study.

Table 70. The calculated and measured SER_a of 2-(2-butoxyethoxy)ethanol (µg/m²·h) emitted from adhesive B spread onto different substrates. c_w is the concentration at the surface (kg/m³), c_∞ is the concentration in the bulk air, and E_w is the emission rate (µg/m²·h).

	E_w calculated			**E_w measured**		
Substrate	RH 20 %	RH 50 %	RH 80 %	RH 20 %	RH 50 %	RH 80 %
Glass	8537	6043	4158	2855	1986	1350
Gypsum board	1085	1078	900	346	343	286
Filller and plaster B on CSB$^{1)}$	7471	-	5260	2480		1720
Plaster C on CSB$^{1)}$	21117	16484	-	17250	12900	

$^{1)}$ CSB denotes calcium silicate brick

9 SUMMARY

This study has concentrated on the VOC-emissions from paints and adhesives applied onto different substrates and kept at specific relative humidities. The substrates used were glass, gypsum board, and a combination of a filler and plaster or a single layer of plaster applied onto calcium silicate brick. The target relative humidities at the start of a test, i.e. when a sample was introduced into an environmental test chamber, were 20 %, 50 %, and 80 %. These cover the relative humidities normally encountered in the Nordic countries. When houses are heated during the winter season, the relative humidity tends to decrease to approximately 20 %, or even lower. The high relative humidity is encountered, except during the summer time, also during a construction period when water-based materials such as concrete, mortars, and plasters are used.

The first part of this study consists of a theoretical review, which covers the following topics: a general description of the materials studied, VOC emissions from materials and structures, and the influence of moisture on VOC emissions. Mathematical expressions for the emission process were also presented.

The literature study indicated that the emission rate of indoor contaminants is affected by the emitted compounds and their concentration and distribution, humidity, surface velocity, air exchange rate, temperature, substrate, material loading factors, and sinks. The emission process can be roughly divided into two rate limiting steps: evaporation and diffusion. Evaporation occurs from liquid materials and is usually rapid in the beginning reaching a peak after typically 0.5-3 hours. It is expressed as a function of the convective mass transfer coefficient. The peak is followed by a rapid decline and the emissions reach a steady level within hours or some days depending on the material in question. Major factors controlling evaporation are vapour pressure differences, surface velocity, temperature and humidity. Evaporation is followed by a diffusion controlled process, which is also the major rate limiting process for initially dry materials. Diffusion is expressed as a function of the diffusion coefficient. It is a slow process compared with evaporation and major factors controlling it are concentration differences, the size and structure of the migrating molecule, the structure of the material, temperature, and relative humidity.

The interaction of functional groups of the emitting compounds with water molecules on the surface of a substrate also affects the emission process. As a consequence the quantity and composition of compounds emitted to the surrounding air may differ from one case to another depending on moisture content of a material and the substrate it is applied onto and the relative humidity of the surrounding air. These factors are important to include when analysing emission data, since moisture can enable, promote, or change chemical and physical processes in building materials.

Initial experiments were conducted to characterise some physical and chemical properties of the materials studied and to clarify the influence of moisture conditions and substrate on the VOC-emissions. The physical and chemical characterisation included FTIR-analysis, light and electron microscopy, the latter together with element analysis, mercury intrusion porosimetry, and the determination of the pH of selected samples using a pH-indicator liquid. The FTIR-results showed that, even though the spectral bands of similar products, e.g. the two water-borne paints, assigned the same components, the peak values occurred at somewhat different wavenumbers indicating differences in the compositions. Similar products emitted also somewhat different compounds and were, thus, not as similar as could be deduced from their product declarations. Mercury intrusion porosimetry showed that the plasters studied have quite different specific surface areas. It influences at least the amount of available adsorption sites for VOCs and water molecules. However, a relationship between specific surface area and i.e. adsorption of VOCs was not established. Another material specific factor affecting VOC emissions is its retention capacity, but the retention capacities of the different substrates were not clarified.

Environmental test chambers were designed by the author to meet the requirements in the European standards for VOC emission testing. Other requirements were: the chambers should be easy to assemble and clean, the relative humidity of the chamber air should be easy to adjust, the flow conditions should be easily controlled, and the surface area of the samples should be big enough for the FLEC-cell.

The experiments for the clarification of the effect of moisture and substrate on the VOC-emissions included, besides VOC sample collection from test chambers and by using the FLEC-cell, also weighing of the samples studied, recording of the relative humidity of the chamber air during sample storage, and olfactory evaluation.

The emission tests showed that the combination of primer and paint spread onto a glass plate gives rise to elevated emissions compared with only a single paint layer, i.e. that two or more materials in close contact act more like one material rather than two separate materials. This was also indicated by the weight change and the relative humidity measurements. The difference in the emission rates can be up to two orders of magnitude. The emission testing of material combinations also showed that the emissions are made up of the characteristic emissions of both the paint and the primer.

When the combinations of primer and paint or adhesives were applied onto gypsum board, the emissions were lower than when they were spread onto glass plates. What is, however, noteworthy is that the emissions from the combinations of primer and paint spread onto gypsum board were higher at 14 days than at 7 days. This was, however, not the case for the adhesives.

When the combinations of primer and paint or adhesives were applied onto a combination of filler and plaster or a single plaster layer which was applied onto calcium silicate brick, the emission results were strongly affected by the substrate still being higher than when the combinations of primer and paint or adhesives were applied onto gypsum board. The emissions were, especially for adhesives, also influenced by the emissions from the substrate. This holds true for all three substrates.

A statistical analysis indicated that the three most influential factors affecting the TVOC-value were the emission characteristics of the combination of primer and paint or adhesive applied (did it have low or high emission rates), the emission characteristics of the combination of filler and plaster used, and the sample collection point of time. Furthermore, there was a strong interaction of filler and plaster and the relative humidity of the surrounding air influencing the $TVOC_{SERa}$ of the structures for the different combinations of primer and paint. A response prediction plot indicated that the $TVOC_{SERa}$ increases with increasing relative humidity of the surrounding air. The analysis indicated further that there was a strong interaction of relative humidity and the point of time of sample collection on the $TVOC_{SERa}$ of the structures for the different adhesives. Contrary to what was observed for the combinations of primer and paint, a response prediction plot indicated that the $TVOC_{SERa}$ of the structure decreases with increasing relative humidity of the surrounding air.

It can be concluded about the two different sample collection methods that the emission results achieved using the FLEC-cell were in general comparable with samples collected from the environmental chamber air. This indicates that the test chambers did not act as significant sinks. The most abundant chemicals or chemical groups emitted from the different products applied onto glass plates are presented in Table 71.

Table 71. The materials used in this study and their main emissions.

Material	Emitted compounds
Primer and paint A, water-borne acrylic latex products	1,2-propanediol, texanol, glycol ethers
Primer and paint B, a water-borne acrylic latex products	1,2-propanediol, glycol ethers, acetic acid
Primer A and paint C, a water-borne acrylic latex primer and an alkyd resin paint	Aliphatic and alicyclic hydrocarbons, 1,2-propanediol, aldehydes, ketones, acids, texanol
Primer and paint C, alkyd resin products	Aliphatic and alicyclic hydrocarbons, aldehydes, acids
Adhesive A, water-borne PVAc-dispersion product	Acetic acid
Adhesive B, water-borne PVAc-dispersion product	Glycol ethers, acetic acid
Adhesive C, water-borne PVC-dispersion product$^{1)}$	1,2-propanediol, acetic acid
Filler and plaster A, polymer binder, water mixable	Alcohols, 1,2-propanediol, glycol ethers
Filler and plaster B, polymer binder, ready-mixed	Alcohols, glycol ethers, esters, nitrogen containing compounds
Plaster C, gypsum binder, water mixable	Acetone, acetic acid
Gypsum board	Aldehydes, halogen containing compounds

$^{1)}$ According to the manufacturer's information

10 CONCLUSIONS

The experimental part of this study concentrated on clarifying the influence of the relative humidity of the surrounding air and different substrates on the VOC emissions from paints and adhesives. The main results can be concluded as follows:

- It was confirmed that VOC emissions differ depending on the material included, the emitting compound, time, the relative humidity of the surrounding air, and the substrate. Thus, the TVOC-value should be treated with reservations when the emissions of single compounds are estimated.
- The emissions of VOCs from material combinations are affected strongly by the substrate, i.e. its physical and chemical characteristics have an effect on both the total emissions and the emission of single compounds from material combinations. The substrate effect has been shown to hold true for gypsum board in earlier studies, but in this study it has been shown to hold true for other substrates as well, including primers.
- The emissions from material combinations may not necessarily meet the TVOC-level set for a low emitting material even though the materials included have separately been classified as low-emitting. The last measuring point for material combinations was 14 days in this study, while the testing age for the classification tests is 28 days. The TVOC-value of, for instance, the combination of primer and paint A spread onto a glass plate was approximately 500 to 1000-times higher compared with a single layer of paint A at 14 days and it can only be speculated what the TVOC-value of the combination would be at 28 days.
- The three main factors influencing the emissions from the combination of primer and paint or adhesive applied onto a combination of filler and plaster applied onto calcium silicate bricks were: the emission characteristics from the combination of primer and paint or adhesive, the combination of filler and plaster, and the point of time of sample collection. When primers and paints were used, the emissions tended to increase with increasing relative humidity while adhesives indicated an opposite tendency. There was a strong interaction of the relative humidity and the combination of filler and plaster on the emissions when primers and paints were applied onto them and of relative humidity and time when adhesives were applied onto them.
- As a continuation to the preceding paragraph: when the combinations of primer and paint were applied onto different substrates the most abundant compounds emitted stemmed from the combination of primer and paint, irrespective of the substrate. When adhesives were applied onto different substrates, at least part of the most abundant compounds emitted stemmed from the substrate. However, when adhesives were applied onto gypsum board, the most abundant compounds differed from that when they were spread onto glass, but none of the most abundant compounds stemmed from the gypsum board.

- The influence of moisture on the emissions has been shown to be directed especially on the drying process rather than the relative humidity of the surrounding air. Only aldehydes emitting from different combinations of primer and paint applied onto glass were statistically significantly affected by the relative humidity of the surrounding air. On the other hand, a high relative humidity of the surrounding air prolongs the duration of the drying process, thus affecting the emission process.
- The FLEC-cell gave comparable results to what was obtained when samples were collected from the test chambers. The only statistically significant discrepancies occurred when aldehydes or ketones were emitted from combinations of primer and paint or adhesives were applied onto the combination of filler and plaster and when ketones were emitted from combinations of primer and paint or adhesives applied onto gypsum board for samples stored at the RH 20 % target relative humidity. This could be a consequence of the higher relative humidity of the air introduced into the FLEC-cell compared with that of the test chamber.
- It is possible to achieve very low emission rates in two weeks even when many different materials are combined in a structure by a proper choice of low emitting materials. The emissions from even a high emitting substrate can be reduced by a dense and low emitting top-layer, but a proper drying of the substrate has to be assured. However, even though the $TVOC_{SERa}$-values were low at 14 days, it is still possible that they increase or stay at least at a significant level for a long period of time.

Based on the results of this study some suggestions for the future are:

- The relation between the drying process and emissions should be clarified more precisely by continuous monitoring of relative humidity and emissions and the results should be related to material and compound specific data, such as specific surface area and polarity.
- The influence of wetting a substrate should be clarified, i.e. it should be clarified how the emissions change in case of a water-damage. This would include the clarification of the emissions generated by hydrolytic degradation reactions.
- The influence of moisture on the emissions from other, e.g. wood-based, materials should be clarified.
- Material emission testing should encompass the testing of materials and material combinations on real substrates used in buildings instead of single material layers on inert substrates, which is common practice today. Then a concept of low-emitting structural components could be introduced. The emission testing in this case should include different relative humidities of the surrounding air.
- Test results from test chambers with actual structural components should be compared with field measurements.

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RESULTS OF THE EDS-ANALYSES

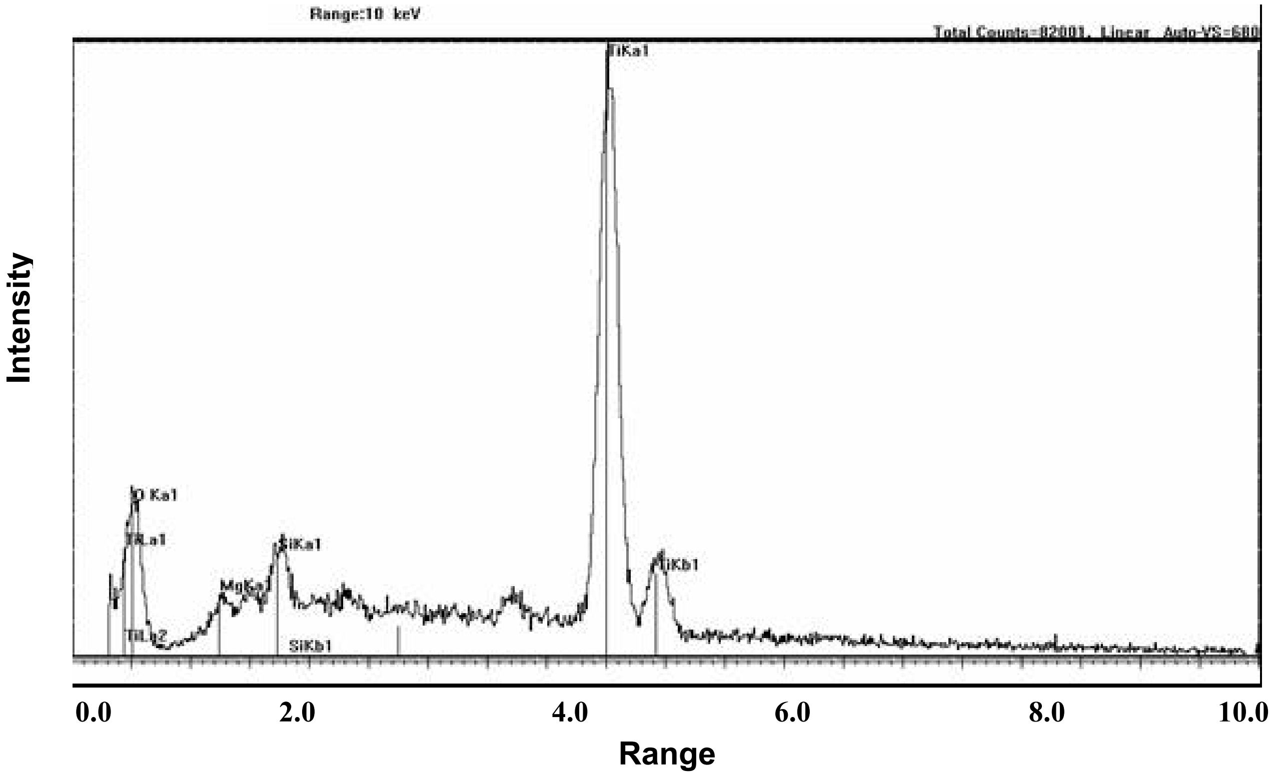


Figure A1. Paint A.

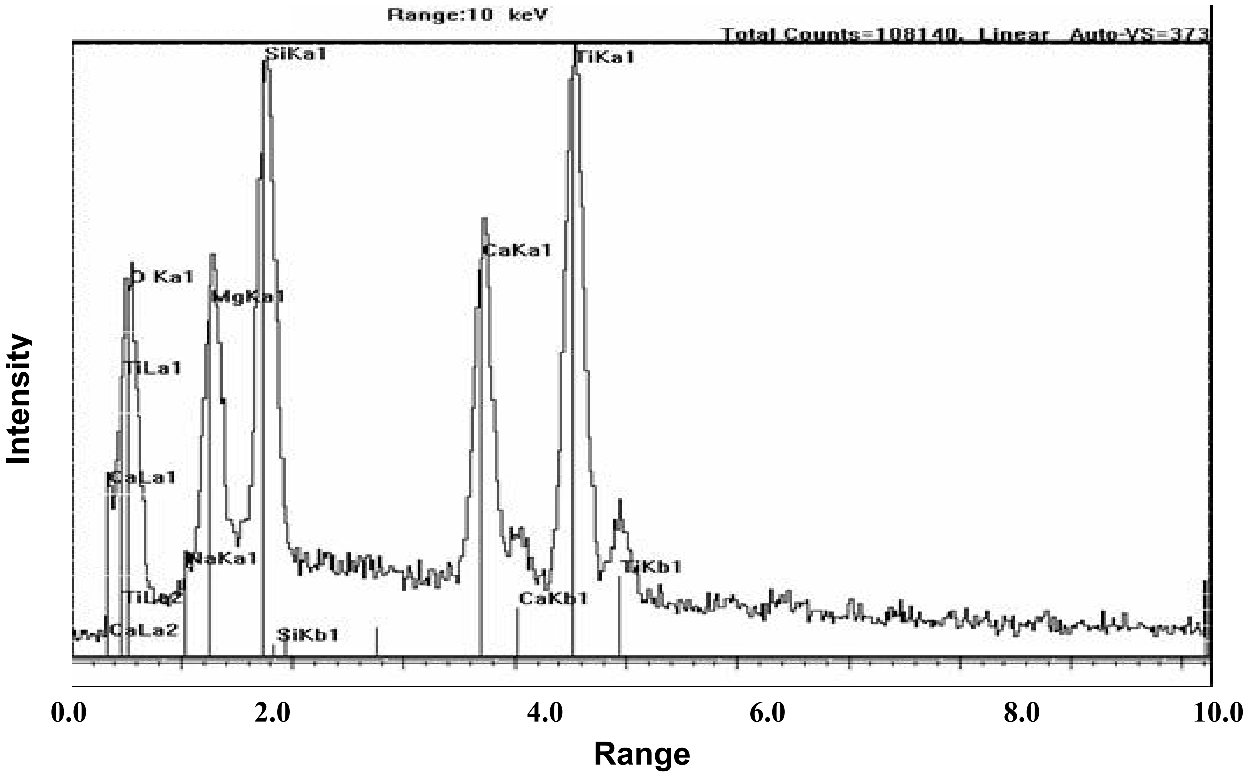
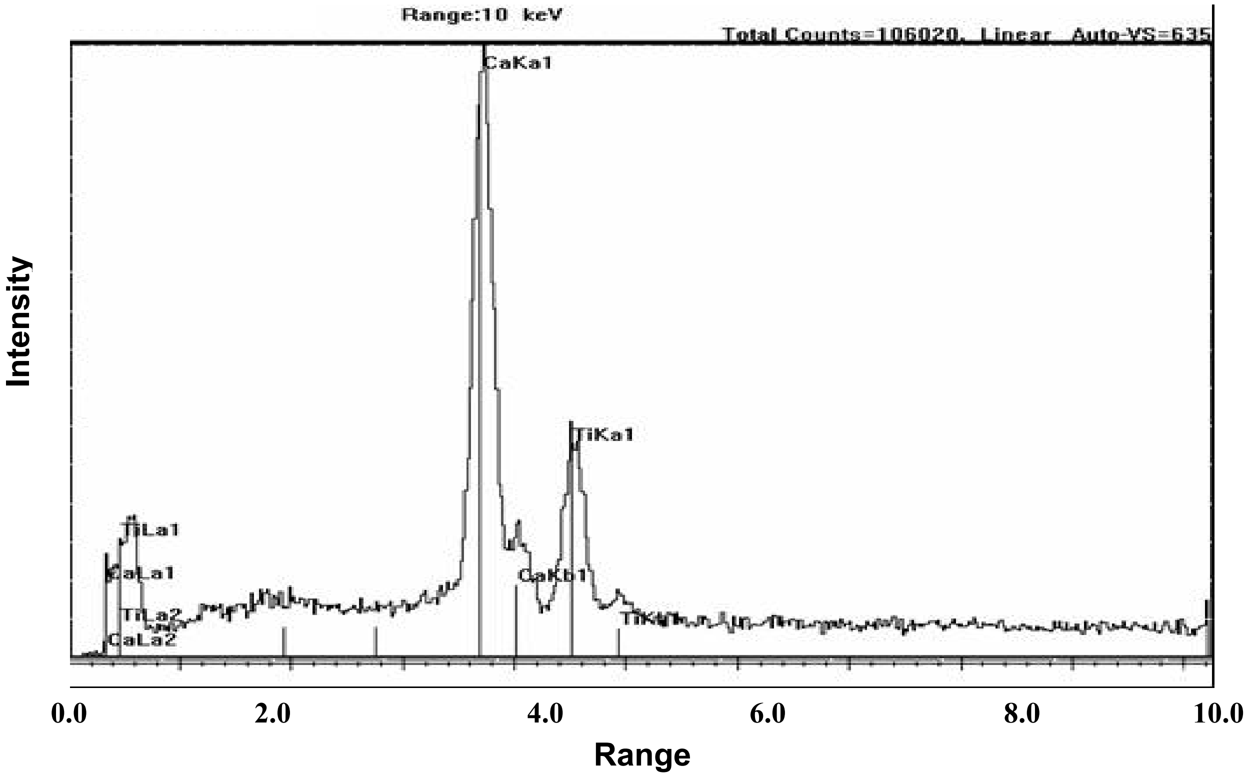


Figure A2. Primer A.



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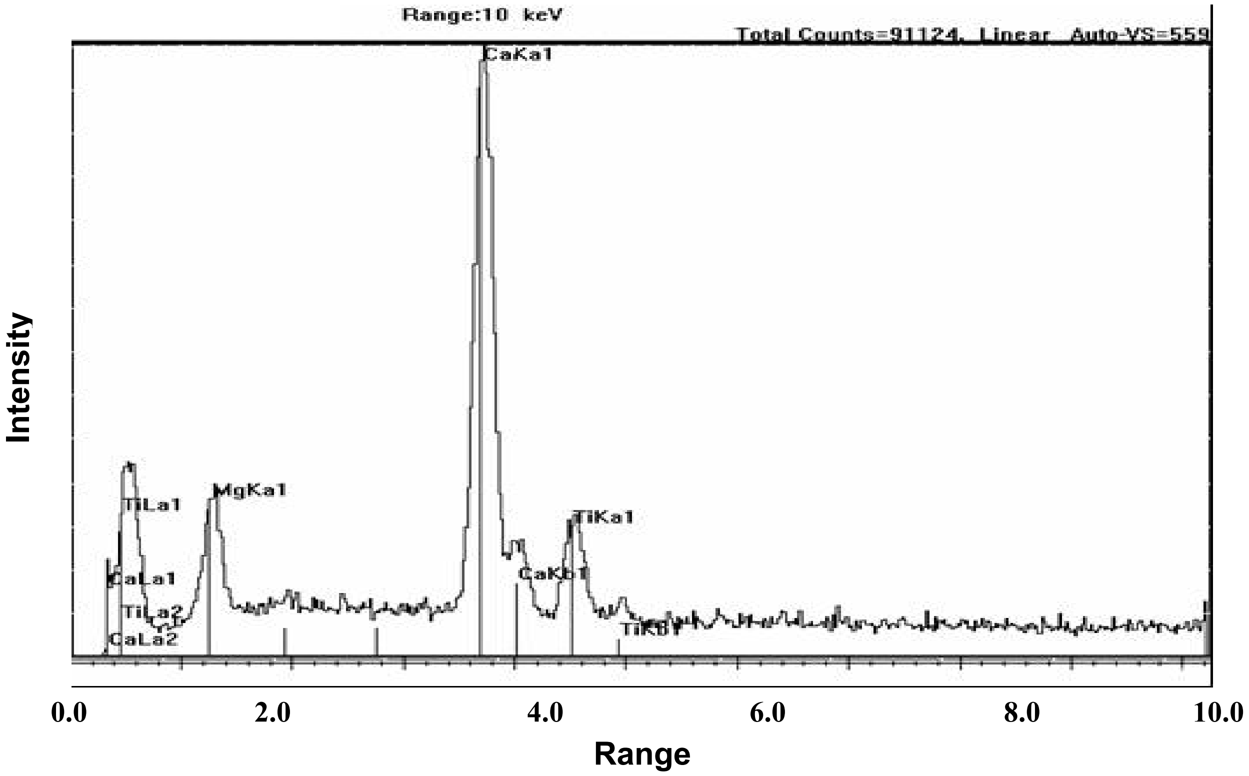

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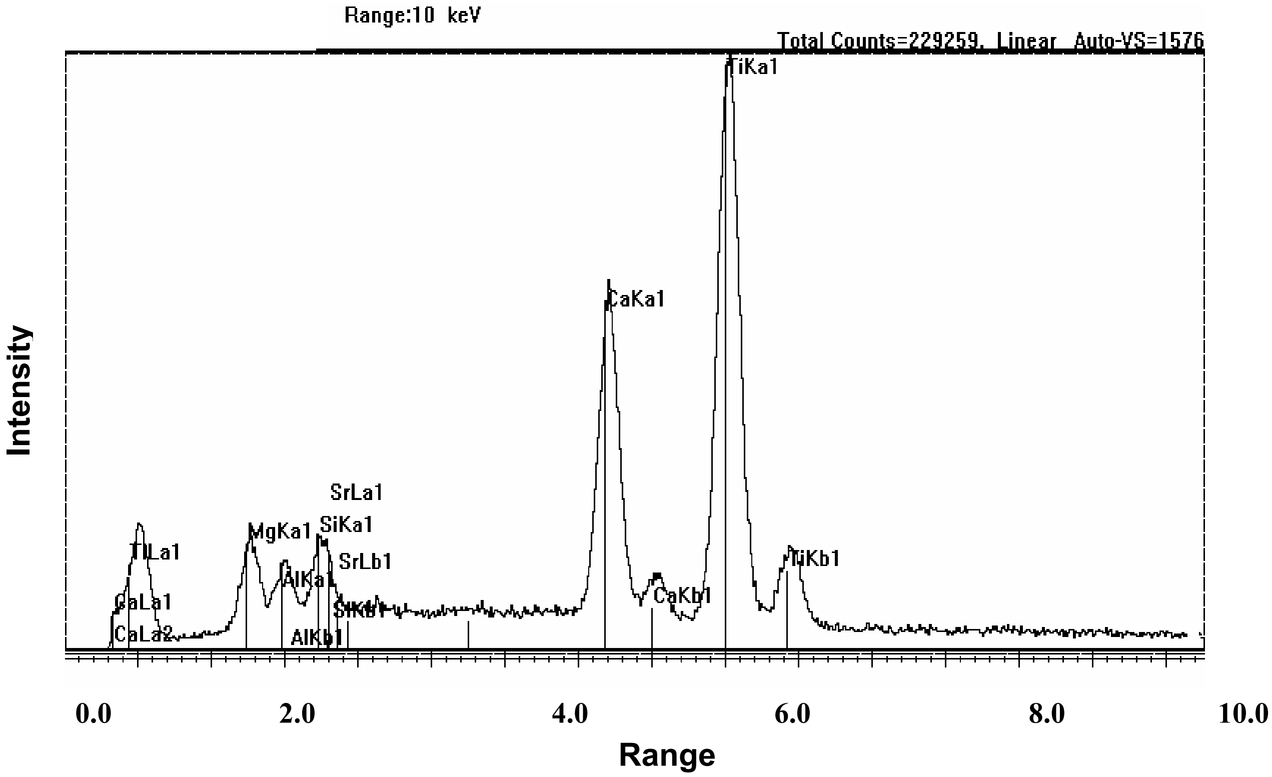

Figure A5. Paint C.

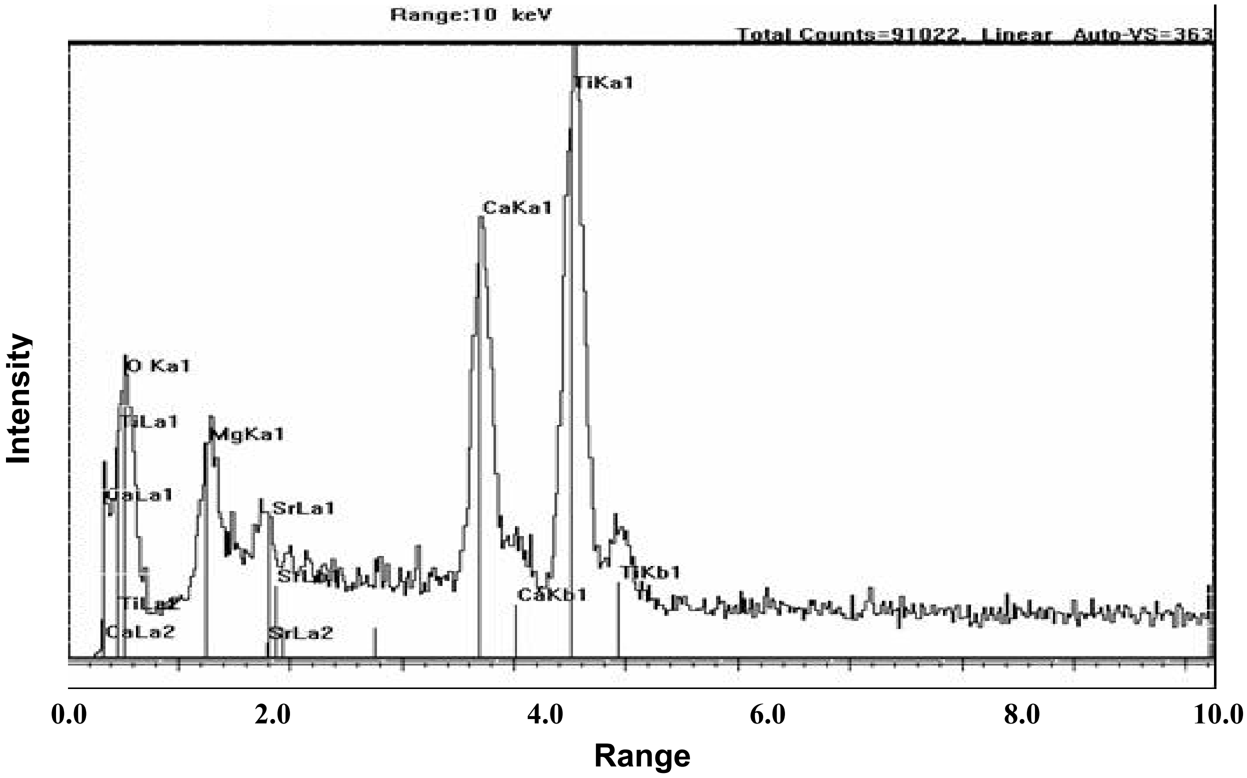

Figure A6. Primer C.

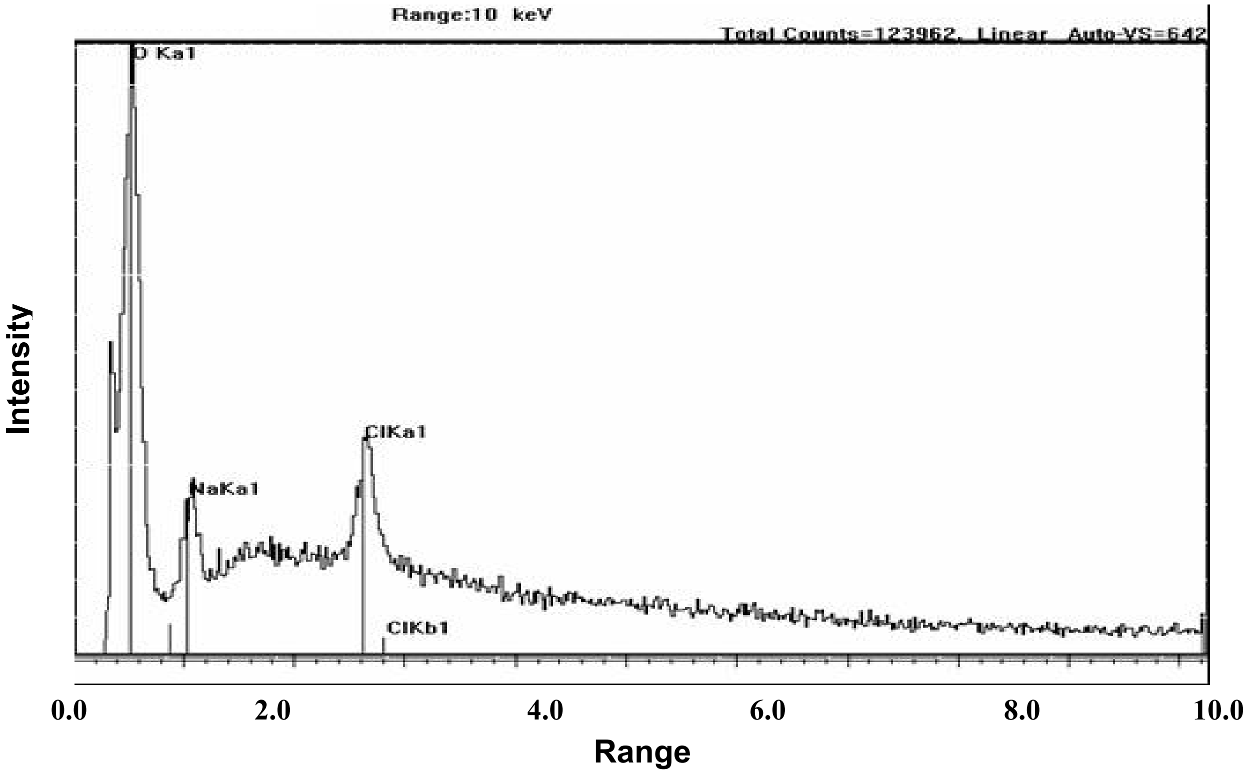

Figure A7. Adhesive A.

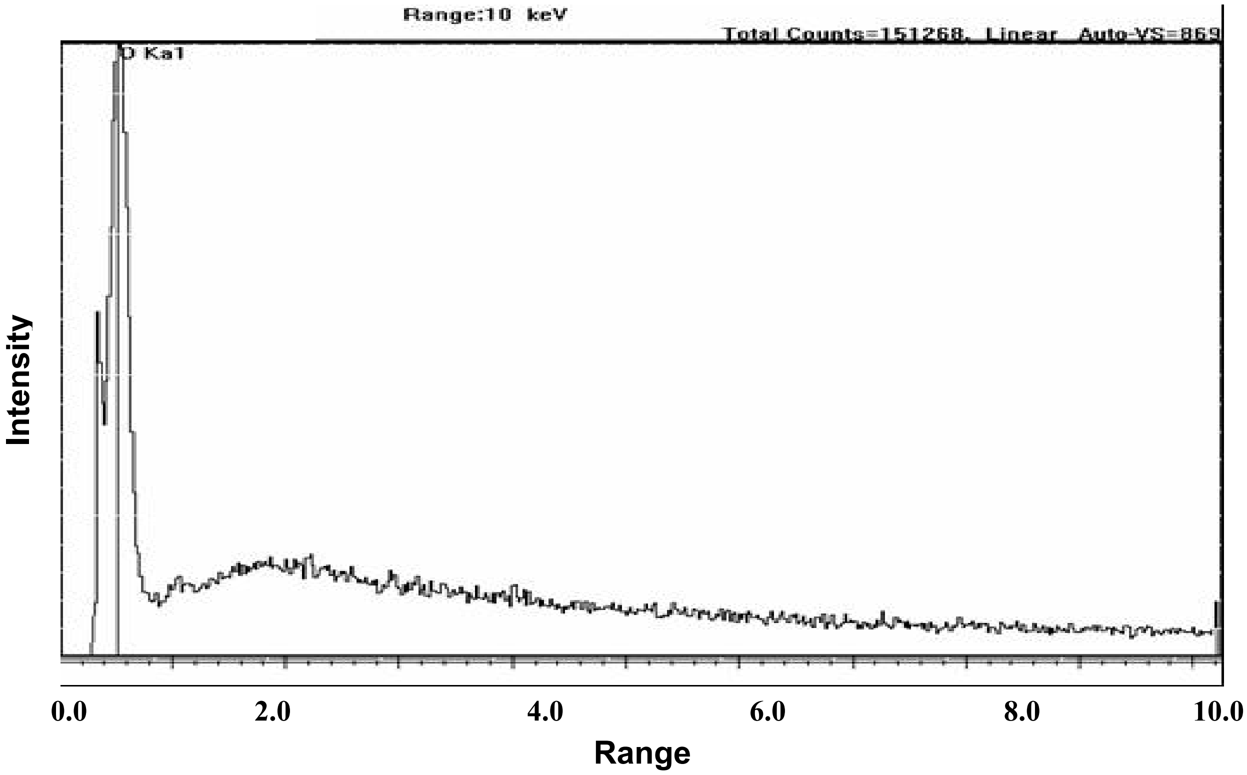

Figure A8. Adhesive B.

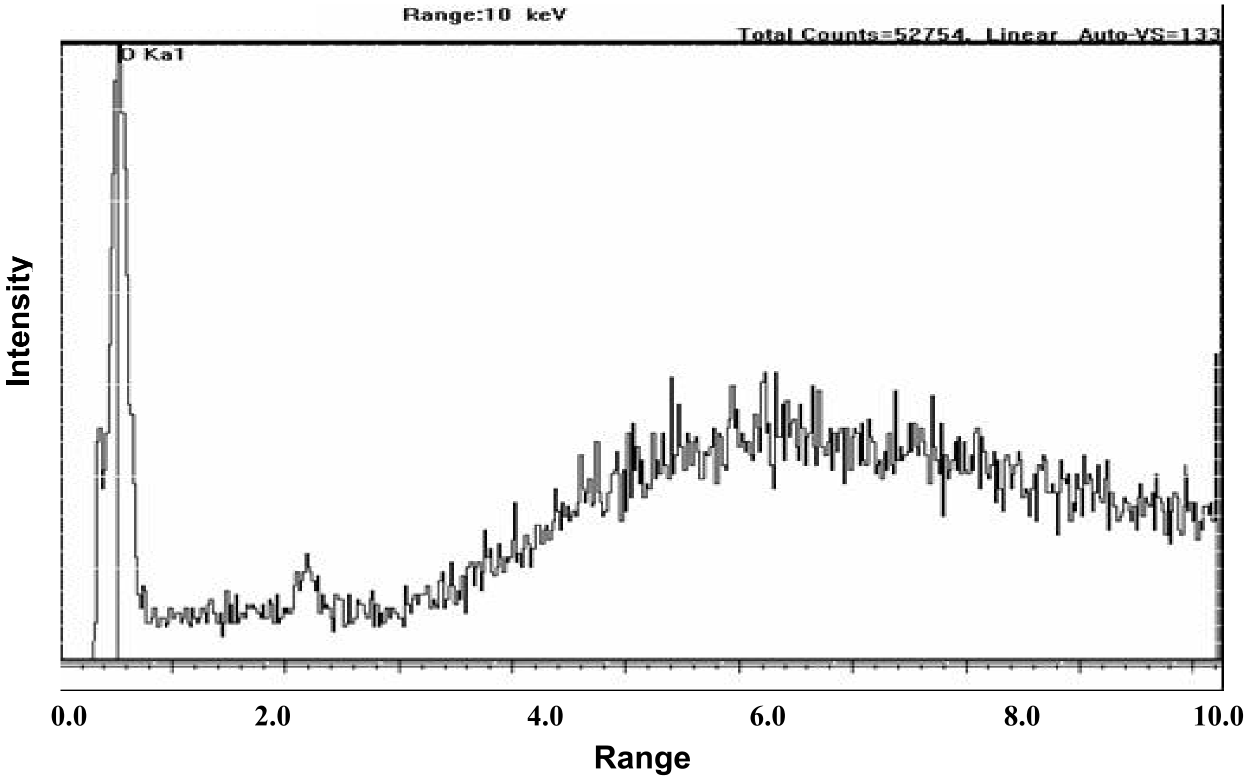

Figure A9. Adhesive C.

SAMPLE WEIGHTS

Table B1. Sample weights and the relative weight changes at the different relative humidities. d indicates the age of the sample in days.

Material / material combination	RH (%)	Sample weight (g)	Evaporated (g)	Relative weight change (%)
Paint A, 28 d	20	7.98	3.23	40.5
	50	7.95	3.11	39.1
	80	8.00	3.08	38.5
Paint C, 28 d	20	5.35	1.04	19.5
	50	5.84	1.22	21.0
	80	5.48	1.06	19.4
Adhesive A, 28 d	20	18.57	14.37	77.4
	50	18.27	14.07	77.0
	80	18.53	13.80	74.5
Adhesive B, 14 d	20	18.65	16.00	85.8
	50	18.62	15.84	85.1
	80	18.52	15.54	83.9
Adhesive C, 28 d	20	18.65	15.38	82.5
	50	18.34	15.03	82.0
	80	18.25	14.62	80.1
Plaster A, 29 d	20	206.63	48.44	23.4
	50	201.66	47.48	23.5
	80	208.59	48.40	23.2
Plaster C, 27 d	20	267.12	110.47	41.4
(3 mm)	50	196.03	50.47	25.7
	80	209.00	6.46	3.1
Gypsum board, 28 d	20	536.97	1.35	0.3
	50	538.08	0.22	0.0
	80	543.93	-2.30	-0.4
Primer and paint A, 14d	20	13.36	4.12	30.84
	50	13.21	3.86	29.22
	80	13.17	3.55	26.96
Primer and paint B, 14d	20	13.80	3.61	26.16
	50	13.74	3.52	25.62
	80	13.90	3.31	23.81
Primer A and paint C, 14d	20	9.76	0.94	9.63
	50	9.70	0.93	9.59
	80	9.79	0.56	5.72
Primer and paint C, 14d	20	10.19	0.62	6.08
	50	10.24	0.62	6.05
	80	10.16	0.74	7.28
Filler and plaster A, 14 d	20	445.82	72.02	16.15
	50	467.03	74.06	15.86
	80	493.28	35.22	7.14
Filler and plaster B, 14 d	20	365.22	113.44	31.29
	50	332.76	79.51	23.89
	80	322.56	30.97	9.60

Table B1 continues

Material / material combination	RH (%)	Sample weight (g)	Evaporated (g)	Relative weight change (%)
Plaster C, 14 d	20	518.18	125.62	24.2
(6 mm)	50	515.54	78.22	15.2
	80	518.61	63.94	12.3
GB and paint A[2)], 14 d	20	14.00	5.11	36.50
	50	14.12	3.64	25.78
	80	13.98	1.58	11.30
GB and paint B[2)], 14 d	20	14.61	4.32	29.57
	50	14.66	2.77	18.89
	80	14.76	0.31	2.10
GB and adh. A[2)], 14 d	20	18.35	13.22	72.04
	50	18.42	11.16	60.59
	80	18.52	7.70	41.58
GB and adh. B[2)], 14 d	20	18.45	14.00	75.88
	50	18.38	11.80	64.20
	80	18.48	8.92	48.27
CSB, plaster B and paint	20	9.84	47.34	481.10
A[3)], 14 d	50	10.04	32.44	323.11
	80	11.34	10.64	93.83
CSB, plaster C and paint	20	13.30	35.10	263.91
A[3)], 14 d	50	13.17	25.77	195.67
	80	13.30	4.70	35.34
CSB, plaster B and paint	20	13.21	34.31	259.73
B[3)], 14 d	50	13.55	22.35	164.94
	80	12.84	6.54	50.93
CSB, plaster C and paint	20	13.32	43.74	328.38
B[3)], 14 d	50	12.23	32.33	264.35
	80	12.01	4.70	35.34
CSB, plaster B and adh.	20	18.41	61.91	336.28
A[3)], 14 d	50	18.48	38.38	207.68
	80	18.46	13.06	70.75
CSB, plaster C and adh.	20	18.49	48.19	260.63
A[3)], 14 d	50	18.55	34.65	186.79
	80	18.59	10.59	56.97
CSB, plaster B and adh.	20	18.37	46.67	254.06
B[3)], 14 d	50	18.35	35.05	191.01
	80	18.41	12.31	66.87
CSB, plaster C and adh.	20	18.37	57.87	315.02
B[3)], 14 d	50	18.40	41.50	225.54
	80	18.41	12.01	65.24

[2)] GB indicates gypsum board and paint is the combination of primer and paint

[3)] CSB indicates calcium silicate brick, plaster B is the combination of filler and plaster B and paint is the combination of primer and paint

AREA SPECIFIC EMISSION RATES

Bold values in respective columns are the averages.

Table C1. Background emission values of paint A in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
decane	0.3	0.4	0.4
undecane	0.3	0.3	0.3
dodecane	0	0.3	0
AROMATIC HYDROCARBONS			
aromatic hydrocarcarbons	0.2	0.2	0.3
ethylbenzene	0.3	0.3	0.4
p,m-xylene	1	1	1
o-xylene	0.4	0.4	0.4
styrene	0.5	0.4	0.4
toluene	1	1	2
1,2,4-trimethylbenzene	0.5	0.5	0.6
TERPENES AND THEIR DERIVATIVES			
limonene	0.5	0.6	0.6
α-pinene	0	0.3	0
ALDEHYDES			
hexanal	0	0	0.4
octanal	0.3	0.2	0.4
nonanal	0	0	1
decanal	0	0	2
ESTERS AND LACTONES			
2-(2-butoxy)ethylacetate	0.3	0	0
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	3	1	0.5
SILICON CONTAINING COMPOUNDS			
organic Si-compounds	2	1	2
Total	10.6	7.9	12.7
TVOC	**18**	**16**	**22**
non-TVOC	3	*2*[1]	2

[1] *Italic* font indicates that the value is below the detection limit.

Table C2. Emission values of paint A at 1 day in the environmental chamber test.

($\mu g/m^2 \cdot h$)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	82	82	**82**	114	109	**111**	214	205	**209**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	218	305	**261**	250	350	**300**	382	396	**389**
DIVALENT ALCOHOLS									
1,2-propanediol	559	573	**566**	786	814	**800**	564	559	**561**
ETHERS									
butyl ether	24	22	**23**	19	19	**19**	20	17	**18**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	132	136	**134**	191	200	**195**	200	196	**198**
ALDEHYDES									
benzaldehyde	5	5	**5**	4	4	**4**	6	6	**6**
decanal	7	0	**4**	0	0	**0**	0	0	**0**
ACIDS									
acetic acid	7	5	**6**	14	11	**13**	0	0	**0**
ESTERS AND LACTONES									
texanol	14	13	**13**	11	16	**14**	19	18	**19**
HALOGEN CONTAINING COMPOUNDS									
1-bromododecane	6	7	**7**	8	8	**8**	11	9	**10**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	11	8	**9**	8	8	**8**	6	5	**6**
Total	1064	1155	**1110**	1405	1539	**1472**	1420	1409	**1415**
TVOC	**569**	**628**	**599**	**775**	**938**	**856**	**931**	**940**	**935**
non-TVOC	8	***8***	**20**	17	22	**20**	***8***	***8***	**8**

Table C3. Emission values of paint A at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH AND ALICYCLIC COMPOUNDS									
1-dodecene	4	4	**4**	5	5	**5**	6	5	**5**
decane	0	0	**0**	0	0	**0**	0	0	**0**
undecane	0	0	**0**	0.1	0.1	**0.1**	0.1	0	**0.1**
AROMATIC HYDROCARBONS									
ethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0	0	**0**
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
o-xylene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.1	0.1	**0.1**
toluene	1	1	**1**	1	1	**1**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0	**0**	1	1	**1**
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	1	1	**1**
1-dodecanol	1	1	**1**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	13	15	**14**	1	2	**2**	2	2	**2**
ETHERS									
butyl ether	0.4	1	**0.5**	0.4	0.4	**0.4**	0.1	0.1	**0.1**
PHENOLS									
phenol	1	1	**1**	1	1	**1**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	4	4	**4**	2	2	**2**	2	2	**2**
KETONES									
2-butanone (MEK)	0	1	**0**	0	0	**0**	0	0	**0**
ACIDS									
methacrylic acid	0.3	0.3	**0.3**	1	1	**1**	1	1	**1**
acetic acid	1	1	**1**	1	1	**1**	1	2	**1**
ESTERS AND LACTONES									
texanol	3	3	**3**	4	4	**4**	4	5	**4**
HALOGEN CONTAINING COMPOUNDS									
1-bromododecane	2	2	**2**	3	3	**3**	3	3	**3**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	1	**0.3**	1	1	**1**	0	0	**0**
2-amino-2-methyl-1-propanol	0	0	**0**	2	2	**2**	4	6	**5**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	0	0	**0**	0	1	**0**	0	0	**0**
SULPHUR CONTAINING COMPOUNDS									
2-methyl-3(2H)-isotiatsolon	1	2	**2**	2	2	**2**	2	2	**2**
OTHERS									
unidentified	1	1	**1**	2	2	**2**	5	6	**5**
Total	31	36	**34**	26	28	**27**	34	37	**35**
TVOC	**14**	**17**	**15**	**20**	**21**	**20**	**25**	**31**	**28**
non-TVOC	0	1	**0**	1	1	**1**	2	2	**2**

Table C4. Emission values of paint A at 28 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	2	2	**2**	2	2	**2**	0	2	**1**
hexane	0	0	**0**	0	0	**0**	0	0	**0**
decane	0	0	**0**	0	0	**0**	0	0	**0**
cyclohexane	0	0	**0**	0	0	**0**	1	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0.1	**0.1**	0	0	**0**
ethylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
propylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
p,m-xylene	0	0	**0**	0	0	**0**	0	0	**0**
o-xylene	0	0	**0**	0	0	**0**	0	0	**0**
styrene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	1	1	**1**	1	1	**1**	0	0	**0**
1,2,3-trimethylbenzene	0	0	**0**	0	0.1	**0.1**	0	0	**0**
1,2,4-trimethylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
1,3,5-trimethylbenzene	0	0.1	**0.1**	0.1	0	**0.1**	0	0	**0**
1-ethyl-2-methylbenzene	0.1	0.1	**0.1**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	0.2	0	**0.1**	0.3	0.4	**0.4**	1	1	**1**
2-ethyl-1-hexanol	0.3	0.3	**0.3**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	1	1	**1**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0.3	1	**0.4**	0	0.2	**0.1**	0	0	**0**
ALDEHYDES									
hexanal	1	1	**1**	2	2	**2**	4	4	**4**
KETONES									
2-butanone (MEK)	0	0	**0**	0	9	**4**	0	0	**0**
4-methyl-2-pentanone	0	0.1	**0.1**	0	0	**0**	0	0	**0**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	0	0	**0**
3-carene	0.1	0	**0.1**	0.1	0	**0.1**	0	0	**0**
ESTERS AND LACTONES									
texanol	1	2	**2**	2	2	**2**	1	2	**2**
methylester of 2-propionic acid	0	0	**0**	0	3	**1**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
1-bromododecane	1	1	**1**	1	1	**1**	0	1	**1**
dichloromethane	0	0	**0**	3	55	**29**	0	0	**0**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	0	0	**0**	0.1	0	**0.1**
2-amino-2-methyl-1-propanol	0	0	**0**	0	0	**0**	3	1	**2**
4,4-dimethyl-1,3-oxazolidine	0	1	**0**	1	2	**2**	4	4	**4**
Total	7	9	**8**	13	77	**45**	14	15	**15**
TVOC	**6**	**10**	**8**	**11**	**20**	**15**	**22**	**17**	**20**
non-TVOC	0	0	**0**	2	62	**32**	0	0	**0**

Table C5. Background emission values of paint C in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC HYDROCARBONS			
hexane	0.3	0	0
heptane	0	0.4	0.3
decane	0.3	0.4	0.4
undecane	0.3	0.4	0.4
dodecane	0.3	0	0.3
AROMATIC HYDROCARBONS			
aromatic hydrocarcarbons, C_9	0.7	0.8	0.8
benzene	0.3	0	0.3
ethylbenzene	0.7	0.8	0.9
propylbenzene	0.3	0	0.3
p,m-xylene	3	3	3
o-xylene	1	1	1
styrene	0.5	0.6	0.6
toluene	4	4	4
1,2,3-trimethylbenzene	0.3	0	0.3
1,2,4-trimethylbenzene	1	1	1
1,3,5-trimethylbenzene	0	0	0.3
TERPENES AND THEIR DERIVATIVES			
limonene	0.9	1	0.9
ALDEHYDES			
hexanal	0	0	0.3
octanal	0.2	0.4	0.3
ESTERITS AND LACTONES			
2-(2-butoxy)ethylacetate	0.4	0	0
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	2	2	0.4
SILICON CONTAINIG COMPOUNDS			
organic Si-comp.	1	2	2
Total	17.5	17.8	17.8
TVOC	**30**	**33**	**32**
non-TVOC	3	2	5

Table C6. Emission values of paint C at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC HYDROCARBONS									
pentane	409	418	**414**	441	423	**432**	341	391	**366**
heptane	64	59	**61**	73	73	**73**	64	64	**64**
octane	68	68	**68**	77	77	**77**	68	73	**70**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	17500	16046	**16773**	21773	21591	**21682**	12182	11955	**12068**
MONATOMIC ALCOHOLS									
1-pentanol	91	96	**93**	105	105	**105**	86	100	**93**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	227	255	**241**	273	300	**286**	291	300	**295**
ALDEHYDES									
propanal	41	46	**43**	55	55	**55**	50	59	**55**
n-butanal	50	46	**48**	55	59	**57**	68	64	**66**
pentanal	446	432	**439**	541	518	**530**	605	550	**577**
hexanal	1346	1291	**1318**	1477	1491	**1484**	1536	1514	**1525**
heptanal	36	32	**34**	46	45	**45**	55	55	**55**
octanal	0	0	**0**	0	0	**0**	43	45	**44**
2-octenal	105	114	**109**	109	114	**111**	146	150	**148**
nonanal	0	0	**0**	0	0	**0**	28	35	**31**
KETONES									
2-butanone (MEK)	27	28	**28**	40	42	**41**	28	28	**28**
ACIDS									
acetic acid	24	40	**32**	50	40	**45**	33	44	**38**
propanoic acid	55	64	**59**	82	86	**84**	82	100	**91**
butanoic acid	6	8	**7**	8	10	**9**	10	12	**11**
pentanoic acid	32	44	**38**	42	46	**44**	50	68	**59**
hexanoic acid	327	418	**373**	355	373	**364**	405	514	**459**
2-ethylhexanoic acid	755	896	**825**	846	927	**886**	741	786	**764**
NITROGEN CONTAINING COMPOUNDS									
2-butanone oxime	77	73	**75**	114	118	**116**	73	68	**70**
OTHERS									
1,2-epoxy alkane	73	64	**68**	82	73	**77**	68	68	**68**
Total	21756	20534	**21145**	26640	26563	**26601**	17049	17041	**17045**
TVOC	**20532**	**20486**	**20509**	**26349**	**26576**	**26462**	**17349**	**17486**	**17417**
non-TVOC	521	540	**530**	586	563	**574**	484	548	**516**

Table C7. Emission values of paint C at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC HYDROCARBONS									
pentane	0.9	0.9	**1**	2	3	**3**	2	2	**2**
heptane	0.9	0.9	**1**	3	3	**3**	3	3	**3**
octane	0.5	0.5	**1**	3	3	**3**	2	2	**2**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	355	346	**350**	273	318	**295**	241	277	**259**
MONATOMIC ALCOHOLS									
1-pentanol	3	3	**3**	11	10	**10**	11	9	**10**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	0	0	**0**	146	0	**73**
ALDEHYDES									
propanal	0.4	0.5	**0**	0.9	0.9	**1**	0.9	0.9	**1**
n-butanal	3	4	**3**	6	6	**6**	5	5	**5**
pentanal	21	21	**21**	32	35	**34**	27	26	**27**
hexanal	77	77	**77**	100	109	**105**	77	77	**77**
heptanal	11	11	**11**	14	15	**14**	10	10	**10**
octanal	19	18	**18**	21	24	**22**	15	15	**15**
2-octenal	3	3	**3**	4	4	**4**	2	3	**3**
nonanal	20	19	**19**	19	21	**20**	13	13	**13**
2-decenal	9	9	**9**	9	10	**9**	6	6	**6**
2-undecenal	8	8	**8**	6	6	**6**	4	4	**4**
KETONES									
2-butanone (MEK)	2	2	**2**	2	3	**3**	2	2	**2**
ACIDS									
acetic acid	1	2	**2**	3	4	**3**	3	6	**4**
propanoic acid	1	2	**2**	4	4	**4**	3	4	**4**
butanoic acid	2	2	**2**	4	4	**4**	3	4	**4**
pentanoic acid	13	13	**13**	27	30	**28**	21	26	**23**
hexanoic acid	168	173	**170**	273	296	**284**	223	255	**239**
2-etylhexanoic acid	159	159	**159**	164	182	**173**	109	123	**116**
heptanoic acid	11	12	**11**	29	31	**30**	24	27	**25**
octanoic acid	11	11	**11**	32	36	**34**	30	37	**33**
nonanoic acid	2	2	**2**	7	7	**7**	5	9	**7**
ESTERS AND LACTONES									
caprolactone	5	5	**5**	7	7	**7**	6	7	**7**
OTHERS									
1,2-epoxy alkane	0.1	0.2	**0.2**	1	0.9	**1**	1	1	**1**
Total	903	903	**903**	1053	1170	**1112**	994	953	**974**
TVOC	**805**	**823**	**814**	**976**	**1049**	**1012**	**786**	**876**	**831**
non-TVOC	11	14	**12**	23	24	**24**	20	24	**22**

Table C8. Emission values of paint C at 28 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC HYDROCARBONS									
nonane	0	0	**0**	0	0	**0**	0	2	**1**
decane	5	5	**5**	4	4	**4**	10	11	**11**
undecane	5	6	**6**	6	6	**6**	10	12	**11**
dodecane	0.8	1	**1**	1	1	**1**	2	2	**2**
AROMATIC HYDROCARBONS									
ethylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
p,m-xylene	0	0	**0**	0	0	**0**	0	0	**0**
o-xylene	0	0	**0**	0	0	**0**	0	0	**0**
styrene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	0	0	**0**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0	4	**2**
ALDEHYDES									
pentanal	10	10	**10**	7	11	**9**	8	8	**8**
hexanal	31	33	**32**	23	33	**28**	28	29	**28**
heptanal	5	5	**5**	5	6	**5**	4	4	**4**
octanal	7	0	**4**	8	10	**9**	6	7	**6**
nonanal	7	8	**7**	9	9	**9**	6	8	**7**
decanal	0.9	0.9	**1**	0.9	0.9	**1**	0.9	0.9	**1**
ACIDS									
acetic acid	15	13	**14**	10	11	**11**	4	6	**5**
propanoic acid	11	11	**11**	9	11	**10**	3	7	**5**
butanoic acid	1	2	**2**	5	5	**5**	2	3	**3**
pentanoic acid	27	35	**31**	33	34	**33**	13	15	**14**
hexanoic acid	286	359	**323**	350	368	**359**	205	227	**216**
2-etylhexanoic acid	24	31	**28**	26	29	**28**	26	28	**27**
heptanoic acid	16	20	**18**	16	18	**17**	4	4	**4**
octanoic acid	25	27	**26**	30	32	**31**	7	8	**8**
nonanoic acid	9	12	**11**	8	11	**9**	9	12	**11**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	0	0	**0**
NITROGEN CONTAINING COMPOUNDS									
2-butanone oxime	0	0	**0**	0	0	**0**	0	0.5	**0**
Total	486	578	**532**	549	602	**575**	347	398	**372**
TVOC	**282**	**336**	**309**	**303**	**349**	**326**	**272**	**336**	**304**
non-TVOC	14	11	**13**	9	11	**10**	2	4	**3**

Table C9. Background emission values of adhesive A in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
decane	0.4	0.4	0.5
undecane	0.3	0.3	0.4
dodecane	0.2	0.2	0.3
aliphatic hydrocarb.			
AROMATIC HYDROCARBONS			
p,m-xylene	1	1	0.9
toluene	3	3	3
1,2,4-trimethylbenzene	0.5	0.5	0.5
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0.6	0.8	2
PHENOLS			
phenol	0.4	0.7	0.9
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	0	2
ALDEHYDES			
hexanal	0	0	0.2
nonanal	0.3	0.6	0.8
decanal	0.4	1	0.6
KETONES			
acetone	0	0	0.9
ACIDS			
hexanic acid	0.3	0	0
2-etylhexanic-acid			
TERPENES AND THEIR DERIVATIVES			
limonene	0.8	1	1
ESTERS AND LACTONES			
diethyl phthalate			
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	0.6	0.4	0.2
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	0.7	0.4	1.4
Total	9.5	10.3	15.6
TVOC	**12**	**15**	**16**
non-TVOC	0.4	***0.3***1)	0.9

1) *Italic* font indicates that the value is below the detection limit.

Table C10. Emission values of adhesive A at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0	0	**0**	0.9	0.5	**0.7**
decane	0	0	**0**	0.3	0	**0.2**	0	0	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	0	0	**0**	0.5	0	**0.3**	0	0	**0**
toluene	0	0	**0**	0	0	**0**	0	0	**0**
1,1'-biphenyl	2	2	**2**	2	2	**2**	3	2	**3**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.2	0.2	**0.2**	0.5	0.1	**0.3**	0	0	**0**
PHENOLS									
phenol	0.3	0.3	**0.3**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
1-allyloxy-2-propanol	2	2	**2**	2	2	**2**	1	1	**1**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0.9	0	**0.5**
octanal	0.5	0	**0.3**	0	0.9	**0.5**	0.9	0	**0.5**
nonanal	1	0	**1**	0.6	2	**1**	2	0	**1**
decanal	2	0	**1**	0	1	**1**	0	0	**0**
KETONES									
acetophenone	0.9	0.9	**0.9**	0.5	0.5	**0.5**	1	0.9	**1**
acetone	2	2	**2**	2	2	**2**	1	1	**1**
ACIDS									
acetic acid	91	141	**116**	73	64	**68**	68	77	**73**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	0.9	0.9	**0.9**	0.5	0.9	**0.7**	0.9	0.5	**0.7**
propyl benzoate	28	26	**27**	26	26	**26**	29	29	**29**
methyl benzoate	0.9	0.9	**0.9**	0.9	1	**1**	0.9	0.9	**0.9**
ethyl benzoate	3	3	**3**	3	3	**3**	3	3	**3**
isopropyl benzoate	2	1	**2**	1	1	**1**	1	1	**1**
allyl benzoate	1	0.9	**1**	1	0.9	**1**	1	1	**1**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	2	0	**1**	0	0	**0**	0	0	**0**
OTHERS									
unidentified	11	11	**11**	12	11	**11**	13	12	**13**
Total	151	193	**172**	127	118	**122**	128	132	**130**
TVOC	**63**	**54**	**58**	**57**	**52**	**55**	**56**	**52**	**54**
non-TVOC	101	162	**132**	82	75	**79**	78	89	**83**

Table C11. Emission values of adhesive A at 14 days in the environmental chamber test.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	2	2	**2**	2	2	**2**	2	1	**1**
undecane	2	2	**2**	3	2	**2**	2	2	**2**
aliphatic hydrocarb.	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.5	0.9	**0.7**
AROMATIC HYDROCARBONS									
ethylbenzene	2	2	**2**	2	2	**2**	2	1	**2**
propylbenzene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
p,m-xylene	10	9	**9**	11	10	**10**	8	8	**8**
o-xylene	4	3	**3**	4	4	**4**	3	3	**3**
toluene	0.5	0.5	**0.5**	0.9	0.5	**0.7**	0	0	**0**
1,2,3-trimethylbenzene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,2,4-trimethylbenzene	3	3	**3**	4	3	**4**	3	3	**3**
1,3,5-trimethylbenzene	0.9	0.5	**0.7**	0.9	0.9	**0.9**	0.5	0.5	**0.5**
1-ethyl-2-methylbenzene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.5	**0.7**
C_3-alkylbenzene	3	3	**3**	4	3	**4**	3	3	**3**
C_4-alkylbenzene	1	0.5	**1**	1	1	**1**	0.9	0.9	**1**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0.2	**0.1**	0.1	0.1	**0.1**	0	0	**0**
2-methyl-1-propanol	2	2	**2**	2	2	**2**	1	1	**1**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0.5	0	**0.3**	0.5	0.5	**0.5**	0	0.5	**0.3**
ALDEHYDES									
decanal	0	0	**0**	0	0	**0**	0	0.2	**0.1**
KETONES									
acetone	0	0	**0**	0	0	**0**	0	0	**0**
ACIDS									
acetic acid	12	9	**10**	21	23	**22**	55	82	**68**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	0	0	**0**	0	0	**0**	0.5	0.5	**0.5**
2-ethylhexylacrylate	0.5	0	**0.3**	0	0	**0**	0	0	**0**
propyl benzoate	0	0	**0**	0	0	**0**	0.5	0.5	**0.5**
OTHERS									
unidentified	0	0	**0**	1	2	**2**	11	11	**11**
Total	46	38	**42**	61	59	**60**	93	120	**107**
TVOC	**45**	**45**	**45**	**57**	**48**	**52**	**52**	**47**	**50**
non-TVOC	12	9	**10**	22	24	**23**	81	90	**85**

Table C12. Emission values of adhesive A at 28 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0.2	0.2	**0.2**	0.3	0.2	**0.3**	0.4	0.2	**0.3**
nonane	0.2	0.2	**0.2**	0.2	0	**0.1**	0	0	**0**
decane	0.3	0.3	**0.3**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
undecane	0.3	0.2	**0.3**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
dodecane	0	0	**0**	0	0.1	**0.1**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	0.9	0.9	**1**	0.9	0.9	**0.9**	0.5	0.5	**0.5**
propylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
p,m-xylene	3	3	**3**	3	3	**3**	2	2	**2**
o-xylene	1	1	**1**	1	1	**1**	0.9	0.9	**0.9**
styrene	0	0	**0**	0.2	0	**0.1**	0	0	**0**
toluene	0	0	**0**	0.5	0	**0**	0	0	**0**
1,2,3-trimethylbenzene	0.3	0.3	**0.3**	0.4	0.3	**0.4**	0.3	0.2	**0.3**
1,2,4-trimethylbenzene	1	0.7	**1**	1	1	**1**	0.7	0.7	**0.7**
1,3,5-trimethylbenzene	0.3	0.3	**0.3**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
1-ethyl-2-methylbenzene	0.3	0.2	**0.3**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
C_3-alkylbenzene	1	1	**1**	1	1	**1**	0.8	0.7	**0.8**
C_4-alkylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.2	0.1	**0.2**	0.1	0.1	**0.1**	0	0	**0**
2-methyl-1-propanol	0.2	0.4	**0.3**	0.3	0.3	**0.3**	0.4	0.2	**0.3**
DIVALENT ALCOHOLS									
1,2-propanediol	0.9	0	**0.5**	0	0	**0**	0	0	**0**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0.2	0	**0.1**	0	0	**0**
1-methoxy-2-propanol	0	0	**0**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
ALDEHYDES									
octanal	0	0	**0**	0	0	**0**	0	0.2	**0.1**
nonanal	0.1	0.1	**0.1**	0	0	**0**	0	0.1	**0.1**
decanal	0	0	**0**	0	0	**0**	0	0.6	**0.3**
KETONES									
acetone	0	0	**0**	0	0	**0**	0	0	**0**
ACIDS									
acetic acid	9	6	**7**	12	11	**11**	20	25.5	**23**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	0	0	**0**	0	0	**0**	0.3	0.3	**0.3**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	0	0	**0**
hexamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
OTHERS									
unidentified	0	0	**0**	0.8	0.8	**0.8**	8	8	**8**
Total	20	16	**18**	25	22	**23**	36	42	**39**
TVOC	**17**	**15**	**16**	**18**	**16**	**17**	**20**	**20**	**20**
non-TVOC	9	6.2	**8**	13	11	**12**	21	27	**24**

Table C13. Background emission values of adhesive C in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
decane	1	1	0.7
undecane	2	2	1
dodecane	0.7	0.6	0.5
aliphatic hydrocarb.	0.4	0.5	0.3
AROMATIC HYDROCARBONS			
p,m-xylene	1	1	1
toluene	3	3	3
1,2,4-trimethylbenzene	0.5	0.5	0.4
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0.3	3	0.4
PHENOLS			
phenol	0.4	0.5	0.7
ALDEHYDES			
hexanal	0.4	0.7	0.6
nonanal	0.9	0.9	0.8
decanal	1	0.7	0.8
ACIDS			
hexanic acid	1	2	7
2-etylhexanic-acid			1
TERPENES AND THEIR DERIVATIVES			
limonene	0.8	0.6	0.6
ESTERS AND LACTONES			
diethyl phthalate	0	0	0.8
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	0.7	0.6	0.6
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	0.5	1	0.9
Total	14.6	18.6	21.1
TVOC	**22**	**28**	**24**
non-TVOC	0.4	0.4	0.7

Table C14. Emission values of adhesive C at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.9	0.9	**0.9**	0.9	0.5	**0.7**	0	0	**0**
decane	0.5	0	**0.3**	0	0	**0**	0.1	0	**0.1**
undecane	0	0	**0**	0	0	**0**	0.5	0.5	**0.5**
AROMATIC HYDROCARBONS									
benzene	0	2	**1**	0	0	**0**	0	0	**0**
p,m-xylene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	0	0.5	**0.3**	0.5	0.5	**0.5**	0	0.5	**0.3**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.8	0	**0.4**	0	0	**0**	0	0.3	**0.2**
DIVALENT ALCOHOLS									
1,2-propanediol	86	86	**86**	39	37	**38**	16	15	**15**
PHENOLS									
phenol	0.7	0.7	**0.7**	0.7	0.7	**0.7**	0.6	0.1	**0.4**
ALDEHYDES									
benzaldehyde	2	1	**2**	0.9	1	**1**	0	0	**0**
pentanal	0	0	**0**	0	0.5	**0**	0	0	**0**
hexanal	1	1	**1**	2	2	**2**	0.6	0.2	**0.4**
octanal	0	0.9	**0.5**	1	1	**1**	0.5	0.5	**0.5**
nonanal	1	1	**1**	2	2	**2**	2	2	**2**
decanal	3	3	**3**	5	6	**5**	5	6	**5**
KETONES									
acetophenone	0.5	0.9	**0.7**	0	0.5	**0.3**	0	0	**0**
acetone	4	3	**4**	3	4	**3**	3	3	**3**
ACIDS									
acetic acid	314	364	**339**	259	209	**234**	136	218	**177**
hexanoic acid	1	1	**1**	0.9	0.5	**0.7**	0.5	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	0.5	0.9	**0.7**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	6	0	**3**
octamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	0.9	0	**0.5**
Total	416	469	**442**	316	265	**291**	173	246	**210**
TVOC	**26**	**25**	**25**	**16**	**10**	**13**	**13**	**8**	**10**
non-TVOC	349	398	**373**	288	238	**263**	154	242	**198**

Table C15. Emission values of adhesive C at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0	**0**	0	0	**0**	0	0	**0**
undecane	0	0	**0**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	2	2	**2**	2	2	**2**	2	2	**2**
propylbenzene	0.5	0.5	**0.5**	0	0	**0**	0	0	**0**
p,m-xylene	11	10	**10**	9	11	**10**	9	11	**10**
o-xylene	4	3	**3**	3	4	**3**	3	4	**3**
toluene	0	0	**0**	0.9	0.5	**0.7**	0.9	0.5	**0.7**
1,2,3-trimethylbenzene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
1,2,4-trimethylbenzene	3	3	**3**	2	3	**2**	2	3	**2**
1,3,5-trimethylbenzene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
1-ethyl-2-methylbenzene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
C_3-alkylbenzene	2	2	**2**	1	2	**2**	1	1	**1**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0	0	**0**
2-methyl-1-propanol	1	1	**1**	1	1	**1**	1	2	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	4	2	**3**	86	86	**86**	227	241	**234**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0	0	**0**	0.5	0.5	**0.5**	0.5	0.9	**0.7**
ALDEHYDES									
nonanal	0	0	**0**	0	0.5	**0.3**	0.1	0	**0.1**
decanal	0	0	**0**	0	0.1	**0.1**	0.1	0	**0.1**
KETONES									
acetone	0	0	**0**	0.5	0	**0.3**	0.5	0.9	**0.7**
ACIDS									
acetic acid	20	13	**16**	59	64	**61**	118	100	**109**
hexanoic acid	0	0	**0**	0	0	**0**	0.5	0.9	**0.7**
2-etylhexanic-acid	0	0	**0**	0	0	**0**	0.5	0.9	**0.7**
HALOGEN CONTAINING COMPOUNDS									
bromnitromethane	0	0	**0**	0	0	**0**	1	2	**2**
SULPHUR CONTAINING COMPOUNDS									
5-chloro-2-methyl-3(2H)-isotiatsolon	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
Total	48	38	**43**	168	175	**172**	371	371	**371**
TVOC	**26**	**23**	**25**	**51**	**56**	**53**	**162**	**180**	**171**
non-TVOC	20	14	**17**	64	69	**66**	129	111	**120**

Table C16. Emission values of adhesive C at 28 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0	0	**0**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
decane	0	0	**0**	0	0	**0**	0	0	**0**
undecane	0	0	**0**	0	0	**0**	0	0	**0**
dodecane	0	0	**0**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
p,m-xylene	2	1	**2**	2	3	**3**	2	2	**2**
o-xylene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
toluene	0	0	**0**	0.5	0	**0.3**	0.5	0	**0.3**
1,2,3-trimethylbenzene	0.2	0.2	**0.2**	0.3	0.3	**0.3**	0.3	0.2	**0.3**
1,2,4-trimethylbenzene	0.7	0.7	**0.7**	0.7	0.7	**0.7**	0.7	0.7	**0.7**
1,3,5-trimethylbenzene	0	0	**0**	0	0.2	**0.1**	0.2	0	**0.1**
C$_3$-alkylbenzene	0.7	0.6	**0.7**	0.7	0.8	**0.8**	0.7	0.7	**0.7**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0	0	**0**
2-methyl-1-propanol	0.2	0.3	**0.3**	0	0.3	**0.2**	0.2	0.3	**0.3**
DIVALENT ALCOHOLS									
1,2-propanediol	1	0.9	**1**	39	43	**41**	50	55	**52**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0.3	0	**0.2**	0	0.4	**0.2**	0.3	0.3	**0.3**
1-methoxy-2-propanol	0	0	**0**	0	0.2	**0.1**	0.3	0.4	**0.4**
ALDEHYDES									
nonanal	0	0	**0**	0	0	**0**	0	0.1	**0.1**
decanal	0	0	**0**	0	0	**0**	0.1	0.1	**0**
ACIDS									
acetic acid	5	5	**5**	11	26	**18**	34	29	**31**
hexanoic acid	0	0	**0**	0	0	**0**	0	0	**0**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
bromnitromethane	0	0	**0**	0	0	**0**	1	2	**2**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	0.3	0	**0.2**
OTHERS									
unidentified	0	0	**0**	0	0	**0**	1	2	**2**
Total	11	10	**11**	55	76	**66**	94	93	**94**
TVOC	**9**	**5**	**7**	**21**	**21**	**21**	**30**	**31**	**30**
non-TVOC	5	5	**5**	11	28	**20**	37	31	**34**

Table C17. Background emission values of plaster A in the environmental chamber test.

(µg/m^3)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**6**	**8**	**11**

Table C18. Emission values of plaster A at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
p,m-xylene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
toluene	0.5	0.5	**0.5**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	0.5	0	**0.3**	0	0	**0**
1-pentanol	0.9	1	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
2-ethyl-1-hexanol	3.2	3	**3**	2.3	2.3	**2**	2.7	2.3	**3**
2-methyl-2-propanol	3.2	2	**3**	3.2	2.3	**3**	2.7	2.3	**3**
1-hexanol	2.3	2	**2**	1.8	1.8	**2**	2.3	1.8	**2**
1-heptanol	2.3	2	**2**	2.3	1.8	**2**	2.3	1.8	**2**
1-octanol	4.1	1	**3**	4.1	4.1	**4**	4.5	3.6	**4**
DIVALENT ALCOHOLS									
1,2-propanediol	7.7	9.5	**9**	5.9	8.6	**7**	4.1	4.1	**4**
ETHERS									
bis(2-ethoxyethyl)ether	1.4	1.4	**1**	1.4	1.4	**1**	1.8	1.4	**2**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	19.5	20	**20**	17.7	18.6	**18**	17.7	18.2	**18**
2-ethoxyethanol	1.4	2	**2**	1.4	1.8	**2**	1.4	1.4	**1**
2-methoxy-1-propanol	1.4	1.4	**1**	0.9	0.9	**1**	0.9	0.9	**1**
ALDEHYDES									
methylbenzaldehyde	0.9	1	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
pentanal	0.9	1	**1**	0.5	0.9	**0.7**	0.9	0.9	**0.9**
hexanal	4.1	5	**4**	3.2	5	**4**	5	5.5	**5**
heptanal	1.8	2	**2**	1.8	2.3	**2**	2.3	2.3	**2**
octanal	2.7	3	**3**	2.3	3.2	**3**	3.6	3.2	**3**
nonanal	3.6	4	**4**	3.2	3.6	**3**	4.1	3.6	**4**
2-nonenal	0.9	1	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
decanal	0.5	1	**1**	0	0.9	**0.5**	0	0.9	**0.5**
2-decenal	1.4	1	**1**	1.4	1.4	**1**	0.9	0.9	**0.9**
KETONES									
acetone	0.9	1	**1**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
cyclohexanone	2.7	3	**3**	2.7	2.3	**3**	3.2	2.3	**3**
2-decanone	1.8	2	**2**	2.3	1.8	**2**	1.8	1.4	**2**
OTHERS									
unidentified	10	10	**10**	10	10	**10**	9.1	10	**10**
Total	80.6	79.6	**80**	72.6	78.7	**76**	75	72.5	**74**
TVOC	**78.2**	**78.2**	**78**	**67.7**	**76.8**	**72**	**72.7**	**72.7**	**73**
non-TVOC	4.1	2.7	**3**	4.1	2.7	**3**	3.2	2.7	**3**

Table C19. Emission values of plaster A at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
dodecane	0	0	**0**	0	0	**0**	0.3	0.3	**0.3**
tetradecane	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
AROMATIC HYDROCARBONS									
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
toluene	1	1	**1**	1	1	**1**	1	1	**1**
1,2,4-trimethylbenzene	0	0	**0**	0	1	**0**	0.4	0.3	**0.4**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	1	**1**	0	0	**0**	0.4	0.4	**0.4**
DIVALENT ALCOHOLS									
1,2-propanediol	159	159	**159**	255	250	**252**	30	29	**29**
ETHERS									
bis(2-ethoxyethyl)ether	0	0	**0**	0	0	**0**	1	2	**2**
bis[2-(2-ethoxyethoxy)ethyl]ether	0	0	**0**	3	2.3	**3**	0.4	0.4	**0.4**
PHENOLS									
phenol	0	0	**0**	0	1	**0**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	7	8	**7**	34	39	**36**	1	1	**1**
2-(2-butoxyethoxy)ethanol	0	0	**0**	1	1	**1**	0	0	**0**
1-methoxy-2-propanol	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
dipropylene glycol methyl ether	3	3	**3**	6	6	**6**	3	3	**3**
bis(2-hydroxypropyl) ether	1	1	**1**	20	21	**21**	0	0	**0**
ALDEHYDES									
hexanal	1	1	**1**	1	1	**1**	1	1	**1**
heptanal	0	0	**0**	0	0	**0**	1	1	**1**
octanal	1	1	**1**	0	1	**0**	1	1	**1**
nonanal	1	1	**1**	1	1	**1**	1	1	**1**
decanal	0	0	**0**	1	0	**0**	1	1	**1**
2-decenal	0	0	**0**	0	0	**0**	0.3	0.3	**0.3**
KETONES									
2-butanone (MEK)	0	0	**0**	1	0	**0**	0	0.2	**0.1**
acetone	1	0	**0**	0	0	**0**	1	1	**1**
1-hydroxy-2-propanone	0	0	**0**	0	0	**0**	1	1	**1**
ACIDS									
acetic acid	8	12	**10**	14	17	**15**	6	4	**5**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	0.7	0.8	**0.8**
hexamethylcyclotrisiloxane	0	0	**0**	1	0	**0**	0	0	**0**
octamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	1	1	**1**
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
triethoxypentylsilane	0	0	**0**	0	0	**0**	0.3	0.3	**0.3**
Total	181	187	**184**	336	340	**338**	51	50	**50**
TVOC	**106**	**106**	**106**	**272**	**272**	**272**	**38**	**36**	**37**
non-TVOC	8	12	**10**	14	17	**15**	6	4.8	**5**

Table C20. Emission values of plaster A at 29 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
ethylbenzene	0.2	0	**0.1**	0.2	0.2	**0.2**	0	0	**0**
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
o-xylene	0.3	0.3	**0.3**	0.4	0.4	**0.4**	0	0	**0**
styrene	0	0	**0**	0.2	0.2	**0.2**	0	0	**0**
toluene	1	1	**1**	1	1	**1**	1	1	**1**
1,2,4-trimethylbenzene	1	1	**1**	1	1	**1**	1	1	**1**
C_3-alkylbenzene	0.3	0.3	**0.3**	0.3	0.3	**0.3**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	1	**1**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	73	96	**84**	55	55	**55**	232	246	**239**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	0	0.2	**0.1**	2	2	**2**	5	6	**6**
PHENOLS									
phenol	0	0	**0**	0.3	0.4	**0.4**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	2	3	**3**	3	3	**3**	21	23	**22**
2-[2-(2ethoxy)ethoxy]ethanol	0	0	**0**	1	0.4	**0.5**	2	2	**2**
2-(2-butoxyethoxy)ethanol	0.3	0.3	**0.3**	1	1	**1**	1	1	**1**
1-methoxy-2-propanol	0	0	**0**	0.3	0.3	**0.3**	0	0	**0**
dipropylene glycol methyl ether	1	1	**1**	0	0	**0**	1	1	**1**
bis(2-hydroxypropyl) ether	0.3	1	**0.4**	13	14	**13**	28	33	**30**
dipropyleneglycol-isomer	0	0	**0**	2	2	**2**	2	2	**2**
ALDEHYDES									
benzaldehyde	0	0	**0**	0.3	0.2	**0.3**	0	0	**0**
pentanal	0	0	**0**	0.2	0	**0.1**	0	0	**0**
hexanal	1	1	**1**	1	1	**1**	1	1	**1**
heptanal	0.2	0.3	**0.3**	0.3	0.3	**0.3**	0	0	**0**
octanal	0.3	0.4	**0.4**	0.4	0.4	**0.4**	1	0.4	**0.5**
nonanal	0.3	0.4	**0.4**	1	1	**1**	1	1	**1**
decanal	0	0	**0**	0.2	1	**0.4**	1	1	**1**
KETONES									
acetone	0	0	**0**	0.2	0.3	**0.3**	1	1	**1**
1-hydroxy-2-propanone	0	0	**0**	0	0	**0**	1	0.4	**0.5**
ACIDS									
acetic acid	0	0.3	**0.2**	0	0.4	**0.2**	0	0	**0**
TERPENES AND THEIR DERIVATIVES									
limonene	0.2	0.3	**0.3**	0	0.3	**0.3**	0	0	**0**
Total	81	107	**94**	82	85	**83**	297	320	**308**
TVOC	**25**	**36**	**30**	**39**	**41**	**40**	**182**	**196**	**189**
non-TVOC	0	0.3	**0.2**	0.2	0.6	**0.4**	1	1	**1**

Table C21. Background emission values of plaster C in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**14**	**20**	**19**

Table C22. Emission values of plaster C at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-nonene	0	0	**0**	0	0.3	**0.2**	0	0	**0**
decane	0.2	0.2	**0.2**	0.3	0.3	**0.3**	0	0	**0**
undecane	0.2	0.2	**0.2**	0.4	0.4	**0.4**	0.3	0.2	**0.3**
tetradecane	0	0	**0**	0.2	0.2	**0.2**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
p,m-xylene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.9	0.9	**0.9**
o-xylene	0.2	0.2	**0.2**	0	0.2	**0.1**	0.3	0.3	**0.3**
toluene	0.5	0.5	**0.5**	0.4	0.5	**0.5**	0.4	0.5	**0.5**
1,2,4-trimethylbenzene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0.2	**0.1**	0.3	0.2	**0.3**
2-ethyl-1-hexanol	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.4	**0.5**
benzylalcohol	0.4	0.5	**0.5**	0.4	0.4	**0.4**	0.4	0.3	**0.4**
2-methyl-1-propanol	0.3	0.4	**0.4**	0	0.4	**0.2**	0.5	0.4	**0.5**
2-methyl-2-propanol	0.2	0	**0.1**	0.2	0.3	**0.3**	0.5	0.5	**0.5**
ETHERS									
bis(2-methoxyethyl)ether	0.4	0.4	**0.4**	0.5	0.3	**0.4**	0.4	0.3	**0.4**
1,2-dimethoxybenzene	0.3	0.3	**0.3**	0.3	0.4	**0.4**	0.4	0.4	**0.4**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0.4	0.4	**0.4**	0	0.3	**0.2**	0.3	0.3	**0.3**
2-methoxyethanol	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.4	0.4	**0.4**
ALDEHYDES									
benzaldehyde	0.3	0.4	**0.4**	0.2	0.4	**0.3**	0.3	0.4	**0.4**
pentanal	0.2	0	**0.1**	0	0.3	**0.2**	0.2	0.2	**0.2**
hexanal	0.9	0.5	**0.7**	0.9	0.9	**1**	0.9	0.9	**0.9**
heptanal	0	0	**0**	0.2	0.5	**0.4**	0.2	0	**0.1**
octanal	0.2	0.3	**0.3**	0	0.9	**0.5**	0.3	0.2	**0.3**
nonanal	0.9	0.9	**0.9**	0.9	2	**1**	0.9	1	**1.2**
decanal	0	0.9	**0**	0	0.9	**0.5**	0	0.5	**0.3**
KETONES									
2-butanone (MEK)	0	0	**0**	0	2	**1**	0	0	**0**
acetone	0	0.3	**0.2**	0	0.4	**0.2**	0.3	0.4	**0.4**
cyclohexanone	0.4	0.4	**0.4**	0.4	0.3	**0.4**	0.9	0.5	**0.7**
6-methyl-5-hepten-2-one	0	0	**0**	0	0.2	**0.1**	0	0	**0**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0.9	0.9	**0.9**	0.9	0.9	**0.9**	1	0.9	**1.2**
n-butylacetate	0.2	0	**0.1**	0	0	**0**	0	0.2	**0.1**
methylmetacrylate	0	0	**0**	0	0.9	**0.5**	0	0	**0**
diethyl phthalate	0	0	**0**	0.5	0	**0.3**	0.9	0	**0.5**
2-butoxyethylacetate	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
NITROGEN CONTAINING COMPOUNDS									
unidentified nitrile	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0.9	0.9	**0.9**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
triethoxypentylsilane	3	3	**3**	3	2	**3**	2	2	**2**
Total	14	14	**14**	13	21	**17**	17	15	**16**
TVOC	**22**	**21**	**21**	**14**	**16**	**15**	**13**	**11**	**12**
non-TVOC	0.2	0.3	**0**	0.2	3	**2**	0.8	0.8	**1**

Table C23. Emission values of plaster C at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0.2	0.2	**0.2**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
undecane	0.1	0.1	**0.1**	0.4	0.3	**0.4**	0.3	0.3	**0.3**
dodecane	0	0	**0**	0.2	0.1	**0.2**	0.2	0.2	**0.2**
tridecane	0	0	**0**	0	0	**0**	0.5	0.9	**0.7**
tetradecane	0	0	**0**	0.1	0.1	**0.1**	2	1	**2**
pentadecane	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
hexadecane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	0	0	**0**	0	0	**0**	18	19	**19**
AROMATIC HYDROCARBONS									
ethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
p,m-xylene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
o-xylene	0.3	0.3	**0.3**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
styrene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
toluene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,2,3-trimethylbenzene	0	0	**0**	0.1	0.1	**0.1**	0.1	0	**0.1**
1,2,4-trimethylbenzene	0.5	0.4	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
C$_3$-alkylbenzene	0.2	0.3	**0.3**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0	**0**	0	0.1	**0.1**
2-ethyl-1-hexanol	0	0	**0**	0.3	0.3	**0.3**	0.3	0.5	**0.4**
benzylalcohol	0	0	**0**	0.1	0	**0.1**	0	0	**0**
2-methyl-1-propanol	0	0	**0**	0	0.1	**0.1**	0	0	**0**
ETHERS									
bis(2-methoxyethyl)ether	0	0	**0**	0	0.2	**0.1**	0.5	0.5	**0.5**
PHENOLS									
phenol	0	0	**0**	0.1	0.2	**0.2**	0.3	0.3	**0.3**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0	0	**0**	0.1	0.1	**0.1**	0.2	0.1	**0.2**
2-phenoxyethanol	0	0	**0**	0	0	**0**	0.1	0.2	**0.2**
2-methoxyethanol	0	0	**0**	0	0	**0**	0.4	0.2	**0.3**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0.3	0	**0.2**
hexanal	0	0	**0**	0.2	0.1	**0.2**	0	0	**0**
octanal	0	0	**0**	0	0	**0**	0	0.1	**0.1**
nonanal	0.2	0.1	**0.2**	0.2	0.2	**0.2**	0.2	0.3	**0.3**
decanal	0.4	0	**0.2**	0	0	**0**	0	0	**0**
KETONES									
2-butanone (MEK)	0	0	**0**	0.2	0.2	**0.2**	0	0	**0**
acetone	0	0	**0**	0.1	0.1	**0.1**	0.3	0	**0.2**
ACIDS									
acetic acid	0	2	**1**	3	2	**2**	2	2	**2**
TERPENES AND THEIR DERIVATIVES									
limonene	0.2	0.2	**0.2**	0.2	0.3	**0.3**	0.2	0.3	**0.3**
α-pinene	0	0	**0**	0	0.1	**0.1**	0	0	**0**
ESTERS AND LACTONES									
n-butylacetate	0.1	0.1	**0.1**	0.2	0.2	**0.2**	0.1	0	**0.1**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0.1	**0.1**	0.5	0.6	**0.6**
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
triethoxypentylsilane	0	0	**0**	0	0	**0**	2	2	**2**
Total	4	6	**5**	9	8	**8**	32	34	**33**
TVOC	**8**	**7**	**7**	**6**	**5**	**5**	**27**	**26**	**27**
non-TVOC	0	2	**1**	3	2	**3**	2	2	**2**

Table C24. Emission values of plaster C at 27 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0	**0**	0.2	0.2	**0.2**	0.1	0.1	**0.1**
undecane	0	0	**0**	0.2	0.2	**0.2**	0.1	0.2	**0.2**
dodecane	0	0	**0**	0.1	0	**0.1**	0	0.1	**0.1**
hexadecane	0	0	**0**	0	0	**0**	0.1	0	**0.1**
AROMATIC HYDROCARBONS									
ethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
p,m-xylene	0.9	0.9	**0.9**	0.9	0.5	**0.7**	0.9	0.9	**0.9**
o-xylene	0.3	0.3	**0.3**	0.4	0.3	**0.4**	0.3	0.3	**0.3**
styrene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
toluene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,2,4-trimethylbenzene	0.3	0.4	**0.4**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
C$_3$-alkylbenzene	0.2	0.2	**0.2**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0	**0**	0.3	0.5	**0.4**
2-ethyl-1-hexanol	0	0	**0**	0.5	0.4	**0.5**	0.2	0.4	**0.3**
ETHERS									
bis(2-methoxyethyl)ether	0	0	**0**	0	0	**0**	0.4	0.5	**0.5**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0	0	**0**	0.1	0	**0.1**	0.1	0.1	**0.1**
2-butoxyethanol	0	0	**0**	0	0	**0**	0.2	0.3	**0.3**
ALDEHYDES									
benzaldehyde	0	0	**0**	0.2	0.2	**0.2**	0	0.1	**0.1**
n-butanal	0	0	**0**	0	0	**0**	0.4	0.5	**0.5**
hexanal	0	0	**0**	0	0.1	**0.1**	0	0	**0**
decanal	0	0	**0**	0.2	0	**0.1**	0	0	**0**
KETONES									
acetone	0	0	**0**	0.1	0	**0.1**	0.3	0.3	**0.3**
TERPENES AND THEIR DERIVATIVES									
limonene	0.2	0.2	**0.2**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
Total	3	3	**3**	5	4	**5**	6	7	**6**
TVOC	**5**	**5.5**	**5**	**1.8**	**0.9**	**1**	**0**	**0**	**0**
non-TVOC	0	0	**0**	0.1	0	**0.1**	0.6	0.8	**0.7**

Table C25. Background emission values of the gypsum board in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**6**	**19**	**20**

Table C26. Emission values of the gypsum board at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 80 %**			**RH 50 %**			**RH 20 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
dodecane	0.2	0.2	**0.2**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.9	0.5	**0.7**
toluene	0.5	0.4	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
1,2,4-trimethylbenzene	0.4	0.4	**0.4**	0.5	0	**0.3**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	0.9	0.9	**0.9**	3	3	**3**	5	5	**5**
1-pentanol	0	0	**0**	0	0	**0**	0.5	0.5	**0.5**
2-methyl-1-propanol	0.5	0.5	**0.5**	1	1	**1**	1	1	**1**
ALDEHYDES									
benzaldehyde	0	0.3	**0.2**	1	0.9	**1**	2	2	**2**
n-butanal	0.2	0	**0.1**	0	0	**0**	0	0.5	**0.3**
pentanal	0.4	0.5	**0.5**	0.9	0.9	**0.9**	1	1	**1**
hexanal	2	2	**2**	6	6	**6**	8	8	**8**
heptanal	0.2	0	**0.1**	1	1	**1**	1	1	**1**
2-heptenal	0	0	**0**	0	0	**0**	0.9	0.5	**0.7**
octanal	0.3	0.3	**0.3**	0.9	0.9	**0.9**	2	1	**2**
2-octenal	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
nonanal	0.5	0.5	**0.5**	2	2	**2**	3	3	**3**
decanal	0	0	**0**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
KETONES									
acetone	0.3	0.3	**0.3**	0.9	0.5	**0.7**	0.9	0.9	**0.9**
TERPENES AND THEIR DERIVATIVES									
limonene	0.3	0.3	**0.3**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0	0	**0**	0	0	**0**	0.5	0	**0.3**
n-butylacetate	0.3	0.3	**0.3**	2	2	**2**	1	1	**1**
HALOGEN CONTAINING COMPOUNDS									
1-chlorononane	1	1	**1**	3	3	**3**	2	2	**2**
1-chlorodecane	2	2	**2**	7	7	**7**	7	7	**7**
1-chloroundecane	0.5	0.5	**0.5**	2	3	**3**	3	4	**3**
Total	12	11	**11**	35	34	**35**	44	44	**44**
TVOC	**9**	**10**	**9**	**30**	**25**	**27**	**33**	**35**	**34**
non-TVOC	0.5	0.3	**0.4**	0.9	0.5	**0.7**	0.9	1	**1**

Table C27. Emission values of the gypsum board at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS	0.3	0.3	**0.3**						
undecane	0	0	**0**	0.4	0.4	**0.4**	0.3	0.3	**0.3**
dodecane				0	0.2	**0.1**	0	0.2	**0.1**
AROMATIC HYDROCARBONS	0.3	0.3	**0.3**						
p,m-xylene	0.2	0	**0.1**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
toluene	0.3	0	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
1,2,4-trimethylbenzene				0.2	0	**0.1**	0.2	0	**0.1**
MONATOMIC ALCOHOLS	0.3	0.3	**0.3**						
1-butanol	0	0	**0**	0	0	**0**	0	0	**0**
2-ethyl-1-hexanol				0.3	0.3	**0.3**	0.3	0.2	**0.3**
PHENOLS	0	0	**0**						
phenol				0	0	**0**	0.2	0.2	**0.2**
ALDEHYDES	0.2	0	**0.1**						
benzaldehyde	0.4	0.4	**0.4**	0.3	0.3	**0.3**	0.4	0.5	**0.5**
pentanal	2	2	**2**	0.3	0.4	**0.4**	0.2	0.3	**0.3**
hexanal	0	0	**0**	0.9	1.4	**1**	0.9	0.9	**1**
octanal	0	0	**0**	0.3	0	**0.2**	0	0	**0**
nonanal				0.9	0.9	**1**	0.5	0.9	**1**
KETONES	0	0	**0**						
acetone				0	0	**0**	0.9	0	**0.5**
ACIDS	0	0	**0**						
propanic acid	0	0	**0**	0	0	**0**	0	0.9	**0.5**
hexanic acid				0	0	**0**	0	0.2	**0.1**
HALOGEN CONTAINING COMPOUNDS	0.2	0.1	**0.2**						
1-chlorononane	0.9	0.9	**0.9**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
1-chlorodecane	0.4	0.4	**0.4**	0.3	0.4	**0.4**	0	0.1	**0.1**
1-chloroundecane				0.9	0.9	**0.9**	0.2	0.3	**0.3**
	5	5	**5**						
Total	**3**	**2**	**3**	5	6	**6**	5	6	**5**
TVOC	12	15	**14**	**0**	**0**	**0**	**0**	**0**	**0**
non-TVOC				0	0	**0**	0.9	0	**0.5**

Table C28. Emission values of the gypsum board at 28 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
undecane	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
AROMATIC HYDROCARBONS									
p,m-xylene	0	0	**0**	0	0	**0**	0	0.3	**0.2**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0.1	0.3	**0.2**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
ALDEHYDES									
benzaldehyde	0.2	0	**0.1**	0.1	0.1	**0.1**	0.3	0.3	**0.3**
pentanal	0.2	0.1	**0.2**	0.2	0.1	**0.2**	0	0	**0**
hexanal	0.9	0.9	**0.9**	0.5	0.5	**0.5**	0.3	0.3	**0.3**
octanal	0	0	**0**	0.1	0	**0.1**	0.1	0.1	**0.1**
nonanal	0.2	0.1	**0.2**	0.4	0.4	**0.4**	0.5	0.5	**0.5**
decanal	0.4	0	**0.2**	0	0.4	**0.2**	0.5	0.4	**0.5**
KETONES									
acetone	0	0	**0**	0.1	0	**0.1**	0.2	0.4	**0.3**
HALOGEN CONTAINING COMPOUNDS									
1-chlorononane	0.1	0	**0.1**	0	0	**0.0**	0	0	**0**
1-chlorodecane	0.3	0.3	**0.3**	0.1	0.1	**0.1**	0	0	**0**
1-chloroundecane	0.2	0.2	**0.2**	0.1	0.2	**0.2**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0.1	0	**0.1**	0	0.1	**0.1**	0.3	0.3	**0.3**
hexamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	0	0.9	**0**
octamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	0	0.2	**0.1**
Trimethyl silanol	0	0	**0**	0	0	**0**	0	0.1	**0.1**
Total	3	2	**2**	2	2	**2**	3	4	**4**
TVOC	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
non-TVOC	0	0	**0**	0.1	0	**0.1**	0.2	0.4	**0.3**

Table C29. Background emission values of adhesive B in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
decane	1	0.5	0.7
undecane	2	0.4	1
dodecane	0.5	1	0.4
AROMATIC HYDROCARBONS			
benzene	0	0.2	0.2
ethylbenzene	0.2	0.2	0.2
p,m-xylene	0.6	0.7	0.7
o-xylene	0.2	0.2	0.2
toluene	1	1	1
1,2,4-trimethylbenzene	0.3	0.3	0.3
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0	3	0.8
PHENOLS			
phenol	0	0.2	0.8
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	0	0.4
2-butoxyethanol	0	0.3	0.5
ALDEHYDES			
benzaldehyde	0.5	0.3	0.3
pentanal	0	0	1
nonanal	0	1	1
ACIDS			
acetic acid	0	3	4
hexanic acid	0	0.3	0
ESTERS AND LACTONES			
texanol	0	0	2
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	0	0	0.4
Total	6.3	12.6	15.9
TVOC	**8**	**8**	**13**
non-TVOC	0	3	4

Table C30. Emission values of adhesive B at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	2850	2859	**2855**	2009	1964	**1986**	1368	1332	**1350**
2-butoxyethanol	28	28	**28**	22	22	**22**	17	18	**17**
ALDEHYDES									
nonanal	0	0	**0**	0	0	**0**	7	0	**4**
ACIDS									
acetic acid	33	43	**38**	20	0	**10**	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	26	26	**26**	20	19	**19**	15	15	**15**
Total	2937	2956	**2947**	2070	2005	**2038**	1407	1364	**1385**
TVOC	**2560**	**2578**	**2569**	**1656**	**1619**	**1637**	**1071**	**1026**	**1049**
non-TVOC	33	43	**38**	20	0	**10**	0	0	**0**

Table C31. Emission values of adhesive B at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
undecane	0	0	**0**	0	0	**0**	1	1	**1**
AROMATIC HYDROCARBONS									
p,m-xylene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	0	0	**0**	0	0	**0**	0	1	**0**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0	**0**	0	1	**1**
2-ethyl-1-hexanol	1	1	**1**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	7	3	**5**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	0	0	**0**	1	1	**1**
2-(2-butoxyethoxy)ethanol	777	796	**786**	2141	2132	**2136**	5818	5954	**5886**
2-butoxyethanol	1	1	**1**	1	1	**1**	2	2	**2**
ALDEHYDES									
benzaldehyde	1	1	**1**	1	0	**1**	1	0	**1**
n-butanal	0	1	**0**	1	0	**0**	2	2	**2**
nonanal	0	0	**0**	0	1	**0**	1	1	**1**
decanal	2	2	**2**	2	2	**2**	0	0	**0**
KETONES									
acetophenone	1	1	**1**	1	0	**0**	1	1	**1**
ACIDS									
acetic acid	28	28	**28**	36	40	**38**	36	27	**32**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	2	2	**2**	4	5	**4**	16	16	**16**
texanol	0	0	**0**	2	2	**2**	3	3	**3**
Total	812	832	**822**	2189	2182	**2186**	5889	6013	**5951**
TVOC	**483**	**483**	**483**	**1160**	**1165**	**1162**	**3958**	**4121**	**4040**
non-TVOC	28	28	**28**	37	40	**38**	38	29	**34**

Table C32. Emission values of adhesive B at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
p,m-xylene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	0	0	**0**	0	0	**0**	0	1	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	0	**0**	1	1	**1**	0	0	**0**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	6	6	**6**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	0	0	**0**	1	1	**1**
2-(2-butoxyethoxy)ethanol	382	386	**384**	946	932	**939**	2473	2436	**2454**
2-butoxyethanol	1	1	**1**	1	1	**1**	2	2	**2**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0	0	**0**
n-butanal	0	0	**0**	0	0	**0**	0	1	**0**
nonanal	0	0	**0**	0	0	**0**	1	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	1	1	**1**	2	2	**2**	4	4	**4**
texanol	1	1	**1**	1	1	**1**	1	1	**1**
Total	385	389	**387**	950	937	**943**	2487	2451	**2469**
TVOC	**237**	**242**	**240**	**546**	**542**	**544**	**1658**	**1631**	**1644**
non-TVOC	0	0	**0**	0	0	**0**	0	0	**0**

Table C33. Background emission values of primer and paint A in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
AROMATIC HYDROCARBONS			
p,m-xylene	2	0	0
toluene	2	0	0
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	2	0	0
DIVALENT ALCOHOLS			
1,2-propanediol	10	0	0
ALCOHOL AND PHENOL ETHERS			
bis(2-hydroxypropyl)ether	0	10	10
ALDEHYDES			
nonanal	1	0	0
Total	17	10	10
TVOC	**23**	**46**	**43**
non-TVOC	0	0	0

Table C34. Emission values of primer and paint A at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	77	77	**77**	109	109	**109**	186	186	**186**
DIVALENT ALCOHOLS									
1,2-propanediol	3586	3723	**3655**	5455	5546	**5500**	2727	2818	**2773**
ETHERS									
butyl ether	28	29	**28**	27	27	**27**	23	23	**23**
ALCIHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	64	68	**66**	109	118	**114**	55	64	**59**
2-(2-butoxy-isopropoxy)-2-propanol, isomers	114	109	**111**	159	173	**166**	191	200	**195**
ALDEHYDES									
benzaldehyde	8	8	**8**	9	10	**10**	10	10	**10**
ESTERS AND LACTONES									
texanol	1682	1682	**1682**	1773	1818	**1795**	2000	2046	**2023**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	9	11	**10**	8	10	**9**	0	0	**0**
4,4-dimethyl-1,3-oxazolidine	0	0	**0**	0	0	**0**	23	30	**26**
Total	5567	5707	**5637**	7649	7810	**7730**	5214	5376	**5295**
TVOC	**6308**	**6626**	**6467**	**10252**	**10616**	**10434**	**6571**	**6890**	**6730**
non-TVOC	0	0	**0**	0	0	**0**	0	0	**0**

Table C35. Emission values of primer and paint A at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	7	7	**7**	6	7	**7**	7	8	**8**
DIVALENT ALCOHOLS									
1,2-propanediol	723	768	**745**	864	864	**864**	1409	1455	**1432**
2,2,4-trimethyl-1,3-pentanediol	0	1	**0**	3	5	**4**	0	0	**0**
ALCIHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	6	8	**7**	9	10	**9**	20	22	**21**
2-(2-butoxy-isopropoxy)-2-propanol, isomers	21	24	**23**	29	33	**31**	33	38	**36**
ESTERS AND LACTONES									
texanol	1091	1091	**1091**	1136	1182	**1159**	1318	1364	**1341**
TXIB	2	2	**2**	3	3	**3**	5	6	**5**
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	4	4	**4**	6	8	**7**	16	17	**17**
SULPHUR CONTAINING COMPOUNDS									
2-methyl-3(2H)-isotiatsolon	2	1	**2**	2	1	**2**	2	2	**2**
Total	1855	1906	**1881**	2057	2112	**2085**	2811	2910	**2860**
TVOC	**1626**	**1717**	**1671**	**1888**	**2025**	**1956**	**2981**	**3117**	**3049**
non-TVOC	0	0	**0**	0	0	**0**	0	0	**0**

Table C36. Emission values of primer and paint A at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	5	5	**5**	5	-	**5**	4	4	**4**
AROMATIC HYDROCARBONS									
p,m-xylene	0	0	**0**	1	-	**1**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	1	1	**1**	1	-	**1**	1	1	**1**
2-ethyl-1-hexanol	0	0	**0**	1	-	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	300	291	**295**	232	-	**232**	627	632	**630**
2,2,4-trimethyl-1,3-pentanediol	1	2	**2**	4	-	**4**	6	0	**3**
PHENOLS									
phenol	1	1	**1**	1	-	**1**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	2	2	**2**	2	-	**2**	7	7	**7**
2-(2-butoxyethoxy)ethanol	1	1	**1**	1	-	**1**	1	1	**1**
2-(2-butoxy-isopropoxy)-2-propanol, isomers	13	13	**13**	16	-	**16**	11	12	**12**
bis(2-hydroxypropyl)ether	2	2	**2**	0	-	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	-	**0**	0	1	**0**
KETONES									
acetone	2	2	**2**	4	-	**4**	6	5	**5**
ESTERS AND LACTONES									
texanol	941	914	**927**	1018	-	**1018**	1018	1041	**1030**
TXIB	3	3	**3**	4	-	**4**	5	5	**5**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	1	1	**1**	1	-	**1**	1	1	**1**
4,4-dimethyl-1,3-oxazolidine	4	2	**3**	7	-	**7**	12	11	**11**
dimethylperhydro-1,3-oxazine	0	0	**0**	0	-	**0**	1	2	**2**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	0	0	**0**	0	-	**0**	1	2	**2**
SULPHUR CONTAINING COMPOUNDS									
2-methyl-3(2H)-isotiatsolon	3	3	**3**	3	-	**3**	3	3	**3**
Total	1279	1240	**1260**	1299	-	**1299**	1707	1729	**1718**
TVOC	**1058**	**1012**	**1035**	**1184**	**-**	**1184**	**1571**	**1621**	**1596**
non-TVOC	2	2	**2**	4	-	**4**	6	5	**5**

Table C37. Background emission values of primer and paint B in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
nonane	0.3	0.3	0
decane	1	0.8	1
undecane	2	2	2
dodecane	0.6	0.4	0.6
A MIXTURE OF HYDROCARBONS			
hydrocarbon-mixture	15.1	11.5	16.4
AROMATIC HYDROCARBONS			
benzene	0	0.1	0
p,m-xylene	0.3	0.3	0.4
toluene	0.3	0.4	0.4
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0.8	0.7	0.9
PHENOLS			
phenol	0	0.7	0.8
ALCOHOL AND PHENOL ETHERS			
2-(2-ethoxyethoxy)ethanol	0	0	0.5
2-(2-butoxyethoxy)ethanol	0	0.6	2
1-methoxy-2-propanol	0.3	0	0
2-butoxyethanol	0.4	0.3	0.3
ALDEHYDES			
benzaldehyde	0.9	0.8	0.5
pentanal	0.3	0	0
octanal	0	0	0.6
nonanal	1	1	2
KETONES			
acetophenone	0	0.3	0.3
ACIDS			
hexanoic acid			
ESTERS AND LACTONES			
texanol	0	4	7
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	0	0.5	0
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	*2*1)	4	7
Total	25	29	43
TVOC	**27**	**27**	**48**
non-TVOC	0	0	0

1) *Italic* font indicates that the value is below the detection limit.

Table C38. Emission values of primer and paint B at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0	0	**0**	2	1	**2**
decane	0	0	**0**	0	0	**0**	0.5	0.5	**0.5**
dodecane	0.6	0	**0.3**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0	**0**	0.3	0	**0.2**
isopropylbenzene	0	0	**0**	0	0	**0**	1	1	**1**
p,m-xylene	0	0	**0**	0	0	**0**	0.7	1	**1**
toluene	4	6	**5**	6	7	**6**	5	7	**6**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	2	1	**1**	2	1	**1**	3	1	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	150	155	**152**	609	623	**616**	105	118	**111**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	16	13	**14**	77	68	**73**	22	18	**20**
2-(2-butoxyethoxy)ethanol	17	19	**18**	145	145	**145**	126	140	**133**
2-butoxyethanol	0	0	**0**	0	0	**0**	6	4	**5**
ALDEHYDES									
benzaldehyde	4	3	**3**	2	1	**1**	7	8	**7**
n-butanal	0	0	**0**	0	0	**0**	5	3	**4**
KETONES									
acetophenone	0	2	**1**	0.8	0	**0.4**	0	0	**0**
ESTERS AND LACTONES									
texanol	0	0	**0**	2	2	**2**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	26	*20*[1]	**23**
Total	193	198	**195**	843	847	**845**	310	322	**316**
TVOC	***124***[1]	***124***[1]	**124**	**261**	**306**	**283**	**178**	**160**	**169**
non-TVOC	0	0	**0**	0	0	**0**	5	3	**4**

[1] *Italic* font indicates that the value is below the detection limit.

Table C39. Emission values of primer and paint B at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	1	1	**1**	1	1	**1**	2	1	**1**
decane	5	6	**5**	7	7	**7**	6	6	**6**
undecane	6	6	**6**	6	6	**6**	6	6	**6**
dodecane	1	1	**1**	1	1	**1**	1	1	**1**
AROMATIC HYDROCARBONS									
p,m-xylene	0	0	**0**	1	1	**1**	0	0	**0**
toluene	4	5	**5**	5	6	**6**	5	5	**5**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	1	**1**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	59	55	**57**	109	91	**100**	109	164	**136**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	8	8	**8**	16	13	**15**	17	19	**18**
2-(2-butoxyethoxy)ethanol	28	26	**27**	68	68	**68**	90	95	**92**
2-butoxyethanol	0	0	**0**	0	0	**0**	1	1	**1**
ACIDS									
acetic acid	0	0	**0**	209	123	**166**	0	118	**59**
ESTERS AND LACTONES									
texanol	0	0	**0**	1	1	**1**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	1	1	**1**
Total	113	108	**111**	426	317	**371**	239	419	**329**
TVOC	**111**	**79**	**95**	**129**	**97**	**113**	**115**	**133**	**124**
non-TVOC	0	0	**0**	209	123	**166**	0	118	**59**

Table C40. Emission values of primer and paint B at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	1	2	**1**	0	0	**0**	0	0	**0**
decane	1	1	**1**	0	0	**0**	0	0	**0**
dodecane	0	0.1	**0.1**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	2	**1**	0	0	**0**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	27	24	**25**	27	28	**28**	32	40	**36**
PHENOLS									
phenol	2	2	**2**	3	2	**3**	2	2	**2**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	25	4	**15**	4	4	**4**	3	3	**3**
2-(2-butoxyethoxy)ethanol	5	20	**12**	38	34	**36**	36	37	**36**
ALDEHYDES									
benzaldehyde	1	3	**2**	1	0	**0**	2	1	**1**
nonanal	2	1	**2**	1	2	**2**	1	1	**1**
ACIDS									
acetic acid	39	20	**30**	40	73	**56**	41	55	**48**
hexanic acid	2	0	**1**	2	3	**3**	0	0	**0**
ESTERS AND LACTONES									
texanol	2	2	**2**	1	1	**1**	0	0	**0**
Total	108	80	**94**	118	146	**132**	118	140	**129**
TVOC	**21**	**12**	**17**	**32**	**20**	**26**	**13**	**17**	**15**
non-TVOC	39	20	**30**	40	73	**56**	41	55	**48**

Table C41. Background emission values of primer A and paint C in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	***12***1)	***12***1)	***12***1)

1) *Italic* font indicates that the value is below the detection limit.

Table C42. Emission values of primer A and paint C at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPHATIC AND ALICYCLIC COMPOUNDS									
pentane	268	264	**266**	282	286	**284**	246	236	**241**
hexane	43	42	**42**	45	43	**44**	39	37	**38**
heptane	68	68	**68**	73	77	**75**	64	59	**61**
octane	68	68	**68**	73	77	**75**	64	59	**61**
nonane	29	29	**29**	30	31	**30**	17	18	**17**
decane	459	455	**457**	477	477	**477**	441	414	**427**
undecane	2077	2005	**2041**	1936	1868	**1902**	1982	1886	**1934**
dodecane	800	796	**798**	764	759	**761**	796	768	**782**
tridecane	105	105	**105**	105	105	**105**	118	109	**114**
tetradecane	11	10	**10**	10	11	**10**	15	13	**14**
pentadecane	3	3	**3**	3	3	**3**	5	5	**5**
hexadecane	0	0	**0**	0	0	**0**	0	2	**1**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	8196	8005	**8100**	8673	7768	**8673**	9027	8005	**8516**
AROMATIC HYDROCARBONS									
benzene	2	2	**2**	0	0	**0**	0	2	**1**
p,m-xylene	7	7	**7**	7	8	**7**	4	3	**3**
1,2,3-trimethylbenzene	12	12	**12**	12	12	**12**	12	12	**12**
1,2,4-trimethylbenzene	28	28	**28**	29	28	**29**	26	25	**25**
1,3,5-trimethylbenzene	6	6	**6**	6	6	**6**	5	5	**5**
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	0	2	**1**	0	0	**0**
1-butanol	16	15	**15**	19	18	**19**	21	21	**21**
DIVALENT ALCOHOLS									
1,2-propanediol	7227	7455	**7341**	7591	7636	**7614**	7500	6909	**7205**
PHENOLS									
phenol	4	4	**4**	5	4	**4**	6	5	**5**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0	0	**0**	0	0	**0**	0	3	**2**
ALDEHYDES									
benzaldehyde	7	11	**9**	8	8	**8**	11	14	**12**
n-butanal	40	43	**42**	50	50	**50**	64	68	**66**
pentanal	364	373	**368**	414	446	**430**	555	568	**561**
hexanal	1727	1741	**1734**	1909	2059	**1984**	2482	2532	**2507**
heptanal	64	68	**66**	77	82	**80**	105	105	**105**
2-heptenal	91	91	**91**	105	109	**107**	123	118	**120**
octanal	38	41	**39**	50	50	**50**	64	64	**64**
2-octenal	177	200	**189**	214	218	**216**	236	227	**232**
KETONES									
2-butanone (MEK)	86	82	**84**	96	96	**96**	100	96	**98**
acetone	141	118	**130**	168	155	**161**	205	214	**209**
ACIDS									
acetic acid	200	227	**214**	418	246	**332**	232	214	**223**
propanoic acid	24	46	**35**	82	41	**61**	43	26	**35**
butanoic acid	30	31	**31**	41	37	**39**	36	27	**32**
pentanoic acid	123	127	**125**	182	155	**168**	182	127	**155**
hexanoic acid	759	796	**777**	1118	941	**1030**	1105	718	**911**
ESTERS AND LACTONES									
texanol	2496	2523	**2509**	2600	2600	**2600**	2618	2486	**2552**
TXIB	7	7	**7**	7	8	**8**	7	6	**7**
NITROGEN CONTAINING COMPOUNDS									
2-butanone oxime	59	68	**64**	59	68	**64**	44	50	**47**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	2	0	**1**	3	2	**2**
Total	25859	25966	**25913**	27736	26586	**27161**	28595	26256	**27425**
TVOC	**19682**	**19000**	**19341**	**20222**	**20404**	**20313**	**21449**	**20222**	**20835**
non-TVOC	536	507	**521**	596	589	**592**	614	614	**614**

Table C43. Emission values of primer A and paint C at 7 days in the environmental chamber test.

(μg/m$^2\cdot$h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
hexane	3	3	**3**	2	3	**3**	0	1	**1**
heptane	8	8	**8**	7	8	**8**	4	4	**4**
octane	7	7	**7**	8	8	**8**	4	4	**4**
nonane	3	3	**3**	2	3	**3**	2	2	**2**
decane	19	19	**19**	19	20	**19**	16	16	**16**
undecane	42	42	**42**	41	39	**40**	34	33	**33**
dodecane	18	17	**17**	15	16	**15**	14	13	**13**
tridecane	3	3	**3**	0	3	**1**	3	3	**3**
pentadecane	0	1	**0**	0	0	**0**	0	1	**0**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	386	374	**380**	458	410	**434**	448	399	**423**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0	**0**	0	1	**0**
p,m-xylene	1	0	**1**	0	0	**0**	0	0	**0**
1,2,3-trimethylbenzene	1	0	**1**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	10	3	**6**	3	3	**3**	3	3	**3**
DIVALENT ALCOHOLS									
1,2-propanediol	1200	1205	**1202**	1200	1209	**1205**	1773	1882	**1827**
ETHERS									
2-pentylfuran	0	0	**0**	0	0	**0**	6	5	**5**
PHENOLS									
phenol	1	2	**2**	0	1	**1**	2	2	**2**
ALDEHYDES									
benzaldehyde	2	2	**2**	1	2	**1**	4	3	**3**
n-butanal	9	8	**8**	9	11	**10**	11	9	**10**
pentanal	55	50	**52**	59	59	**59**	68	64	**66**
hexanal	186	177	**182**	191	196	**193**	255	241	**248**
heptanal	13	13	**13**	18	17	**18**	24	23	**23**
octanal	16	16	**16**	22	22	**22**	31	29	**30**
nonanal	17	17	**17**	21	21	**21**	35	35	**35**
decanal	1	1	**1**	0	0	**0**	2	3	**2**
2-decenal	12	11	**12**	19	18	**18**	26	24	**25**
KETONES									
2-butanone (MEK)	3	3	**3**	3	3	**3**	3	3	**3**
acetone	23	21	**22**	23	25	**24**	32	30	**31**
ACIDS									
acetic acid	118	96	**107**	35	50	**43**	50	96	**73**
propanoic acid	8	8	**8**	9	9	**9**	0	14	**7**
butanoic acid	15	15	**15**	16	16	**16**	16	18	**17**
pentanoic acid	41	41	**41**	64	64	**64**	55	68	**61**
hexanoic acid	282	277	**280**	405	414	**409**	336	400	**368**
2-ethylhexanoic-acid	82	77	**80**	109	109	**109**	164	177	**170**
TERPENES AND THEIR DERIVATIVES									
limonene	0	1	**1**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
texanol	482	482	**482**	641	646	**643**	982	1005	**993**
TXIB	2	2	**2**	2	2	**2**	4	4	**4**
2-ethylhexyl acrylate	0	1	**0**	0	0	**0**	0	0	**0**
Total	3068	3004	**3036**	3401	3404	**3402**	4401	4611	**4506**
TVOC	**1755**	**1714**	**1734**	**2067**	**2090**	**2079**	**2549**	**2826**	**2688**
non-TVOC	34	31	**33**	35	39	**37**	47	41	**44**

Table C44. Emission values of primer A and paint C at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-decene	0	0	**0**	0	0.5	**0**	0	0	**0**
hexane	0	0	**0**	0	0.5	**0**	0	0	**0**
heptane	3	3	**3**	3	3	**3**	0	0	**0**
octane	3	3	**3**	2	2	**2**	0	0	**0**
nonane	0	0	**0**	0	0.9	**0**	0	0	**0**
decane	5	5	**5**	4	4	**4**	3	3	**3**
undecane	13	13	**13**	11	11	**11**	10	10	**10**
dodecane	6	6	**6**	5	5	**5**	3	3	**3**
tridecane	0.9	0.9	**1**	0.9	0.9	**1**	0.9	0.9	**1**
pentadecane	0	0	**0**	0	0	**0**	0	0.9	**0**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	112	149	**131**	143	111	**127**	142	133	**138**
MONATOMIC ALCOHOLS									
1-butanol	0	2	**1**	2	2	**2**	0	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	482	464	**473**	464	441	**452**	559	559	**559**
PHENOLS									
phenol	0	0.9	**0**	0.9	0.9	**1**	0.9	0.9	**1**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0.9	**0**	0.5	0.9	**1**
n-butanal	4	4	**4**	4	5	**5**	3	4	**4**
pentanal	22	21	**21**	25	24	**24**	21	23	**22**
hexanal	73	68	**70**	77	77	**77**	82	82	**82**
heptanal	7	7	**7**	10	9	**9**	11	11	**11**
octanal	8	9	**9**	13	13	**13**	16	16	**16**
nonanal	10	10	**10**	13	14	**13**	18	17	**17**
decanal	0	0.9	**0**	0	0.5	**0**	4	1	**3**
2-decenal	5	6	**5**	7	6	**7**	10	8	**9**
KETONES									
2-butanone (MEK)	2	2	**2**	2	2	**2**	0.9	1	**1**
acetone	9	11	**10**	10	9	**10**	12	11	**11**
ACIDS									
acetic acid	40	19	**30**	29	44	**36**	15	36	**25**
propanoic acid	4	0	**2**	0	0	**0**	6	0	**3**
butanoic acid	8	8	**8**	9	9	**9**	6	8	**7**
pentanoic acid	25	25	**25**	34	35	**34**	31	31	**31**
hexanoic acid	186	173	**180**	255	246	**250**	223	227	**225**
2-ethylhexanoic-acid	43	40	**42**	73	64	**68**	100	96	**98**
ESTERS AND LACTONES									
texanol	218	209	**214**	327	318	**323**	541	527	**534**
TXIB	0.9	0.9	**1**	1	1	**1**	2	2	**2**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	0	4	**2**	0	0	**0**
Total	1288	1257	**1272**	1523	1462	**1492**	1818	1812	**1815**
TVOC	**723**	**91**	**407**	**958**	**908**	**933**	**1231**	**1131**	**1181**
non-TVOC	55	36	**45**	45	60	**52**	31	52	**41**

Table C45. Background emission values of primer and paint C in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
decane	1	1	0.7
undecane	3	3	2
dodecane	0.7	0.7	0.6
A MIXTURE OF HYDROCARBONS			
hydrocarbon-mixture	20	19	19
AROMATIC HYDROCARBONS			
p,m-xylene	0.4	0.5	0
toluene	0.4	0.5	0.5
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0.7	1	1
ALDEHYDES			
benzaldehyde	0.7	0	0.7
nonanal	0	0.9	0.9
ESTERS AND LACTONES			
texanol	0	3	4
PHENOLS			
phenol	0	0.4	0.6
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	1	2
2-butoxyethanol	0.4	0	0
ACIDS			
hexanic acid	0	0	1
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	0	4	4
Total	27	35	37
TVOC	**32**	**40**	**38**
non-TVOC	0	4	4

Table C46. Emission values of primer and paint C at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
pentane	273	264	**268**	291	282	**286**	273	277	**275**
hexane	42	42	**42**	45	46	**45**	46	44	**45**
heptane	77	77	**77**	86	86	**86**	91	91	**91**
octane	73	73	**73**	82	82	**82**	91	86	**89**
decane	813	777	**795**	850	818	**834**	863	836	**850**
undecane	2008	1926	**1967**	2121	2062	**2092**	2386	2317	**2351**
dodecane	477	463	**470**	518	504	**511**	627	609	**618**
tridecane	68	68	**68**	73	73	**73**	91	91	**91**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	7714	7255	**7484**	8382	8351	**8382**	10114	10455	**10285**
MONATOMIC ALCOHOLS									
1-pentanol	96	91	**93**	114	114	**114**	168	159	**164**
ALDEHYDES									
n-butanal	41	41	**41**	45	45	**45**	59	59	**59**
pentanal	286	286	**286**	305	314	**309**	427	418	**423**
hexanal	1305	1296	**1300**	1568	1632	**1600**	2414	2400	**2407**
heptanal	55	55	**55**	59	64	**61**	86	86	**86**
2-octenal	164	173	**168**	209	177	**193**	427	250	**339**
KETONES									
2-butanone (MEK)	42	43	**43**	46	46	**46**	59	59	**59**
ACIDS									
acetic acid	291	223	**257**	305	200	**252**	332	382	**357**
propanoic acid	259	282	**270**	396	364	**380**	546	491	**518**
butanoic acid	37	36	**36**	43	38	**41**	40	44	**42**
pentanoic acid	168	159	**164**	196	173	**184**	168	155	**161**
hexanoic acid	1009	964	**986**	1105	1000	**1052**	818	750	**784**
2-ethylhexanoic-acid	996	1000	**998**	1055	986	**1020**	827	796	**811**
Total	16293	15591	**15942**	17891	17454	**17672**	20952	20854	**20903**
TVOC	**13986**	**13486**	**13736**	**15573**	**15255**	**15414**	**18665**	**18210**	**18437**
non-TVOC	647	571	**609**	684	571	**627**	721	776	**748**

Table C47. Emission values of primer and paint C at 7 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
pentane	39	41	**40**	37	38	**38**	21	21	**21**
hexane	7	7	**7**	7	7	**7**	0	0	**0**
heptane	21	22	**21**	23	23	**23**	0	0	**0**
octane	18	19	**18**	21	21	**21**	0	14	**7**
decane	23	24	**23**	26	26	**26**	19	19	**19**
undecane	67	62	**65**	76	76	**76**	58	58	**58**
dodecane	18	18	**18**	22	22	**22**	21	22	**21**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	386	403	**394**	538	466	**502**	733	782	**758**
MONATOMIC ALCOHOLS									
1-pentanol	11	12	**12**	15	16	**15**	20	21	**20**
ALDEHYDES									
n-butanal	0	0	**0**	7	7	**7**	0	0	**0**
pentanal	34	32	**33**	43	43	**43**	68	73	**70**
hexanal	105	105	**105**	168	159	**164**	273	296	**284**
heptanal	9	10	**9**	14	13	**13**	21	22	**22**
octanal	14	14	**14**	19	20	**19**	29	31	**30**
2-octenal	8	10	**9**	14	15	**14**	23	24	**23**
nonanal	17	14	**15**	21	25	**23**	38	35	**37**
2-decenal	11	10	**10**	18	17	**18**	32	32	**32**
undecenal	11	9	**10**	17	16	**16**	22	26	**24**
KETONES									
2-butanone (MEK)	0	0	**0**	9	9	**9**	0	0	**0**
ACIDS									
acetic acid	43	55	**49**	36	43	**39**	33	35	**34**
propanoic acid	64	64	**64**	77	82	**80**	82	91	**86**
butanoic acid	17	19	**18**	21	22	**22**	23	25	**24**
pentanoic acid	59	68	**64**	86	91	**89**	100	100	**100**
hexanoic acid	405	432	**418**	550	564	**557**	591	595	**593**
2-ethylhexanoic-acid	146	146	**146**	205	209	**207**	259	264	**261**
Total	1531	1592	**1561**	2071	2028	**2049**	2464	2584	**2524**
TVOC	**963**	**1013**	**988**	**1359**	**1355**	**1357**	**1892**	**1742**	**1817**
non-TVOC	82	96	**89**	87	96	**91**	52	54	**53**

Table C48. Emission values of primer and paint C at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
pentane	19	19	**19**	13	14	**13**	0	0	**0**
hexane	5	0	**2**	0	0	**0**	0	0	**0**
heptane	14	14	**14**	13	12	**13**	0	0	**0**
octane	12	11	**12**	12	12	**12**	0	0	**0**
decane	9	9	**9**	10	10	**10**	6	6	**6**
undecane	25	25	**25**	29	29	**29**	14	17	**15**
dodecane	7	7	**7**	10	9	**9**	6	6	**6**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	185	166	**175**	255	246	**251**	341	321	**331**
MONATOMIC ALCOHOLS									
1-pentanol	8	7	**8**	11	11	**11**	14	11	**13**
PHENOLS									
phenol	0	0	**0**	0.9	0.9	**0.9**	0.9	0	**0.5**
ALDEHYDES									
n-butanal	0	0	**0**	8	6	**7**	8	9	**8**
pentanal	17	18	**18**	26	26	**26**	41	41	**41**
hexanal	50	50	**50**	86	86	**86**	150	155	**152**
heptanal	6	6	**6**	9	9	**9**	14	14	**14**
octanal	9	8	**8**	12	6	**9**	20	20	**20**
2-octenal	0	0	**0**	6	7	**7**	9	9	**9**
nonanal	7	9	**8**	14	15	**14**	23	21	**22**
decanal	0	0	**0**	0	0	**0**	5	0	**2**
2-decenal	5	5	**5**	10	9	**9**	17	14	**16**
undecenal	5	5	**5**	9	10	**9**	14	16	**15**
KETONES									
2-butanone (MEK)	5	5	**5**	0	0	**0**	0	0	**0**
ACIDS									
acetic acid	64	55	**59**	20	20	**20**	12	32	**22**
propanoic acid	59	64	**61**	68	64	**66**	41	50	**46**
butanoic acid	16	16	**16**	19	18	**18**	13	15	**14**
pentanoic acid	50	50	**50**	73	68	**70**	59	68	**64**
hexanoic acid	309	305	**307**	441	427	**434**	400	422	**411**
2-ethylhexanoic-acid	68	64	**66**	118	114	**116**	155	150	**152**
heptanoic acid	19	20	**20**	22	21	**22**	10	11	**10**
octanoic acid	19	22	**20**	29	26	**28**	12	12	**12**
Total	989	956	**973**	1322	1274	**1298**	1383	1418	**1401**
TVOC	**545**	**536**	**540**	**832**	**841**	**836**	**915**	**842**	**878**
non-TVOC	87	227	**157**	39	43	**41**	18	39	**28**

Table C49. Background emission values of filler and plaster A in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
nonane	0	0.4	0.6
decane	2	5	4
undecane	3	0.3	7
dodecane	0.8	2	2
tridecane	0	0.3	0
hexadecane	0	0	0.2
A MIXTURE OF HYDROCARBONS			
hydrocarbon-mixture	18	56	41
AROMATIC HYDROCARBONS			
benzene			
ethylbenzene	0	0.2	0.2
p,m-xylene	0.6	0.7	0.7
o-xylene	0.2	0.2	0.2
styrene	0	0	0.2
toluene	0.8	0.8	0.8
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0	1	1
PHENOLS			
phenol	0	0	0.6
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0.4	1	0
2-butoxyethanol	0	0.3	0
ALDEHYDES			
benzaldehyde	0.6	0.5	0.8
pentanal	0.2	0	0.9
nonanal	0.7	1	2
decanal	1	1	2
KETONES			
acetophenone	0	0	0.4
ESTERS AND LACTONES			
texanol	0	0	1
NITROGEN CONTAINING COMPOUNDS			
1-methyl-2-pyrrolidinone	0	0.7	0.6
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	2	0	1
Total	30	71	67
TVOC	**19**	**65**	**54**
non-TVOC	0	0	0

Table C50. Emission values of filler and plaster A at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0	**0**	0	0	**0**	0	0	**0**
undecane	0	0	**0**	4	3	**3**	0	0	**0**
dodecane	0	0	**0**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
toluene	0	0	**0**	1	0.5	**1**	1	0	**1**
MONATOMIC ALCOHOLS									
ethanol	0	0	**0**	6	0	**3**	0	7	**3**
2-propanol	4	4	**4**	3	4	**3**	5	5	**5**
2-ethyl-1-hexanol	3	6	**4**	2	2	**2**	3	3	**3**
2-methyl-2-propanol	16	16	**16**	12	15	**14**	23	25	**24**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	4	2	**3**	27	3	**15**	82	14	**48**
1-methoxy-2-propanol	17	18	**18**	11	17	**14**	17	16	**17**
ALDEHYDES									
benzaldehyde	3	3	**3**	3	3	**3**	3	4	**4**
pentanal	0	0	**0**	0	0	**0**	2	0	**1**
hexanal	9	8	**8**	9	10	**9**	11	8	**10**
heptanal	5	5	**5**	5	6	**5**	6	0	**3**
octanal	6	5	**5**	5	6	**6**	6	6	**6**
nonanal	8	7	**8**	6	10	**8**	10	7	**8**
decanal	5	3	**4**	2	8	**5**	7	4	**6**
KETONES									
acetophenone	2	2	**2**	2	1	**2**	2	3	**2**
acetone	7	6	**7**	9	6	**8**	7	6	**7**
cyclohexanone	0	0	**0**	4	0	**2**	6	0	**3**
ACIDS									
acetic acid	0	0	**0**	0	0	**0**	25	0	**12**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0	0	**0**	0.9	0	**0**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	11	**5**	0	10	**5**	0	13	**6**
Total	90	95	**93**	112	104	**108**	216	120	**168**
TVOC	**51**	**41**	**46**	**39**	**39**	**39**	**76**	**62**	**69**
non-TVOC	27	26	**26**	30	25	**28**	60	42	**51**

Table C51. Emission values of filler and plaster A at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0	**0**	0	0	**0**	0	0	**0**
undecane	0	0	**0**	3	3	**3**	0	0	**0**
dodecane	1	1	**1**	0	0	**0**	0	0	**0**
tridecane	0	1	**0**	0	0	**0**	0	0	**0**
tetradecane	1	1	**1**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
toluene	1	1	**1**	1	1	**1**	1	1	**1**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	1	**1**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	155	164	**159**	13	13	**13**	0	0	**0**
ETHERS									
bis(2-ethoxyethyl)ether	6	6	**6**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	13	16	**14**	0	0	**0**	0	0	**0**
1-methoxy-2-propanol	9	10	**9**	8	8	**8**	7	7	**7**
2-ethoxyethanol	3	4	**3**	0	0	**0**	0	0	**0**
dipropylene glycol methyl ether	12	12	**12**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	1	2	**1**	1	1	**1**	1	1	**1**
pentanal	0	1	**0**	0	0	**0**	0	0	**0**
nonanal	6	6	**6**	5	5	**5**	3	3	**3**
decanal	1	2	**2**	2	0	**1**	0	3	**1**
KETONES									
acetophenone	1	1	**1**	1	0	**0**	0	1	**1**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	4	0	**2**	0	0	**0**	0	0	**0**
octamethylcyclotrisiloxane	2	0	**1**	0	0	**0**	0	0	**0**
decamethylcyclopentasiloxane	1	0	**0**	0	0	**0**	0	0	**0**
Total	217	226	**222**	34	31	**33**	13	16	**15**
TVOC	**91**	**101**	**96**	**5**	**0**	**3**	**0**	**0**	**0**
non-TVOC	0	0	**0**	0	0	**0**	0	0	**0**

Table C52. Emission values of filler and plaster A at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0	**0**	0	0	**0**	0	0	**0**
undecane	0	0	**0**	2	2	**2**	0	0	**0**
dodecane	0	0	**0**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	0.6	0.6	**1**	0	0	**0**	0.6	0.6	**1**
o-xylene	0	0	**0**	0	0	**0**	0.2	0.2	**0**
toluene	0	0	**0**	0	0	**0**	0.5	0.5	**1**
1,2,4-trimethylbenzene	0	0	**0**	0	0	**0**	0.4	0.4	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0	0	**0**
DIVALENT ALCOHOLS									
1,2-propanediol	296	300	**298**	582	600	**591**	10	13	**11**
ETHERS									
bis(2-ethoxyethyl)ether	0	0	**0**	3	3	**3**	0.9	0.9	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	11	10	**10**	55	55	**55**	0.9	1	**1**
1-methoxy-2-propanol	0	0	**0**	0	0	**0**	2	2	**2**
dipropylene glycol methyl ether	2	3	**3**	23	24	**24**	2	0	**1**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0.1	0.5	**0**
pentanal	0	0	**0**	0	0	**0**	0	0	**0**
hexanal	1	2	**2**	0	0	**0**	0.9	1	**1**
heptanal	0.9	0.9	**1**	0	0	**0**	0	0	**0**
octanal	0.9	0.9	**1**	0	0	**0**	0.9	0.9	**1**
nonanal	2	2	**2**	2	2	**2**	0.9	1	**1**
decanal	0.9	0.5	**1**	0	0	**0**	0	0	**0**
KETONES									
acetophenone	0	0	**0**	0	0	**0**	0.2	0	**0**
acetone	1	1	**1**	3	4	**3**	1	0	**1**
ACIDS									
acetic acid	9	11	**10**	9	7	**8**	6	5	**5**
OTHERS									
unidentified	0	0	**0**	9	10	**9**	0	0	**0**
Total	325	331	**328**	688	706	**697**	28	29	**28**
TVOC	**82**	**82**	**82**	**266**	**284**	**275**	**4**	**6**	**5**
non-TVOC	10	12	**11**	12	11	**12**	7	5	**6**

Table C53. Background emission values of filler and plaster B in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALIPHATIC AND ALICYCLIC COMPOUNDS			
nonane	0	0.5	0.6
decane	0.6	0.5	0.6
undecane	1	0.7	1
dodecane	0.4	0.3	0.4
AROMATIC HYDROCARBONS			
benzene	0	0.2	0.2
ethylbenzene	0.4	0.4	0.4
propylbenzene	0.1	0.2	0
p,m-xylene	1	2	2
o-xylene	0.5	0.6	0.5
styrene	0.2	0.3	0.3
toluene	1	1	1
1,2,3-trimethylbenzene	0	0.2	0
1,2,4-trimethylbenzene	0.7	0.8	0.8
1,3,5-trimethylbenzene	0.1	0.2	0.2
1-ethyl-2-methylbenzene	0.1	0.2	0
MONATOMIC ALCOHOLS			
1-butanol	0	0	1
2-ethyl-1-hexanol	0.4	5	0.7
PHENOLS			
phenol	0	0.3	1
ALCOHOL AND PHENOL ETHERS			
2-(2-ethoxyethoxy)ethanol	0	0	0.7
2-(2-butoxyethoxy)ethanol	0	0	**94**
1-methoxy-2-propanol	0	0.1	0
2-butoxyethanol	0	0.6	0.7
ALDEHYDES			
benzaldehyde	0.8	1	0.9
pentanal	0	0	0.3
nonanal	1	0.8	1
KETONES			
acetophenone	0	0.5	0.4
ACIDS			
acetic acid	0	4	2
TERPENES AND THEIR DERIVATIVES			
limonene	0.8	1	0.8
ESTERS AND LACTONES			
2-(2-butoxyethoxy)ethylacetate	0	0	0.4
texanol	0	0	2
Total	9	21	114
TVOC	**11**	**19**	**87**
non-TVOC	0	4	2

Table C54. Emission values of filler and plaster B at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	16	20	**18**	17	18	**17**	21	19	**20**
AROMATIC HYDROCARBONS									
styrene	24	24	**24**	23	21	**23**	24	21	**22**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1286	1250	**1268**	1275	1184	**1230**	1241	1177	**1209**
2-methyl-2-propanol	264	246	**255**	268	159	**214**	209	200	**205**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	28	32	**30**	31	28	**30**	0	0	**0**
ALDEHYDES									
benzaldehyde	59	59	**59**	59	50	**54**	59	50	**54**
KETONES									
acetone	91	68	**80**	77	50	**64**	59	55	**57**
ESTERS AND LACTONES									
texanol	18	26	**22**	18	31	**24**	24	28	**26**
2-ethylhexyl acetate	146	155	**150**	146	141	**143**	150	141	**145**
2-ethylhexyl acrylate	25	27	**26**	24	24	**24**	27	23	**25**
2-ethyl-1-hexyl propionate	34	36	**35**	36	34	**35**	35	34	**35**
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	546	523	**534**	555	482	**518**	550	482	**516**
dimethyl perhydro-1,3-oxazine	91	86	**89**	100	91	**95**	91	91	**91**
Total	2624	2550	**2587**	2627	2311	**2469**	2489	2319	**2404**
TVOC	**2127**	**2127**	**2127**	**2178**	**2014**	**2096**	**2142**	**2011**	**2076**
non-TVOC	355	314	**334**	344	207	**275**	267	254	**260**

Table C55. Emission values of filler and plaster B at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	3	3	**3**	3	3	**3**	3	3	**3**
undecane	0	2	**1**	2	2	**2**	1	1	**1**
dodecane	0	2	**1**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	4	4	**4**	2	2	**2**	2	0	**1**
isopropylbenzene	4	4	**4**	2	2	**2**	0	0	**0**
styrene	10	10	**10**	4	4	**4**	4	3	**3**
MONATOMIC ALCOHOLS									
ethanol	3	3	**3**	2	2	**2**	2	0	**1**
2-ethyl-1-hexanol	464	464	**464**	398	398	**398**	354	359	**357**
ETHERS									
bis(2-ethoxyethyl)ether	15	15	**15**	9	10	**9**	8	6	**7**
PHENOLS									
phenol	2	0	**1**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	16	19	**18**	6	7	**7**	5	4	**4**
2-(2-butoxyethoxy)ethanol	82	86	**84**	46	46	**46**	0	0	**0**
2-butoxyethanol	4	4	**4**	3	3	**3**	2	2	**2**
ALDEHYDES									
benzaldehyde	3	3	**3**	2	3	**3**	2	2	**2**
nonanal	0	0	**0**	0	0	**0**	0	1	**1**
decanal	0	0	**0**	0	0	**0**	0	2	**1**
KETONES									
acetone	17	15	**16**	8	8	**8**	14	11	**13**
ACIDS									
acetic acid	8	16	**12**	7	11	**9**	2	14	**8**
ESTERS AND LACTONES									
texanol	159	159	**159**	146	155	**150**	181	163	**172**
2-ethylhexyl acetate	123	123	**123**	73	73	**73**	50	50	**50**
2-ethylhexyl acrylate	26	27	**26**	15	15	**15**	9	9	**9**
2-ethyl-1-hexyl propionate	34	35	**34**	21	21	**21**	13	14	**13**
NITROGEN CONTAINING COMPOUNDS									
2-amino-2-methyl-1-propanol	14	28	**21**	28	40	**34**	22	50	**36**
4,4-dimethyl-1,3-oxazolidine	723	755	**739**	368	382	**375**	332	209	**270**
dimethyl perhydro-1,3-oxazine	123	132	**127**	82	82	**82**	64	55	**59**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	7	4	**6**	13	7	**10**	0	0	**0**
Total	1839	1909	**1874**	1239	1271	**1255**	1069	956	**1013**
TVOC	**1754**	**1836**	**1795**	**1201**	**1237**	**1219**	**992**	**892**	**942**
non-TVOC	27	34	**30**	16	20	**18**	18	25	**22**

Table C56. Emission values of filler and plaster B at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
styrene	0	0	**0**	6	6	**6**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	104	104	**104**	143	143	**143**	145	154	**150**
ETHERS									
bis(2-ethoxyethyl)ether	15	15	**15**	14	15	**14**	7	7	**7**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	227	227	**227**	37	38	**37**	9	8	**9**
2-(2-butoxyethoxy)ethanol	214	214	**214**	141	141	**141**	7	7	**7**
KETONES									
acetone	5	7	**6**	6	8	**7**	16	6	**11**
ACIDS									
acetic acid	7	7	**7**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
texanol	64	64	**64**	150	155	**152**	167	181	**174**
2-ethylhexyl acetate	146	146	**146**	86	86	**86**	41	44	**43**
2-ethylhexyl acrylate	59	59	**59**	29	29	**29**	10	10	**10**
2-ethyl-1-hexyl propionate	50	55	**52**	31	31	**31**	12	12	**12**
NITROGEN CONTAINING COMPOUNDS									
2-amino-2-methyl-1-propanol	13	19	**16**	16	40	**28**	9	7	**8**
4,4-dimethyl-1,3-oxazolidine	591	573	**582**	600	559	**580**	291	305	**298**
dimethyl perhydro-1,3-oxazine	100	96	**98**	96	96	**96**	50	46	**48**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	64	59	**61**	9	8	**9**	0	0	**0**
Total	1657	1643	**1650**	1364	1354	**1359**	765	786	**776**
TVOC	**1536**	**1518**	**1527**	**1332**	**1337**	**1335**	**747**	**770**	**758**
non-TVOC	12	15	**13**	5	6	**5**	16	5	**10**

Table C57. Background emission values of a 6 mm layer of plaster C in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**11**	**8**	**20**

Table C58. Emission values of a 6 mm layer of plaster C at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
p,m-xylene	2	2	**2**	2	2	**2**	2	2	**2**
toluene	2	2	**2**	2	2	**2**	2	1	**2**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	2	5	**3**	3	5	**4**	4	5	**4**
2-methyl-2-propanol	7	7	**7**	6	6	**6**	6	6	**6**
ALDEHYDES									
hexanal	6	6	**6**	0	4	**2**	0	0	**0**
octanal	3	3	**3**	2	2	**2**	3	1	**2**
nonanal	8	11	**9**	7	6	**6**	9	5	**7**
decanal	7	11	**9**	8	**5**1)	**6**	9	**5**1)	**7**
KETONES									
acetone	13	13	**13**	12	11	**11**	14	11	**13**
ACIDS									
acetic acid	55	**27**1)	**41**	46	36	**41**	64	**27**1)	**45**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	0	4	**2**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	**3**1)	**3**1)	**3**	4	**3**1)	**3**	4	**3**1)	**4**
Total	108	90	**99**	90	81	**85**	115	71	**93**
TVOC	**36**	**32**	**34**	**18**	**25**	**21**	**29**	**13**	**21**
non-TVOC	75	47	**61**	63	53	**58**	83	44	**64**

1) *Italic* font indicates that the value is below the detection limit.

Table C59. Emission values of a 6 mm layer of plaster C at 7 days in the environmental chamber test.

(μg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.9	0.5	**0.7**	0	0	**0**	0.9	0	**0.5**
decane	0.5	0.5	**0.5**	0	0.3	**0.2**	0	0	**0**
undecane	1	1	**1**	0	0	**0**	0	0	**0**
dodecane	0.9	0.9	**0.9**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
tridecane	0.9	0.9	**0.9**	0.3	0.4	**0.4**	0	0	**0**
tetradecane	0.9	1	**1**	0.5	0	**0.3**	0	0.3	**0.2**
pentadecane	0	0.5	**0.3**	0	0	**0**	0	0	**0**
aliphatic hydrocarb.	10	10	**10**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	1	0	**0**	0.2	0	**0.1**	0.3	0.2	**0.3**
ethylbenzene	0	0	**0**	0	0.2	**0.1**	0	0	**0**
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
o-xylene	0	0	**0**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
toluene	1	1	**1**	1	1	**1**	1	1	**1**
1,2,4-trimethylbenzene	0	0	**0**	1	1	**1**	1	1	**1**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	1	1	**1**	2	2	**2**	3	3	**3**
benzylalcohol	1	1	**1**	0.9	1	**1**	1	0.9	**1**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0.5	0.5	**0.5**	0.9	0.5	**0.7**	0	0.9	**0.5**
2-butoxyethanol	0.5	0	**0.3**	0.9	0	**0.5**	0	0	**0**
2-phenoxyethanol	0.9	0.9	**0.9**	0.5	0.9	**0.7**	0.9	0.5	**0.7**
2-methoxyethanol	0.9	0.9	**0.9**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	1	0	**1**	0	0	**0**	2	0	**1**
n-butanal	0.9	0.4	**0.7**	0	0	**0**	0	0.9	**0.5**
hexanal	0.9	0	**0.5**	0	0	**0**	0	0	**0**
nonanal	3	6	**4**	2	2	**2**	3	1	**2**
decanal	3	4	**3**	3	3	**3**	4	0.9	**3**
KETONES									
acetophenone	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
acetone	1	3	**2**	1	2	**2**	3	3	**3**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0.4	**0.2**	0	0	**0**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0	0	**0**	0.9	0.5	**0.7**	0.9	0.5	**0.7**
TXIB	0	0	**0**	0.1	0	**0.1**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
triethoxypentylsilane	4	3	**4**	0	2	**1**	0	0	**0**
Total	38	39	**38**	16	18	**17**	24	16	**20**
TVOC	**50**	**68**	**59**	**14**	**34**	**24**	**34**	**17**	**26**
non-TVOC	2	3	**3**	1	2	**2**	3	4	**3**

Table C60. Emission values of a 6 mm layer of plaster C at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0.2	**0.1**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
undecane	0	0.2	**0.1**	3	3	**3**	0.5	0.9	**0.7**
dodecane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
tridecane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
tetradecane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
hexadecane	0	0	**0**	0	0	**0**	0.1	0	**0.1**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	50	46	**48**	50	64	**57**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0.4	0.3	**0.4**	0.3	0.3	**0.3**	0.3	0.4	**0.4**
ethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
propylbenzene	0	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
p,m-xylene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
o-xylene	0.3	0.3	**0.3**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
toluene	0.9	1	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,2,4-trimethylbenzene	0.4	0.4	**0.4**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
1,3,5-trimethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
1-ethyl-2-methylbenzene	0	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0	**0.1**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0.5	**0.3**	2	0	**1**
benzylalcohol	0.5	0.5	**0.5**	0	0	**0**	0	0	**0**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	0	0.5	**0.3**
PHENOLS									
phenol	0.9	0.1	**0.5**	1	0.9	**1**	1	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0.9	0	**0.5**	0	0	**0**	0	0	**0**
2-phenoxyethanol	0.9	0.9	**0.9**	0	0	**0**	0	0	**0**
2-methoxyethanol	2	1	**2**	0.5	0	**0.3**	0	0	**0**
ALDEHYDES									
benzaldehyde	0.9	0.3	**0.6**	0.9	0.5	**0.7**	0.9	0.9	**0.9**
nonanal	1	2	**2**	0.9	2	**2**	1	1	**1**
decanal	1	3	**2**	1	3	**2**	0.9	1	**1**
KETONES									
acetophenone	0	0	**0**	0	0.2	**0.1**	0	0	**0**
acetone	1	1	**1**	0	2	**1**	0	1	**1**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0.3	**0.2**	0.3	0.3	**0.3**	0	0.3	**0.2**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0	0	**0**	0	0	**0**	0.1	0	**0.1**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	6	6	**6**	10	9	**9**	0.5	2	**1**
decamethylcyclopentasiloxane	0.5	0.3	**0**	0.9	0.9	**1**	0.5	0.5	**1**
Total	70	66	**68**	72	89	**81**	13	15	**14**
TVOC	**73**	**64**	**68**	**72**	**72**	**72**	**19**	**21**	**20**
non-TVOC	1	1	**1**	0	2	**1**	0	1	**1**

Table C61. Background emission values of primer and paint A spread onto gypsum board in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**7**	**11**	**11**

Table C62. Emission values of primer and paint A spread onto gypsum board at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	17	16	**17**	21	20	**20**	19.5	20	**20**
AROMATIC HYDROCARBONS									
ethylbenzene	6	6	**6**	7	8	**8**	7	7	**7**
isopropylbenzene	0	0	**0**	5	5	**5**	5	5	**5**
p,m-xylene	7	7	**7**	8	8	**8**	8	8	**8**
styrene	21	20	**20**	29	29	**29**	27	28	**28**
MONATOMIC ALCOHOLS									
ethanol	0	0	**0**	6	0	**3**	8	6	**7**
2-propanol	5	5	**5**	9	8	**8**	11	11	**11**
1-butanol	17	17	**17**	46	45	**45**	50	55	**52**
DIVALENT ALCOHOLS									
1,2-propanediol	1523	1577	**1550**	1686	1677	**1682**	1050	1255	**1152**
ETHERS									
butyl ether	55	50	**52**	68	73	**70**	64	68	**66**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	150	155	**152**	146	136	**141**	0	118	**59**
ALDEHYDES									
benzaldehyde	10	11	**10**	11	13	**12**	18	16	**17**
hexanal	0	0	**0**	0	5	**2**	5	5	**5**
decanal	7	7	**7**	34	5	**20**	6	5	**5**
KETONES									
acetone	14	7	**10**	17	11	**14**	17	11	**14**
ACIDS									
acetic acid	114	37	**75**	432	32	**232**	38	36	**37**
ESTERS AND LACTONES									
texanol	546	568	**557**	655	682	**668**	818	918	**868**
n-butylacetate	0	0	**0**	10	10	**10**	10	11	**10**
butyl propanoate	9	9	**9**	13	13	**13**	12	15	**13**
Total	2498	2493	**2496**	3200	2779	**2989**	2171	2595	**2383**
TVOC	**732**	**732**	**732**	**992**	**951**	**972**	**731**	**913**	**822**
non-TVOC	132	49	**90**	463	51	**257**	74	64	**69**

Table C63. Emission values of primer and paint A spread onto gypsum board at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	1	1	**1**	1	1	**1**	1	2	**2**
decane	0	0	**0**	1	0	**0**	0	0	**0**
hexadecane	0	0	**0**	7	0	**3**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	1	0	**0**	1	1	**1**	0	0	**0**
isopropylbenzene	0	1	**0**	0	0	**0**	0	0	**0**
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
o-xylene	1	0	**0**	0	1	**0**	0	1	**0**
styrene	0	1	**0**	0	0	**0**	0	0	**0**
toluene	1	1	**1**	1	1	**1**	1	1	**1**
MONATOMIC ALCOHOLS									
ethanol	0	0	**0**	0	4	**2**	4	3	**3**
2-propanol	1	1	**1**	1	1	**1**	1	1	**1**
1-butanol	2	2	**2**	8	8	**8**	0	11	**6**
DIVALENT ALCOHOLS									
1,2-propanediol	305	296	**300**	323	296	**309**	432	468	**450**
ETHERS									
butyl ether	3	3	**3**	3	3	**3**	2	3	**3**
ALDEHYDES									
benzaldehyde	2	1	**2**	2	2	**2**	3	3	**3**
n-butanal	0	0	**0**	0	1	**1**	0	0	**0**
pentanal	0	0	**0**	1	0	**0**	0	0	**0**
nonanal	0	0	**0**	0	0	**0**	0	3	**2**
decanal	0	0	**0**	0	2	**1**	0	6	**3**
KETONES									
2-butanone (MEK)	0	0	**0**	1	0	**1**	0	0	**0**
acetone	4	2	**3**	8	3	**5**	4	6	**5**
ESTERS AND LACTONES									
texanol	396	396	**396**	382	368	**375**	418	423	**420**
TXIB	0	0	**0**	17	0	**9**	3	0	**2**
butyl propanoate	1	1	**1**	1	1	**1**	1	1	**1**
Total	717	705	**711**	759	694	**726**	871	931	**901**
TVOC	**159**	**150**	**155**	**183**	**151**	**167**	**241**	**268**	**254**
non-TVOC	5	3	**4**	10	9	**10**	9	9	**9**

Table C64. Emission values of primer and paint A spread onto gypsum board at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	1	1	**1**	0.5	0.9	**0.7**
tetradecane	0	0	**0**	0	0	**0**	0.9	0	**0.5**
AROMATIC HYDROCARBONS									
p,m-xylene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
toluene	0.5	0.9	**0.7**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
MONATOMIC ALCOHOLS									
2-propanol	0.5	0	**0.3**	0	0	**0**	0	0	**0**
1-butanol	1	1	**1**	5	5	**5**	5	5	**5**
DIVALENT ALCOHOLS									
1,2-propanediol	68	77	**73**	150	159	**155**	318	323	**320**
ALCOHOL AND PHENOL ETHERS									
2-butoxyethanol	0.5	0.5	**0.5**	2	1	**2**	0.9	0.9	**0.9**
ALDEHYDES									
benzaldehyde	1	0.9	**1**	1	1	**1**	2	2	**2**
n-butanal	0	0	**0**	0	0	**0**	0	1	**1**
pentanal	0	0.5	**0.3**	0	0.5	**0.3**	0.5	0	**0.3**
hexanal	0	0	**0**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
nonanal	0	0.9	**0.5**	0.9	1	**1**	0.9	1	**1**
decanal	1	2	**2**	2	2	**2**	2	1	**2**
2-furfural	0	0	**0**	0	0	**0**	0.5	0	**0.3**
KETONES									
acetophenone	0	0	**0**	0	0	**0**	1	0.5	**0.5**
acetone	2	2	**2**	3	3	**3**	3	5	**4**
ACIDS									
acetic acid	0	4	**2**	2	9	**5**	4	0	**2**
ESTERS AND LACTONES									
texanol	346	359	**352**	314	309	**311**	346	359	**352**
TXIB	0.5	0.5	**0.5**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
Total	423	451	**437**	485	497	**491**	687	703	**695**
TVOC	**305**	**300**	**302**	**297**	**288**	**292**	**431**	**404**	**418**
non-TVOC	2	6	**4**	5	12	**8**	7	5	**6**

Table C65. Background emission values of primer and paint B spread onto gypsum board in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**4**	**6**	**8**

Table C66. Emission values of primer and paint B spread onto gypsum board at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
octane	0	0	**0**	0	0.2	**0.1**	0.2	0.9	**0.6**
nonane	0	0	**0**	0.5	0.5	**0.5**	0.5	2	**1**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0	**0**	0	0.2	**0.1**
ethylbenzene	0.9	0.5	**0.7**	1	0.9	**1**	2	2	**2**
propylbenzene	0	0	**0**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
isopropylbenzene	0.5	0.5	**0.5**	0.9	0.9	**0.9**	1	1	**1**
p,m-xylene	1	1	**1**	2	2	**2**	4	4	**4**
o-xylene	0.5	0.5	**0.5**	0.9	0.9	**0.9**	1	1	**1**
styrene	0.5	0.5	**0.5**	1	1	**1**	2	2	**2**
toluene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
1,2,4-trimethylbenzene	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
MONATOMIC ALCOHOLS									
2-propanol	20	20	**20**	31	30	**31**	30	30	**30**
1-butanol	0.5	0.5	**0.5**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
2-methyl-2-propanol	0.9	0.9	**0.9**	1	1	**1**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	50	55	**52**	64	73	**68**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	0	0	**0**	21	22	**21**
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	96	105	**100**
ALDEHYDES									
benzaldehyde	0	0	**0**	2	2	**2**	3	6	**4**
pentanal	0	0	**0**	0	0	**0**	0.5	0	**0.3**
hexanal	0.9	0.5	**0.7**	1	2	**2**	2	2	**2**
nonanal	0	0	**0**	0	0	**0**	1	0.9	**1**
decanal	0	0	**0**	0	1	**1**	2	0	**1**
KETONES									
acetophenone	0	0	**0**	0	0	**0**	0	1	**1**
acetone	4	4	**4**	5	5	**5**	7	6	**6**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	2	0	**1**	0	0	**0**	2	0	**1**
Total	32	29	**30**	100	105	**102**	243	263	**253**
TVOC	**6**	**3**	**4**	**8**	**9**	**9**	**28**	**29**	**29**
non-TVOC	24	24	**24**	37	36	**37**	38	37	**37**

Table C67. Emission values of primer and paint B spread onto gypsum board at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0.2	0	**0.1**	0	0	**0**	0	0	**0**
nonane	0	0	**0**	0	0	**0**	0.2	0	**0.1**
AROMATIC HYDROCARBONS									
benzene	0.2	0.1	**0.2**	0	0	**0**	0.1	0.1	**0.1**
ethylbenzene	0.4	0.4	**0.4**	0	1	**0**	0.3	0.3	**0.3**
isopropylbenzene	0	0	**0**	0	0	**0**	0.2	0	**0.1**
p,m-xylene	1	1	**1**	0	1	**1**	1	1	**1**
o-xylene	0.4	0.4	**0.4**	0	0.5	**0.3**	0.4	0.4	**0.4**
toluene	1	1	**1**	0	0.9	**0.5**	1	1	**1**
1,2,4-trimethylbenzene	0.2	0.2	**0.2**	0	0.3	**0.2**	0.2	0.2	**0.2**
1,3,5-trimethylbenzene	0	0.3	**0.2**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
ethanol	0	0.4	**0.2**	0	1	**1**	1	1	**1**
2-propanol	3	2	**3**	0	4	**2**	3	2	**2**
1-butanol	0	0	**0**	0	0	**0**	0	0.1	**0.1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	18	0	**9**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	22	15	**18**
ALDEHYDES									
benzaldehyde	1	1	**1**	0	1	**0**	2	1	**1**
n-butanal	0	0	**0**	0	1	**0**	0	0	**0**
hexanal	0	0	**0**	0	1	**0**	1	1	**1**
nonanal	0	0	**0**	0	0	**0**	1	0	**0**
decanal	1	1	**1**	0	2	**1**	1	1	**1**
KETONES									
acetophenone	0	0	**0**	0	0	**0**	0.2	0	**0.1**
acetone	1	1	**1**	0	1	**0**	2	3	**2**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0	0	**0**	0	0	**0**	0	0.1	**0.1**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	0	0	**0**	0	0	**0**
Total	9	9	**9**	0	14	**7**	54	26	**40**
TVOC	**2**	**2**	**2**	***0***[1]	**3**	**1**	**7**	**6**	**7**
non-TVOC	4	4	**4**	0	6	**3**	6	6	**6**

[1] *Italic* font indicates that the value is below the detection limit.

Table C68. Emission values of primer and paint B spread onto gypsum board at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0	0	**0**	0	0.2	**0.1**	0	0	**0**
octane	0	0	**0**	0	0.1	**0.1**	0	0	**0**
nonane	0.2	0.1	**0.2**	0	0.1	**0.1**	0.1	0.3	**0.2**
decane	0.1	0.1	**0.1**	0	0.1	**0.1**	0.1	0.1	**0.1**
undecane	0	0	**0**	0	0.1	**0.1**	0	0	**0**
dodecane	0	0	**0**	0	0	**0**	0.1	0	**0.1**
AROMATIC HYDROCARBONS									
benzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
ethylbenzene	0.3	0.3	**0.3**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
propylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0	0	**0**
isopropylbenzene	0.1	0.1	**0.1**	0.1	0.2	**0.2**	0.1	0.1	**0.1**
p,m-xylene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.5	0.5	**0.5**
o-xylene	0.3	0.2	**0.3**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
styrene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0	0	**0**
toluene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.5	0.4	**0.5**
1,2,4-trimethylbenzene	0.1	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.1	**0.2**
1,3,5-trimethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
1-ethyl-2-methylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	0.9	0.9	**0.9**	0.5	0.5	**0.5**	0.1	0.2	**0.2**
1-butanol	0.1	0.1	**0.1**	0.2	0.2	**0.2**	0	0	**0**
2-ethyl-1-hexanol	0.1	0.1	**0.1**	0	0.2	**0.1**	0.2	0.1	**0.2**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	5	5	**5**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	1	**1**	0.3	2	**1**
1-methoxy-2-propanol	0	0	**0**	0	0.1	**0.1**	0.1	0	**0.1**
2-butoxyethanol	0.1	0.1	**0.1**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	0.1	0.5	**0.3**	0.5	0.9	**0.7**	0.9	1	**1**
n-butanal	0	0	**0**	0.3	0	**0.2**	0	0	**0**
pentanal	0	0.4	**0.2**	0.3	0	**0.2**	0.3	0	**0.2**
hexanal	0.4	0	**0.2**	0.1	0	**0.1**	0.9	0.9	**0.9**
heptanal	0	0	**0**	0	0.1	**0.1**	0	0	**0**
octanal	0	0	**0**	0.1	0	**0.1**	0	0	**0**
nonanal	0	0.4	**0.2**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
decanal	0	0.5	**0.3**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
KETONES									
2-butanone (MEK)	0	0	**0**	0	0.1	**0.1**	0.2	0	**0.1**
acetophenone	0	0	**0**	0.1	0	**0.1**	0.2	0.1	**0.2**
acetone	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.9	0.9	**0.9**
ACIDS									
acetic acid	0	0.9	**0.5**	16	0	**8**	2	7	**5**
HALOGEN CONTAINING COMPOUNDS									
dichloromethane	0	0	**0**	0	0	**0**	0	3	**1**
Total	5	7	**6**	23	9	**16**	15	23	**19**
TVOC	***11***[1]	***11***[1]	**11**	***10***[1]	***10***[1]	**10**	**14**	***14***[1]	**14**
non-TVOC	1	2	**2**	17	0.9	**9**	3	11	**7**

[1] *Italic* font indicates that the value is below the detection limit.

Table C69. Background emission values of adhesive A spread onto gypsum board in the environmental chamber test.

(µg/m^3)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALDEHYDES			
decanal	-	11	-
TVOC	**7**	**28**	**14**

Table C70. Emission values of adhesive A spread onto gypsum board at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0	0.5	**0**	0.3	0.3	**0.3**
decane	0.2	0	**0.1**	0.2	0.3	**0.3**	0	0.3	**0.2**
undecane	0.3	0.2	**0.3**	0.3	0.3	**0.3**	0.3	0.3	**0.3**
dodecane	0	0	**0**	0.2	0.2	**0.2**	0	0.2	**0.1**
AROMATIC HYDROCARBONS									
p,m-xylene	0.5	0.4	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
o-xylene	0	0	**0**	0.2	0	**0.1**	0	0.3	**0.2**
toluene	0.5	0.4	**0.5**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
1,2,4-trimethylbenzene	0.3	0.3	**0.3**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
MONATOMIC ALCOHOLS									
2-propanol	0.3	0	**0.2**	0.3	0.3	**0.3**	0.3	0.4	**0.4**
1-butanol	0.9	0.9	**0.9**	1	1	**1**	2	2	**2**
2-ethyl-1-hexanol	0.4	0.4	**0.4**	0.4	0.5	**0.5**	0.4	0.5	**0.5**
benzylalcohol	0.3	0	**0.2**	0.2	0	**0.1**	0	0	**0**
2-methyl-1-propanol	0	0	**0**	0.5	0.4	**0.5**	0.5	0.5	**0.5**
2-methyl-2-propanol	6	6	**6**	8	6	**7**	9	11	**10**
DIVALENT ALCOHOLS									
1,2-propanediol	0.4	0	**0.2**	0	0.3	**0.2**	0	0	**0**
PHENOLS									
phenol	0.5	0.4	**0.5**	0.5	0.4	**0**	0.5	0.3	**0.4**
ALCOHOL AND PHENOL ETHERS									
2-butoxyethanol	0.3	0	**0.2**	0	0	**0**	0	0	**0**
2-phenoxyethanol	0	0	**0**	0	0.2	**0.1**	0	0	**0**
ALDEHYDES									
benzaldehyde	0.9	0.9	**0.9**	2	1	**2**	2	2	**2**
pentanal	0	0	**0**	0.9	0.9	**0.9**	0	0.9	**0.5**
hexanal	6	6	**6**	6	6	**6**	8	8	**8**
heptanal	0.9	0.9	**0.9**	0.9	0.9	**0.9**	1	1	**1**
octanal	0.9	0.9	**0.9**	0.5	1	**1.0**	1	0.9	**1**
nonanal	3	3	**3**	2	6	**4**	5	4	**5**
decanal	1	2	**2**	0	0.5	**0**	3	3	**3**
2-furfural	0.4	0.3	**0.4**	0.5	0.5	**0.5**	0.9	0.9	0.9
KETONES									
acetophenone	0.3	0.4	**0.4**	0.4	0.4	**0.4**	0.5	0.5	**0.5**
acetone	0.9	0.9	**0.9**	1	2	**2**	2	2	**2**
ACIDS									
acetic acid	17	14	**15**	11	6	**8**	14	16	**15**
hexanoic acid	0	0	**0**	0	0	**0**	0	0.5	**0**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0.2	**0.1**	0.4	0.3	**0.4**	0.3	0.3	**0.3**
3-carene	0.2	0.2	**0.2**	0.9	0.9	**0.9**	0.5	0.5	**0.5**
ESTERS AND LACTONES									
n-butyl acetate	1	0.9	**1**	0.9	0.9	**0.9**	0	1	**1**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0.5	0.3	**0.4**	0	0.2	**0.1**	0	0.2	**0.1**
Total	45	39	**42**	41	40	**41**	54	60	**57**
TVOC	**16**	**14**	**15**	**10**	**14.5**	**12**	**26**	**26**	**26**
non-TVOC	24	20	**22**	20	14	**17**	25	30	**27**

Table C71. Emission values of adhesive A spread onto gypsum board at 7 days in the environmental chamber test.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0.1	**0.2**	0.1	0	**0.1**	0	0	**0**
decane	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
undecane	0	0	**0**	0	0.1	**0.1**	0.1	0.1	**0.1**
dodecane	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
tridecane	0	0	**0**	0	0.1	**0.1**	0.1	0.1	**0.1**
tetradecane	0	0.0	**0.0**	0	0.1	**0.1**	0.1	0.1	**0.1**
pentadecane	0	0.1	**0.1**	0	0.1	**0.1**	0.1	0.1	**0.1**
hexadecane	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0	**0**	0	0	**0**
ethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
propylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
p,m-xylene	0.3	0.3	**0.3**	0.3	0.4	**0.4**	0.3	0.3	**0.3**
o-xylene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
styrene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	0.3	0.4	**0.4**	0.4	1	**0.5**	0.4	0.4	**0.4**
1,2,3-trimethylbenzene	0	0	**0**	0	0	**0**	0.1	0.1	**0.1**
1,2,4-trimethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
1,3,5-trimethylbenzene	0.0	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
1-ethyl-2-methylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0.2	0	**0.1**	0.2	0	**0.1**
2-ethyl-1-hexanol	0.1	0.1	**0.1**	0.3	0.2	**0.3**	0.3	0.3	**0.3**
benzylalcohol	0	0	**0**	0.1	0	**0.1**	0.1	0.1	**0.1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	1	0	**0.5**	0.4	0.4	**0.4**
PHENOLS									
phenol	0	0	**0**	0.2	0	**0.1**	0.4	0.4	**0.4**
ALCOHOL AND PHENOL ETHERS									
2-butoxyethanol	0	0	**0**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
2-phenoxyethanol	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
ALDEHYDES									
benzaldehyde	0.0	0.1	**0.1**	0	0	**0**	0.4	0.3	**0.4**
pentanal	0.4	0.4	**0.4**	0	0	**0**	0	0	**0**
hexanal	1	1	**1**	1	1	**1**	1	1	**1**
heptanal	0	0.2	**0.1**	0.3	0.3	**0.3**	0.4	0.4	**0.4**
octanal	0.3	0.4	**0.4**	1	0.3	**0.4**	0.4	0.4	**0.4**
nonanal	1	1	**1**	1	1	**1**	2	2	**2**
decanal	2	1	**2**	0	0	**0**	1	1	**1**
KETONES									
acetophenone	0	0.1	**0.1**	0	0.1	**0.1**	0.2	0.1	**0.2**
acetone	0.2	1	**0.4**	0.4	0.4	**0.4**	1	1	**1**
ACIDS									
acetic acid	0	0	**0**	1	4	**3**	13	7	**10**
propanoic acid	0	0	**0**	0	0	**0**	1	1	**1**
TERPENES AND THEIR DERIVATIVES									
limonene	0.2	0.2	**0.2**	0.3	0.2	**0.3**	0.3	0.2	**0.3**
α-pinene	0.4	0.3	**0.4**	1	0.3	**0.4**	1	0.4	**0.5**
3-carene	0.4	0.4	**0.4**	1	1	**1**	1	1	**1**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	0	0.1	**0.1**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
Total	7	8	**8**	10	10	**10**	25	18	**21**
TVOC	**2**	**2**	**2**	**0**	**0**	**0**	**5**	**13**	**9**
non-TVOC	0	1	**0**	2	4	**3**	13	8	**10**

Table C72. Emission values of adhesive A spread onto gypsum board at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.2	0.1	**0.2**	0	0.1	**0.1**	0.1	0.2	**0.2**
decane	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
undecane	0	0	**0**	0.1	0	**0.1**	0.1	0.1	**0.1**
dodecane	0	0	**0**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
tridecane	0	0	**0**	0	0	**0**	0.1	0.1	**0.1**
tetradecane	0	0	**0**	0	0	**0**	0.1	0.1	**0.1**
pentadecane	0	0	**0**	0	0	**0**	0.1	0	**0.1**
AROMATIC HYDROCARBONS									
benzene	0.1	0	**0.1**	0	0	**0**	0	0	**0**
ethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
propylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
p,m-xylene	0.5	0.4	**0**	0.5	0.5	**1**	0.5	0.5	**1**
o-xylene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
toluene	0.4	0.3	**0.4**	0.5	0.4	**0.5**	0.5	0.4	**0**
1,2,4-trimethylbenzene	0.1	0.1	**0.1**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
1,3,5-trimethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
1-ethyl-2-methylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.1	0.1	**0.1**	0.2	0.2	**0.2**	0.2	0.3	**0.3**
benzylalcohol	0	0	**0**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	0.4	0.3	**0.4**
PHENOLS									
phenol	0.2	0.1	**0.2**	0	0	**0**	0.1	0.4	**0.3**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0.1	0.1	**0.1**	0	0.1	**0.1**
2-butoxyethanol	0	0	**0**	0.1	0.2	**0.2**	0.2	0.2	**0.2**
2-phenoxyethanol	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
ALDEHYDES									
benzaldehyde	0.1	0	**0.1**	0.1	0.1	**0.1**	0.2	0.3	**0.3**
pentanal	0.5	0.5	**0.5**	0	0	**0**	0	0	**0**
hexanal	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.5	0.5	**0.5**
heptanal	0	0	**0**	0.2	0.2	**0.2**	0.2	0.3	**0.3**
octanal	0	0.3	**0.2**	0	0.3	**0.2**	0.3	0.5	**0.4**
nonanal	0.5	0.9	**0.7**	0.9	0.9	**0.9**	1	2	**2**
decanal	0.9	1	**1**	0	0	**0**	0.9	2	**1**
KETONES									
acetophenone	0	0	**0**	0.1	0	**0.1**	0.2	0.1	**0.2**
acetone	0.2	0.2	**0.2**	0.2	0.3	**0.3**	0.5	0.5	**0.5**
ACIDS									
acetic acid	7	0	**4**	4	15	**9**	18	14	**16**
propanoic acid	0	0	**0**	0	0	**0**	0.9	0.9	**1**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
α-pinene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
3-carene	0	0	**0**	0.1	0	**0.1**	0.1	0.1	**0.1**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0.1	0	**0.1**	0	0.3	**0.2**	0	0.2	**0.1**
Total	13	6	**9**	9	20	**14**	27	25	**26**
TVOC	**3**	**0**	**1**	**0**	**0**	**0**	**0**	**4**	**2**
non-TVOC	8	0.2	**4**	4	15	**9**	19	15	**17**

Table C73. Background emission values of adhesive B spread onto gypsum board in the environmental chamber test.

(µg/m^3)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**7**	**16**	**17**

Table C74. Emission values of adhesive B spread onto gypsum board at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.9	0	**0.5**	0.5	0.3	**0.4**	0.5	0	**0.3**
dodecane	0.2	0	**0.1**	0.2	0	**0.1**	0.3	0.3	**0.3**
AROMATIC HYDROCARBONS									
benzene	0	0.2	**0.1**	0.3	0	**0.2**	0.2	0	**0.1**
p,m-xylene	0.5	0.5	**0.5**	0.9	0.5	**0.7**	0.5	0.5	**0.5**
toluene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,2,4-trimethylbenzene	0.3	0.3	**0.3**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
MONATOMIC ALCOHOLS									
1-butanol	4	4	**4**	6	6	**6**	7	7	**7**
2-ethyl-1-hexanol	0.9	1	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
PHENOLS									
phenol	0	1	**1**	0.9	1	**1**	0.9	0.9	**0.9**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	346	346	**346**	336	350	**343**	282	291	**286**
2-butoxyethanol	2	2	**2**	2	2	**2**	2	2	**2**
2-phenoxyethanol	0.3	0.4	**0.4**	0.4	0.5	**0.5**	0.5	0.5	**0.5**
ALDEHYDES									
benzaldehyde	0.3	2	**1**	2	2	**2**	2	3	**3**
hexanal	6	6	**6**	6	6	**6**	8	8	**8**
heptanal	2	0	**1**	2	0	**1**	2	2	**2**
octanal	2	1	**2**	2	0	**1**	0	0	**0**
nonanal	7	3	**5**	6	4	**5**	7	5	**6**
decanal	10	3	**6**	5	1	**3**	9	2	**6**
KETONES									
acetophenone	0.5	0.5	**0.5**	0.9	0.5	**0.7**	0.9	0.9	**0.9**
acetone	3	2	**2**	4	3	**3**	4	3	**3**
ACIDS									
acetic acid	16	10	**13**	55	33	**44**	16	10	**13**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	1	1	**1**	1	1	**1**	0.9	0.9	**1**
SULPHUR CONTAINING COMPOUNDS									
5-chloro-2-methyl-3(2H)-isotiatsolon	1	1	**1**	2	2	**2**	1	1	**1**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0.5	0.5	**0.5**	0.3	0.9	**0.6**	0.4	0.4	**0.4**
Total	405	387	**396**	435	417	**426**	347	342	**345**
TVOC	**238**	**238**	**238**	**242**	**251**	**247**	**214**	**223**	**218**
non-TVOC	19	11	**15**	58	36	**47**	19	13	**16**

Table C75. Emission values of adhesive B spread onto gypsum board at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0.1	**0.1**	0	0	**0**	0.1	0.2	**0.2**
decane	0	0.1	**0.1**	0.1	0	**0.1**	0	0.1	**0.1**
dodecane	0	0.1	**0.1**	0	0	**0**	0	0.1	**0.1**
tridecane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
tetradecane	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
pentadecane	0	0	**0**	0	0	**0**	0.2	0.1	**0.2**
hexadecane	0.1	0.2	**0.2**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0	**0**	0	0	**0**
ethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
p,m-xylene	1	1	**1**	1	1	**1**	1	1	**1**
o-xylene	0.1	0.1	**0.1**	0	0.1	**0.1**	0.1	0.1	**0.1**
toluene	0.4	0.4	**0.4**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
1,2,4-trimethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0.4	**0.2**	0.3	0	**0.2**
2-ethyl-1-hexanol	0.2	0.2	**0.2**	0.4	0.4	**0.4**	1	0.4	**0**
benzylalcohol	0	0	**0**	0	0	**0**	0.2	0	**0.1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	1	1	**1**
PHENOLS									
phenol	1	0.3	**0.4**	0	0	**0**	0.3	0.2	**0.3**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	3	5	**4**	68	73	**70**
1-methoxy-2-propanol	0	0	**0**	0	0.1	**0.1**	0	0	**0**
2-butoxyethanol	0	0	**0**	1	1	**1**	1	1	**1**
2-phenoxyethanol	0	0	**0**	0	0	**0**	0.2	0.3	**0.3**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0.3	**0.2**	0.4	0	**0.2**
pentanal	0	0	**0**	1	0.4	**0**	0	0	**0**
hexanal	1	1	**1**	1	1	**1**	1	1	**1**
heptanal	0	0	**0**	0	0	**0**	0.4	0	**0.2**
octanal	0	0	**0**	1	0	**0**	1	1	**1**
nonanal	1	1	**1**	2	1	**2**	3	3	**3**
decanal	1	1	**1**	2	1	**1**	2	3	**2**
KETONES									
acetophenone	0	0	**0**	0.1	0.1	**0.1**	0.1	0	**0.1**
acetone	1	1	**1**	1	1	**1**	1	1	**1**
ACIDS									
acetic acid	0	0	**0**	3	9	**6**	13	13	**13**
TERPENES AND THEIR DERIVATIVES									
limonene	0.2	0	**0.1**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
α-pinene	0.3	0.3	**0.3**	0.3	0.2	**0.3**	0.2	0.2	**0.2**
3-carene	0.4	0.3	**0.4**	0.4	0.3	**0.4**	0.3	0.3	**0.3**
decamethylcyclopentasiloxane	0	0.1	**0.1**	0.0	0.1	**0.1**	0.1	0	**0.1**
Total	7	7	**7**	16	22	**19**	96	100	**98**
TVOC	***0***1)	***0***1)	**0**	***0***1)	***0***1)	**0**	**55**	**55**	**55**
non-TVOC	1	1	**1**	4	10	**7**	15	14	**14**

1) *Italic* font indicates that the value is below the detection limit.

Table C76. Emission values of adhesive B spread onto gypsum board at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
decane	0.1	0.1	**0.1**	0.1	0.2	**0.2**	0.1	0.2	**0.2**
undecane	0	0	**0**	0	0	**0**	0.1	0	**0.1**
dodecane	0	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0	**0**	0	0	**0**
ethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
p,m-xylene	0.3	0.4	**0.4**	0.4	0.5	**0.5**	0.4	0.5	**0**
o-xylene	0.1	0.1	**0.1**	0.1	0.2	**0.2**	0.1	0.1	**0.1**
styrene	0	0.1	**0.1**	0	0.1	**0.1**	0	0	**0**
toluene	0.2	0.3	**0**	0.3	0.5	**0.4**	0.4	0.5	**0**
1,2,4-trimethylbenzene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
1,3,5-trimethylbenzene	0	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
MONATOMIC ALCOHOLS									
1-butanol	0.2	0	**0.1**	0	0.3	**0.2**	0.2	0	**0.1**
2-ethyl-1-hexanol	0.2	0.2	**0.2**	0.3	0.3	**0.3**	0.4	0.4	**0.4**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	5	6	**5**	64	64	**64**
2-butoxyethanol	0.3	0.3	**0.3**	0.5	0.5	**0.5**	0.9	0.9	**0.9**
2-phenoxyethanol	0	0	**0**	0	0	**0**	0.2	0.2	**0.2**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0	0.2	**0.1**
pentanal	0.5	0.5	**0.5**	0.3	0.3	**0.3**	0.4	0.3	**0.4**
hexanal	1	1	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
nonanal	0.5	0.4	**0.5**	0.9	0.9	**0.9**	1	1	**1**
decanal	0.9	0.4	**0.7**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
KETONES									
acetophenone	0	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
acetone	0.1	0.5	**0.3**	0.3	0.9	**0.6**	0.3	0.4	**0.4**
ACIDS									
acetic acid	11	0	**5**	5	5	**5**	13	7	**10**
propanic acid	0	0	**0**	0	0	**0**	1	0.9	**1**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0.1	0.1	**0.1**	0	0.2	**0.1**
α-pinene	0.1	0.1	**0.1**	0.1	0.1	**0.1**	0.1	0.1	**0.1**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	0.1	0	**0.1**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0.1	0	**0.1**	0.1	0	**0.1**
SULPHUR CONTAINING COMPOUNDS									
5-chloro-2-methyl-3(2H)-isotiatsolon	0	0	**0**	0	0	**0**	0.3	0.5	**0.4**
Total	16	5	**10**	15	17	**16**	85	80	**82**
TVOC	***0*1)**	***0*1)**	**0**	**0**	**0.9**	**0**	**46**	**50**	**48**
non-TVOC	11	0.5	**6**	5	6	**5**	13	8	**10**

1) *Italic* font indicates that the value is below the detection limit.

Table C77. Background emission values of primer and paint A spread onto filler and plaster B applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
AROMATIC HYDROCARBONS			
p,m-xylene	0	2	0
toluene	0	2	0
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	0	2	0
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	0	23
ALDEHYDES			
nonanal	0	2	0
decanal	0	2	0
ACIDS			
acetic acid	0	22	0
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	0	3	0
TVOC	**8**	**21**	**29**

Table C78. Emission values of primer and paint A spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	91	100	**95**	-	-	-	105	105	**105**
nonane	0	0	**0**	-	-	-	8	9	**8**
decane	0	0	**0**	-	-	-	2	0	**1**
pentadecane	4	0	**2**	-	-	-	11	0	**5**
hexadecane	5	0	**2**	-	-	-	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	10	10	**10**	-	-	-	8	8	**8**
propylbenzene	3	3	**3**	-	-	-	2	2	**2**
isopropylbenzene	8	8	**8**	-	-	-	7	7	**7**
p,m-xylene	7	7	**7**	-	-	-	7	7	**7**
o-xylene	4	4	**4**	-	-	-	4	4	**4**
styrene	23	24	**23**	-	-	-	21	20	**20**
toluene	2	2	**2**	-	-	-	2	0	**1**
MONATOMIC ALCOHOLS									
2-propanol	11	11	**11**	-	-	-	11	11	**11**
1-butanol	36	36	**36**	-	-	-	31	29	**30**
2-ethyl-1-hexanol	196	200	**198**	-	-	-	264	268	**266**
benzyl alcohol	0	0	**0**	-	-	-	6	0	**3**
DIVALENT ALCOHOLS									
1,2-propanediol	2309	2405	**2357**	-	-	-	1732	1768	**1750**
ETHERS									
butyl ether	50	50	**50**	-	-	-	55	55	**55**
PHENOLS									
phenol	0	0	**0**	-	-	-	16	7	**12**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	155	159	**157**	-	-	-	114	118	**116**
2-(2-butoxyethoxy)ethanol	277	286	**282**	-	-	-	262	271	**267**
1-methoxy-2-propanol	0	5	**2**	-	-	-	0	0	**0**
2-butoxyethanol	2	2	**2**	-	-	-	1	2	**2**
ALDEHYDES									
benzaldehyde	18	21	**20**	-	-	-	36	22	**29**
nonanal	8	7	**8**	-	-	-	10	9	**10**
KETONES									
acetophenone	8	4	**6**	-	-	-	3	4	**3**
acetone	36	31	**33**	-	-	-	35	32	**33**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	3	4	**3**	-	-	-	5	5	**5**
texanol	1632	1632	**1632**	-	-	-	1909	1909	**1909**
TXIB	2	2	**2**	-	-	-	2	2	**2**
2-ethylhexyl acetate	23	21	**22**	-	-	-	22	23	**23**
2-ethylhexyl acrylate	6	6	**6**	-	-	-	5	5	**5**
butyl propanoate	8	6	**7**	-	-	-	11	10	**10**
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	573	582	**577**	-	-	-	1146	1159	**1152**
dimethyl perhydro-1,3-oxazine	68	73	**70**	-	-	-	164	168	**166**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	68	132	**100**	-	-	-	77	50	**64**
Total	5645	5832	**5738**	-	-	-	6091	6089	**6090**
TVOC	**3678**	**3815**	**3746**	-	-	-	**4851**	**4805**	**4828**
non-TVOC	46	42	**44**	-	-	-	46	43	**45**

Table C79. Emission values of primer and paint A spread onto filler and plaster B applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	-	-	-	18	21	**20**	-	-	-
AROMATIC HYDROCARBONS									
ethylbenzene	-	-	-	2	2	**2**	-	-	-
isopropylbenzene	-	-	-	3	3	**3**	-	-	-
p,m-xylene	-	-	-	2	2	**2**	-	-	-
styrene	-	-	-	6	6	**6**	-	-	-
MONATOMIC ALCOHOLS									
1-butanol	-	-	-	5	5	**5**	-	-	-
2-ethyl-1-hexanol	-	-	-	58	63	**60**	-	-	-
DIVALENT ALCOHOLS									
1,2-propanediol	-	-	-	1332	1364	**1348**	-	-	-
ETHERS									
butyl ether	-	-	-	3	3	**3**	-	-	-
bis(2-ethoxyethyl)ether	-	-	-	1	1	**1**	-	-	-
bis[2-(2-ethoxyethoxy)ethyl]ether	-	-	-	10	10	**10**	-	-	-
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	-	-	-	105	109	**107**	-	-	-
2-[2-(2ethoxy)ethoxy]ethanol	-	-	-	6	6	**6**	-	-	-
2-(2-butoxyethoxy)ethanol	-	-	-	200	205	**202**	-	-	-
ALDEHYDES									
benzaldehyde	-	-	-	5	6	**5**	-	-	-
nonanal	-	-	-	2	3	**3**	-	-	-
KETONES									
acetone	-	-	-	9	10	**10**	-	-	-
ESTERS AND LACTONES									
texanol	-	-	-	718	727	**723**	-	-	-
TXIB	-	-	-	2	2	**2**	-	-	-
2-ethylhexyl acetate	-	-	-	17	17	**17**	-	-	-
2-ethylhexyl acrylate	-	-	-	6	6	**6**	-	-	-
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	-	-	-	141	136	**139**	-	-	-
dimethyl perhydro-1,3-oxazine	-	-	-	12	12	**12**	-	-	-
Total	-	-	-	2661	2719	**2690**	-	-	-
TVOC	-	-	-	**1581**	**1627**	**1604**	-	-	-
non-TVOC	-	-	-	9	10	**10**	-	-	-

Table C80. Emission values of primer and paint A spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	7	8	**8**	-	-	-	9	10	**9**
AROMATIC HYDROCARBONS									
styrene	2	2	**2**	-	-	-	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	3	3	**3**	-	-	-	6	6	**6**
2-ethyl-1-hexanol	32	33	**33**	-	-	-	55	55	**55**
DIVALENT ALCOHOLS									
1,2-propanediol	373	377	**375**	-	-	-	509	518	**514**
ETHERS									
butyl ether	1	1	**1**	-	-	-	2	2	**2**
bis(2-ethoxyethyl)ether	0.2	0.3	**0.3**	-	-	-	0.2	0.1	**0.2**
bis[2-(2-ethoxyethoxy)ethyl]ether	6	6	**6**	-	-	-	9	9	**9**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	22	23	**23**	-	-	-	34	36	**35**
2-[2-(2ethoxy)ethoxy]ethanol	4	4	**4**	-	-	-	5	6	**5**
2-(2-butoxyethoxy)ethanol	82	86	**84**	-	-	-	103	103	**103**
ALDEHYDES									
benzaldehyde	0	0	**0**	-	-	-	3	3	**3**
KETONES									
acetone	0	0	**0**	-	-	-	5	4	**4**
ESTERS AND LACTONES									
texanol	282	286	**284**	-	-	-	459	459	**459**
TXIB	0	0	**0**	-	-	-	3	3	**3**
2-ethylhexyl acetate	8	9	**8**	-	-	-	12	13	**13**
2-ethylhexyl acrylate	4	4	**4**	-	-	-	6	6	**6**
2-ethyl-1-hexyl propionate	5	5	**5**	-	-	-	5	5	**5**
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	33	34	**33**	-	-	-	232	241	**236**
dimethyl perhydro-1,3-oxazine	3	3	**3**	-	-	-	24	25	**24**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	-	-	-	5	4	**4**
Total	868	885	**876**	-	-	-	1483	1504	**1494**
TVOC	**528**	**546**	**537**	-	-	-	**1132**	**1155**	**1144**
non-TVOC	0	0	**0**	-	-	-	5	4	**4**

Table C81. Background emission values of primer and paint A spread onto plaster C applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
AROMATIC HYDROCARBONS			
p,m-xylene	0	4	0
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	0	6
TVOC	**20**	**27**	**38**

Table C82. Emission values of primer and paint A spread onto plaster C applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	91	96	**93**	96	182	**139**	-	-	-
decane	0	1	**1**	1	2	**2**	-	-	-
dodecane	0.9	0.9	**0.9**	0	0.9	**0.5**	-	-	-
AROMATIC HYDROCARBONS									
ethylbenzene	5	5	**5**	6	6	**6**	-	-	-
propylbenzene	1	1	**1**	1	1	**1**	-	-	-
isopropylbenzene	4	4	**4**	4	4	**4**	-	-	-
p,m-xylene	7	8	**8**	6	6	**6**	-	-	-
o-xylene	4	4	**4**	4	4	**4**	-	-	-
styrene	21	21	**21**	23	23	**23**	-	-	-
toluene	0.9	0.5	**0.7**	0.9	0.9	**0.9**	-	-	-
1,2,4-trimethylbenzene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	-	-	-
MONATOMIC ALCOHOLS									
2-propanol	2	2	**2**	3	3	**3**	-	-	-
1-butanol	8	8	**8**	16	16	**16**	-	-	-
2-ethyl-1-hexanol	1	0.9	**1**	3	6	**4**	-	-	-
benzyl alcohol	0	0	**0**	2	0	**1**	-	-	-
DIVALENT ALCOHOLS									
1,2-propanediol	2741	2773	**2757**	2418	2486	**2452**	-	-	-
ETHERS									
butyl ether	50	50	**50**	50	55	**52**	-	-	-
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	4	4	**4**	3	3	**3**	-	-	-
2-(2-butoxyethoxy)ethanol	6	6	**6**	6	8	**7**	-	-	-
2-butoxyethanol	0	15	**8**	0	0	**0**	-	-	-
2-(2-butoxy-isopropoxy)-2-propanol, isomers	46	50	**48**	55	55	**55**	-	-	-
ALDEHYDES									
benzaldehyde	2	8	**5**	11	6	**8**	-	-	-
hexanal	0	0	**0**	3	0	**1**	-	-	-
heptanal	0	0	**0**	0	2	**1**	-	-	-
nonanal	0	0	**0**	2	2	**2**	-	-	-
decanal	0	0	**0**	0	2	**1**	-	-	-
KETONES									
acetophenone	2	2	**2**	1	1	**1**	-	-	-
acetone	11	7	**9**	18	15	**16**	-	-	-
ESTERS AND LACTONES									
texanol	1055	1082	**1068**	1350	1364	**1357**	-	-	-
TXIB	0	0	**0**	2	2	**2**	-	-	-
butyl propanoate	6	6	**6**	6	6	**6**	-	-	-
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	13	12	**12**	14	13	**13**	-	-	-
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0.5	**0.3**	0	0	**0**	-	-	-
Total	4081	4166	**4124**	4103	4273	**4188**	-	-	-
TVOC	**2582**	**2659**	**2620**	**3051**	**3183**	**3117**	-	-	-
non-TVOC	13	9	**11**	21	17	**19**	-	-	-

Table C83. Emission values of primer and paint A spread onto plaster C applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	-	-	-	-	-	-	19	19	**19**
decane	-	-	-	-	-	-	1	1	**1**
undecane	-	-	-	-	-	-	0	1	**0**
pentadecane	-	-	-	-	-	-	1	1	**1**
hexadecane	-	-	-	-	-	-	0	1	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	-	-	-	-	-	-	1	1	**1**
styrene	-	-	-	-	-	-	1	1	**1**
MONATOMIC ALCOHOLS									
2-propanol	-	-	-	-	-	-	1	1	**1**
1-butanol	-	-	-	-	-	-	8	8	**8**
2-ethyl-1-hexanol	-	-	-	-	-	-	1	2	**2**
benzyl alcohol	-	-	-	-	-	-	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	-	-	-	-	-	-	750	764	**757**
ETHERS									
butyl ether	-	-	-	-	-	-	4	5	**4**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	-	-	-	-	-	-	1	1	**1**
2-(2-butoxyethoxy)ethanol	-	-	-	-	-	-	0	2	**1**
2-(2-butoxy-isopropoxy)-2-propanol, isomers	-	-	-	-	-	-	6	6	**6**
ALDEHYDES									
benzaldehyde	-	-	-	-	-	-	2	1	**1**
pentanal	-	-	-	-	-	-	0	1	**1**
nonanal	-	-	-	-	-	-	1	2	**1**
KETONES									
acetone	-	-	-	-	-	-	7	5	**6**
ESTERS AND LACTONES									
texanol	-	-	-	-	-	-	568	568	**568**
TXIB	-	-	-	-	-	-	3	3	**3**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	-	-	-	-	-	-	5	5	**5**
Total	-	-	-	-	-	-	1381	1398	**1389**
TVOC	-	-	-	-	-	-	**946**	**937**	**942**
non-TVOC	-	-	-	-	-	-	8	6	**7**

Table C84. Emission values of primer and paint A spread onto plaster C applied onto calcium silicate brick at 14 days in the environmental chamber test.

(μg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	7	7	**7**	-	-	-	11	11	**11**
1-octene	0	0.5	**0.3**	-	-	-	0	0	**0**
hexadecane	0.5	0.5	**0.5**	-	-	-	0	0	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	0.5	0.5	**0.5**	-	-	-	0.9	0.5	**0.7**
toluene	0.5	0.5	**0.5**	-	-	-	0.5	0.5	**0.5**
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	-	-	-	0.5	0	**0.3**
1-butanol	2	2	**2**	-	-	-	6	6	**6**
2-ethyl-1-hexanol	0	0.5	**0.3**	-	-	-	0.5	0.5	**0.5**
benzyl alcohol	0.5	0	**0.3**	-	-	-	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	146	141	**143**	-	-	-	259	259	**259**
2,2,4-trimethyl-1,3-pentanediol	2	3	**3**	-	-	-	0.9	0.9	**0.9**
ETHERS									
butyl ether	0.9	0.9	**0.9**	-	-	-	2	3	**3**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	3	3	**3**	-	-	-	0	0.5	**0.3**
2-(2-butoxy-isopropoxy)-2-propanol, isomers	4	4	**4**	-	-	-	0	0	**0**
ALDEHYDES									
benzaldehyde	0.5	0.5	**0.5**	-	-	-	1	2	**2**
hexanal	0	0	**0**	-	-	-	1	1	**1**
octanal	0	0	**0**	-	-	-	1	0	**1**
nonanal	0.5	0	**0.3**	-	-	-	3	0.5	**2**
decanal	0.9	0.5	**0.7**	-	-	-	2	0	**1**
KETONES									
acetophenone	0	0.5	**0**	-	-	-	0	0	**0**
acetone	0.9	1	**1**	-	-	-	2	2	**2**
ESTERS AND LACTONES									
texanol	300	305	**302**	-	-	-	236	241	**239**
TXIB	3	3	**3**	-	-	-	3	3	**3**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.9	0.9	**0.9**	-	-	-	2	2	**2**
4,4-dimethyl-1,3-oxazolidine	0	0	**0**	-	-	-	3	3	**3**
Total	473	474	**473**	-	-	-	538	538	**538**
TVOC	**446**	**459**	452	-	-	-	**378**	**387**	383
non-TVOC	0.9	1	**1**	-	-	-	3	2	**3**

Table C85. Background emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
DIVALENT ALCOHOLS			
1,2-propanediol	0	6	0
ESTERS AND LACTONES			
texanol	0	0	17
TVOC	**20**	**32**	**58**

Table C86. Emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	3	**1**	0	0.9	**0.5**	0	0	**0**
decane	0	0	**0**	0	0	**0**	0	0.9	**0.5**
dodecane	0	0	**0**	0	0.9	**0.5**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0.9	0	**0.5**	0.5	2	**1**	0	0	**0**
ethylbenzene	4	4	**4**	3	2	**3**	5	5	**5**
propylbenzene	1	1	**1**	0.9	0.9	**0.9**	2	2	**2**
isopropylbenzene	3	3	**3**	2	2	**2**	4	4	**4**
p,m-xylene	4	4	**4**	4	4	**4**	4	4	**4**
o-xylene	2	1	**2**	1	1	**1**	2	2	**2**
styrene	4	4	**4**	3	3	**3**	7	7	**7**
toluene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	1	**1**
1,2,4-trimethylbenzene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,3,5-trimethylbenzene	0	0	**0**	0	0	**0**	0	1	**1**
1-ethyl-2-methylbenzene	0.5	0.5	**0.5**	0	0	**0**	0.5	0.5	**0.5**
MONATOMIC ALCOHOLS									
2-propanol	10	11	**10**	4	4	**4**	9	9	**9**
1-butanol	4	4	**4**	3	3	**3**	7	7	**7**
2-ethyl-1-hexanol	16	16	**16**	34	34	**34**	159	159	**159**
benzyl alcohol	0.9	0	**0.5**	0	0.5	**0.3**	0.9	0	**0**
2-methyl-1-propanol	0	0	**0**	0	0	**0**	0	2	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	150	150	**150**	179	42	**111**	64	50	**57**
ETHERS									
bis(2-ethoxyethyl)ether	0	0	**0**	0	0	**0**	10	9	**9**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	96	100	**98**	200	200	**200**	159	159	**159**
2-(2-butoxyethoxy)ethanol	250	259	**255**	427	418	**423**	427	432	**430**
2-butoxyethanol	0	0	**0**	0	2	**1**	2	0	**1**

Table C86. Emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test. Table continues

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALDEHYDES									
benzaldehyde	6	2	**4**	5	5	**5**	10	6	**8**
pentanal	0	2	**1**	0	0	**0**	0	0	**0**
octanal	0	2	**1**	0	0	**0**	0	0	**0**
nonanal	0	7	**3**	0	0	**0**	0	0	**0**
decanal	0	0.5	**0.3**	0	0	**0**	0	0	**0**
KETONES									
acetophenone	0.5	2	**1**	0.9	2	**1**	1	1	**1**
acetone	17	21	**19**	13	55	**34**	27	24	**25**
4-methyl-2-pentanone	0	0	**0**	0	0	**0**	0	15	**8**
ACIDS									
acetic acid	168	205	**186**	132	0	**66**	0	0	**0**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0	**0**	4	4	**4**
ESTERS AND LACTONES									
texanol	23	8	**15**	20	16	**18**	0.9	0.9	**0.9**
2-ethylhexyl acetate	5	6	**6**	5	5	**5**	16	16	**16**
2-ethylhexyl acrylate	2	1	**2**	1	1	**1**	3	4	**3**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	13	13	**13**	13	14	**13**	3	4	**3**
2-amino-2-methyl-1-propanol	0	0	**0**	0	0	**0**	9	9	**9**
4,4-dimethyl-1,3-oxazolidine	64	64	**64**	127	43	**85**	823	814	**818**
dimethyl perhydro-1,3-oxazine	7	7	**7**	13	6	**9**	96	91	**93**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0.5	0.5	**0.5**	0.5	0.5	**0.5**	0.9	1	**1**
Total	853	904	**878**	1193	869	**1031**	1857	1844	**1850**
TVOC	**250**	**273**	**261**	**445**	**358**	**401**	**1310**	**1287**	**1299**
non-TVOC	195	236	**215**	149	58	**104**	36	33	**35**

Table C87. Emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	-	-	-	-	-	-	1	1	**1**
decane	-	-	-	-	-	-	1	1	**1**
dodecane	-	-	-	-	-	-	1	1	**1**
AROMATIC HYDROCARBONS									
ethylbenzene	-	-	-	-	-	-	1	1	**1**
propylbenzene	-	-	-	-	-	-	1	1	**1**
isopropylbenzene	-	-	-	-	-	-	1	1	**1**
p,m-xylene	-	-	-	-	-	-	1	1	**1**
o-xylene	-	-	-	-	-	-	1	1	**1**
styrene	-	-	-	-	-	-	2	2	**2**
1,2,4-trimethylbenzene	-	-	-	-	-	-	1	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	-	-	-	-	-	-	1	1	**1**
1-butanol	-	-	-	-	-	-	4	5	**4**
2-ethyl-1-hexanol	-	-	-	-	-	-	68	68	**68**
benzyl alcohol	-	-	-	-	-	-	1	1	**1**
2-methyl-1-propanol	-	-	-	-	-	-	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	-	-	-	-	-	-	33	34	**33**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	-	-	-	-	-	-	82	82	**82**
2-(2-butoxyethoxy)ethanol	-	-	-	-	-	-	255	259	**257**
2-butoxyethanol	-	-	-	-	-	-	0	1	**0**
ALDEHYDES									
benzaldehyde	-	-	-	-	-	-	5	5	**5**
octanal	-	-	-	-	-	-	2	0	**1**
nonanal	-	-	-	-	-	-	5	2	**3**
decanal	-	-	-	-	-	-	4	0	**2**
KETONES									
acetophenone	-	-	-	-	-	-	1	0	**0**
acetone	-	-	-	-	-	-	10	9	**9**
TERPENES AND THEIR DERIVATIVES									
limonene	-	-	-	-	-	-	1	2	**2**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	-	-	-	-	-	-	1	0	**0**
texanol	-	-	-	-	-	-	27	28	**28**
2-ethylhexyl acetate	-	-	-	-	-	-	11	11	**11**
2-ethylhexyl acrylate	-	-	-	-	-	-	5	5	**5**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	-	-	-	-	-	-	1	1	**1**
2-amino-2-methyl-1-propanol	-	-	-	-	-	-	6	6	**6**
4,4-dimethyl-1,3-oxazolidine	-	-	-	-	-	-	264	282	**273**
dimethyl perhydro-1,3-oxazine	-	-	-	-	-	-	26	28	**27**
Total	-	-	-	-	-	-	821	840	**830**
TVOC	-	-	-	-	-	-	**728**	**569**	**649**
non-TVOC	-	-	-	-	-	-	11	11	**11**

Table C88. Emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
undecane	0.2	0.2	**0.2**	-	-	-	0	0	**0**
dodecane	0	0	**0**	-	-	-	0	0.9	**0.5**
tetradecane	0.4	0	**0.2**	-	-	-	0	0	**0**
pentadecane	0.2	0.3	**0.3**	-	-	-	0	0	**0**
hexadecane	1	0.9	**1**	-	-	-	0.9	0.9	**0.9**
AROMATIC HYDROCARBONS									
ethylbenzene	0.3	0.4	**0.4**	-	-	-	0	0.5	**0.3**
propylbenzene	0.2	0.2	**0.2**	-	-	-	0	0	**0**
isopropylbenzene	0.4	0.4	**0.4**	-	-	-	0.5	0.5	**0.5**
p,m-xylene	0.9	0.9	**0.9**	-	-	-	0.9	0.9	**0.9**
o-xylene	0.4	0.4	**0.4**	-	-	-	0	0.5	**0**
styrene	0.5	0.5	**0.5**	-	-	-	0.5	0.5	**0.5**
toluene	0.5	0.5	**0.5**	-	-	-	0.5	0.5	**0.5**
1,2,4-trimethylbenzene	0.3	0.3	**0.3**	-	-	-	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	0.4	0	**0.2**	-	-	-	0.5	0.5	**0.5**
1-butanol	0.9	1	**1**	-	-	-	3	3	**3**
2-ethyl-1-hexanol	6	6	**6**	-	-	-	40	40	**40**
benzyl alcohol	0.5	0.5	**0.5**	-	-	-	1	1	**1**
2-methyl-1-propanol	0	0	**0**	-	-	-	0.9	0.9	**0.9**
DIVALENT ALCOHOLS									
1,2-propanediol	8	9	**8**	-	-	-	20	19	**19**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	1	1	**1**	-	-	-	8	9	**8**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	7	7	**7**	-	-	-	27	28	**28**
2-(2-butoxyethoxy)ethanol	44	46	**45**	-	-	-	114	114	**114**
2-butoxyethanol	0.3	0.3	**0.3**	-	-	-	0	0	**0**
ALDEHYDES									
benzaldehyde	1	2	**2**	-	-	-	3	3	**3**
pentanal	0	0	**0**	-	-	-	0	0.5	**0.3**
octanal	0	0	**0**	-	-	-	0.9	0	**0.5**
nonanal	0	0.4	**0.2**	-	-	-	0.9	0	**0.5**
decanal	0.4	0	**0.2**	-	-	-	0	0	**0**
KETONES									
acetophenone	0	0.2	**0.1**	-	-	-	0	0	**0**
acetone	0.9	0.9	**0.9**	-	-	-	4	3	**3**
ACIDS									
acetic acid	0	9	**5**	-	-	-	6	0	**3**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethylacetate	0	0	**0**	-	-	-	0	1	**1**
texanol	6	3	**4**	-	-	-	25	25	**25**
2-ethylhexyl acetate	1	0.9	**1**	-	-	-	6	6	**6**
2-ethylhexyl acrylate	0.5	0.5	**0.5**	-	-	-	4	4	**4**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.9	0.9	**0.9**	-	-	-	0.9	0.5	**0.7**
2-amino-2-methyl-1-propanol	0	0	**0**	-	-	-	5	6	**5**
4,4-dimethyl-1,3-oxazolidine	5	6	**5**	-	-	-	159	159	**159**
dimethyl perhydro-1,3-oxazine	0	0	**0**	-	-	-	15	16	**15**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	-	-	-	4	6	**5**
Total	89	98	**94**	-	-	-	449	447	**448**
TVOC	**25**	**26**	**25**	-	-	-	**324**	**324**	**324**
non-TVOC	1	10	**6**	-	-	-	10	3	**7**

Table C89. Background emission values of primer and paint B spread onto plaster C applied onto calcium silicate brick in the environmental chamber test.

(µg/m^3)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol			13
TVOC	**6**	**16**	**25**

Table C90. Emission values of primer and paint B spread onto plaster C applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	-	-	-	1	1	**1**
dodecane	0	0	**0**	-	-	-	0.5	0	**0.3**
pentadecane	0	0	**0**	-	-	-	0.9	0	**0.5**
hexadecane	0	0	**0**	-	-	-	1	0.9	**1**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	-	-	-	0	0	**0**
ethylbenzene	1	1	**1**	-	-	-	2	2	**2**
p,m-xylene	3	3	**3**	-	-	-	5	6	**5**
o-xylene	0.9	0.9	**0.9**	-	-	-	2	2	**2**
styrene	0.9	0.9	**0.9**	-	-	-	0.9	0.9	**0.9**
toluene	0.3	0	**0.2**	-	-	-	0.9	1	**1**
1,2,4-trimethylbenzene	0	0	**0**	-	-	-	0.9	0.9	**0.9**
MONATOMIC ALCOHOLS									
2-propanol	14	14	**14**	-	-	-	24	28	**26**
2-ethyl-1-hexanol	1	0.9	**1**	-	-	-	4	2	**3**
benzylalcohol	2	2	**2**	-	-	-	2	2	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	123	118	**120**	-	-	-	59	64	**61**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	9	9	**9**	-	-	-	10	12	**11**
2-(2-butoxyethoxy)ethanol	100	96	**98**	-	-	-	135	140	**137**
2-phenoxyethanol	0	0	**0**	-	-	-	0	0.5	**0.3**
ALDEHYDES									
benzaldehyde	5	6	**5**	-	-	-	4	5	**4**
octanal	0	0	**0**	-	-	-	4	3	**3**
nonanal	0	3	**2**	-	-	-	9	6	**8**
decanal	0	0.5	**0.3**	-	-	-	11	5	**8**
KETONES									
acetophenone	0.2	0.9	**0.6**	-	-	-	0	2	**1**
acetone	6	5	**5**	-	-	-	9	11	**10**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	24	23	**23**	-	-	-	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	-	-	-	9	32	**20**
decamethylcyclopentasiloxane	0.4	0.4	**0.4**	-	-	-	0	0	**0**
Total	291	285	**288**	-	-	-	295	327	**311**
TVOC	**56**	**56**	**56**	-	-	-	**102**	**107**	**105**
non-TVOC	20	19	**19**	-	-	-	33	39	**36**

Table C91. Emission values of primer and paint B spread onto plaster C applied onto calcium silicate brick at 7 days in the environmental chamber test.

$(\mu g/m^2 \cdot h)$	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.2	0	**0.1**	-	-	-	-	-	-
tetradecane	0.2	0	**0.1**	-	-	-	-	-	-
pentadecane	0.1	0.2	**0.2**	-	-	-	-	-	-
hexadecane	0.3	0.3	**0.3**	-	-	-	-	-	-
AROMATIC HYDROCARBONS									
ethylbenzene	0.2	0.2	**0.2**	-	-	-	-	-	-
p,m-xylene	1	1	**1**	-	-	-	-	-	-
o-xylene	0.2	0.2	**0.2**	-	-	-	-	-	-
toluene	0.3	0.3	**0.3**	-	-	-	-	-	-
1,2,4-trimethylbenzene	0.1	0.2	**0.2**	-	-	-	-	-	-
MONATOMIC ALCOHOLS									
2-propanol	0.9	1	**1**	-	-	-	-	-	-
1-butanol	0.9	0.9	**0.9**	-	-	-	-	-	-
benzylalcohol	0.3	0.3	**0.3**	-	-	-	-	-	-
DIVALENT ALCOHOLS									
1,2-propanediol	6	7	**7**	-	-	-	-	-	-
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0.5	0.5	**0.5**	-	-	-	-	-	-
2-(2-butoxyethoxy)ethanol	13	13	**13**	-	-	-	-	-	-
2-butoxyethanol	0.4	0.4	**0.4**	-	-	-	-	-	-
2-phenoxyethanol	0	0.2	**0.1**	-	-	-	-	-	-
ALDEHYDES									
benzaldehyde	1	0.9	**1**	-	-	-	-	-	-
nonanal	0.4	0.9	**0.7**	-	-	-	-	-	-
decanal	0.5	0.9	**0.7**	-	-	-	-	-	-
KETONES									
acetophenone	0.3	0.3	**0.3**	-	-	-	-	-	-
acetone	0.9	1	**1**	-	-	-	-	-	-
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	1	2	**2**	-	-	-	-	-	-
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0.3	**0.2**	-	-	-	-	-	-
Total	29	32	**30**	-	-	-	-	-	-
TVOC	**10**	**12**	**11**	-	-	-	-	-	-
non-TVOC	0.9	3	**2**	-	-	-	-	-	-

Table C92. Emission values of primer and paint B spread onto plaster C applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0.5	0.5	**0.5**	0.9	0.9	**0.9**
decane	0.3	0.2	**0.3**	2	2	**2**	2	2	**2**
undecane	0.3	0.4	**0.4**	0.9	1	**0.9**	0.9	0.9	**0.9**
dodecane	0.1	0.1	**0.1**	0.4	0.5	**0.5**	0.4	0.4	**0.4**
tridecane	0	0	**0**	0.2	0	**0.1**	0	0	**0**
tetradecane	0	0.1	**0.1**	0.2	0	**0.1**	0.3	0.4	**0.4**
pentadecane	0	0.2	**0.1**	0	0	**0**	0	0	**0**
hexadecane	0	0.3	**0.2**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0.1	**0.1**	0	0	**0**	0	0	**0**
ethylbenzene	0.1	0.1	**0.1**	0.3	0.3	**0.3**	0	0	**0**
p,m-xylene	0.4	0.4	**0.4**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
o-xylene	0.1	0.1	**0.1**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
toluene	0.3	0.4	**0.4**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
1,2,4-trimethylbenzene	0.1	0.1	**0.1**	0.5	0.5	**0.5**	0.5	0.5	**0.5**
1,3,5-trimethylbenzene	0	0	**0**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	0.9	0.9	**0.9**	1	1	**1**
1-butanol	0.4	0.4	**0.4**	0	0	**0**	0.9	0.9	**0.9**
2-ethyl-1-hexanol	0.4	0.2	**0.3**	0.5	0.5	**0.5**	1	0.5	**0.5**
benzylalcohol	0.3	0.2	**0.3**	0.5	0.5	**0.5**	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	1	2	**2**	3	0.9	**2**	10	10	**10**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0.2	**0.1**	0	0	**0**	0.9	0.9	**1**
2-(2-butoxyethoxy)ethanol	3	3	**3**	7	7	**7**	20	21	**20**
2-butoxyethanol	0.3	0.3	**0.3**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	1	0.9	**1**	0.9	1	**1**	0.9	1	**1**
pentanal	0.3	0	**0.2**	0	0	**0**	0	0	**0**
octanal	0	0	**0**	1	0	**1**	0	0	**0**
nonanal	0.5	0.9	**0.7**	2	2	**2**	2	0.9	**1**
decanal	0.1	0.9	**0.5**	4	2	**3**	0.9	1	**1**
KETONES									
acetophenone	0	0.2	**0.1**	0	0	**0**	0	0	**0**
acetone	0.4	0.5	**0.5**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.5	0.5	**0.5**	0	0	**0**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0.4	0.3	**0.4**
Total	11	13	**12**	29	25	**27**	47	49	**48**
TVOC	**3**	**7**	**5**	**19**	**13**	**16**	**21**	**20**	**20**
non-TVOC	0.4	0.5	**0.5**	2	2	**2**	2	2	**2**

Table C93. Background emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	0	29
TVOC	**7**	**11**	**34**

Table C94. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-octene	0	6	**3**	0	0	**0**	0	0	**0**
dodecane	0	4	**2**	4	3	**3**	3	0	**2**
hexadecane	5	0	**2**	5	5	**5**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0.9	0.5	**0.7**	0.5	0.9	**0.7**	0	0.9	**0.5**
ethylbenzene	11	11	**11**	9	9	**9**	8	8	**8**
propylbenzene	5	5	**5**	5	5	**5**	5	5	**5**
isopropylbenzene	10	10	**10**	9	9	**9**	8	8	**8**
p,m-xylene	6	6	**6**	6	6	**6**	6	6	**6**
o-xylene	5	5	**5**	4	4	**4**	4	4	**4**
styrene	19	19	**19**	15	15	**15**	13	13	**13**
toluene	1	1	**1**	1	0.9	**1**	0.9	0.9	**0.9**
MONATOMIC ALCOHOLS									
2-propanol	5	6	**5**	0	0	**0**	5	4	**4**
1-butanol	15	16	**15**	13	13	**13**	13	12	**13**
2-ethyl-1-hexanol	664	682	**673**	541	532	**536**	541	527	**534**
2-methyl-1-propanol	0	7	**3**	6	6	**6**	5	0	**3**
2-methyl-2-propanol	40	46	**43**	30	31	**30**	29	26	**28**
DIVALENT ALCOHOLS									
1,2-propanediol	0	13	**7**	0	0	**0**	0	0	**0**
ETHERS									
bis(2-ethoxyethyl)ether	17	22	**20**	19	23	**21**	19	16	**17**
PHENOLS									
phenol	1	0	**1**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	42	41	**42**	55	55	**55**	50	50	**50**
2-(2-butoxyethoxy)ethanol	196	177	**186**	209	209	**209**	187	187	**187**
1-methoxy-2-propanol	0	6	**3**	0	6	**3**	0	0	**0**
2-ethoxyethanol	10	11	**10**	9	8	**8**	6	6	**6**
2-butoxyethanol	9	10	**9**	7	7	**7**	6	7	**7**
2-phenoxyethanol	0	8	**4**	0	8	**4**	0	0	**0**
ALDEHYDES									
benzaldehyde	20	18	**19**	11	11	**11**	12	16	**14**
n-butanal	8	8	**8**	0	0	**0**	0	0	**0**
heptanal	0	0	**0**	4	0	**2**	0	0	**0**
nonanal	6	8	**7**	7	10	**8**	9	8	**8**
decanal	0	2	**1**	2	3	**3**	4	2	**3**
KETONES									
acetophenone	0.5	3	**2**	0.5	0.5	**0.5**	0	2	**1**
acetone	77	82	**80**	64	64	**64**	55	55	**55**
4-methyl-2-pentanone	0	11	**5**	15	0	**8**	19	33	**26**
ACIDS									
acetic acid	7	38	**23**	15	30	**22**	0	20	**10**
ESTERS AND LACTONES									
texanol	14	10	**12**	17	16	**17**	21	21	**21**
2-ethylhexyl acetate	59	59	**59**	50	50	**50**	50	50	**50**
2-ethylhexyl acrylate	13	13	**13**	13	12	**13**	13	12	**13**
2-ethyl-1-hexyl propionate	10	11	**10**	8	8	**8**	9	9	**9**

Table C94. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test. Table continues

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	1636	1641	**1639**	1946	1896	**1921**	1764	1741	**1752**
dimethyl perhydro-1,3-oxazine	250	259	**255**	300	291	**295**	273	264	**268**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	82	59	**70**	64	82	**73**	55	25	**40**
Total	3243	3331	**3287**	3460	3427	**3444**	3188	3137	**3163**
TVOC	**2770**	**2770**	**2770**	**2995**	**2950**	**2972**	**2757**	**2712**	**2735**
non-TVOC	130	171	**150**	108	124	**116**	88	105	**97**

Table C95. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
dodecane	-	-	-	-	-	-	2	2	**2**
AROMATIC HYDROCARBONS									
ethylbenzene	-	-	-	-	-	-	2	2	**2**
propylbenzene	-	-	-	-	-	-	1	1	**1**
isopropylbenzene	-	-	-	-	-	-	3	3	**3**
p,m-xylene	-	-	-	-	-	-	2	2	**2**
o-xylene	-	-	-	-	-	-	1	1	**1**
styrene	-	-	-	-	-	-	3	3	**3**
toluene	-	-	-	-	-	-	1	1	**1**
1,2,4-trimethylbenzene	-	-	-	-	-	-	1	1	**1**
1,3,5-trimethylbenzene	-	-	-	-	-	-	1	1	**1**
MONATOMIC ALCOHOLS									
1-butanol	-	-	-	-	-	-	6	5	**5**
2-ethyl-1-hexanol	-	-	-	-	-	-	91	91	**91**
benzylalcohol	-	-	-	-	-	-	4	3	**3**
2-methyl-1-propanol	-	-	-	-	-	-	0	2	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	-	-	-	-	-	-	6	6	**6**
PHENOLS									
phenol	-	-	-	-	-	-	1	2	**2**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	-	-	-	-	-	-	109	105	**107**
2-(2-butoxyethoxy)ethanol	-	-	-	-	-	-	287	282	**285**
ALDEHYDES									
benzaldehyde	-	-	-	-	-	-	6	6	**6**
nonanal	-	-	-	-	-	-	2	2	**2**
decanal	-	-	-	-	-	-	1	0	**1**
KETONES									
acetophenone	-	-	-	-	-	-	0	1	**0**

Table C95. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 7 days in the environmental chamber test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ACIDS									
acetic acid	-	-	-	-	-	-	9	16	**13**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	-	-	-	-	-	-	3	3	**3**
texanol	-	-	-	-	-	-	37	36	**36**
TXIB	-	-	-	-	-	-	2	0	**1**
2-ethylhexyl acetate	-	-	-	-	-	-	24	26	**25**
2-ethylhexyl acrylate	-	-	-	-	-	-	11	10	**10**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	-	-	-	-	-	-	3	3	**3**
4,4-dimethyl-1,3-oxazolidine	-	-	-	-	-	-	509	518	**514**
dimethyl perhydro-1,3-oxazine	-	-	-	-	-	-	59	59	**59**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	-	-	-	-	-	-	31	13	**22**
Total	-	-	-	-	-	-	1217	1206	**1211**
TVOC	-	-	-	-	-	-	**966**	**939**	**953**
non-TVOC	-	-	-	-	-	-	9	16	**13**

Table C96. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0	0	**0**	-	-	-	0.9	2	**1**
dodecane	0.9	0.5	**0.7**	-	-	-	1	1	**1**
AROMATIC HYDROCARBONS									
ethylbenzene	0.5	0.5	**0.5**	-	-	-	0	0	**0**
propylbenzene	0.5	0.5	**0.5**	-	-	-	0	0	**0**
isopropylbenzene	1	1	**1**	-	-	-	0.9	0.9	**0.9**
p,m-xylene	0.5	0.5	**0.5**	-	-	-	0	0	**0**
styrene	1	1	**1**	-	-	-	0.9	0.9	**0.9**
toluene	0	0	**0**	-	-	-	0	0.5	**0.3**
MONATOMIC ALCOHOLS									
1-butanol	1	2	**2**	-	-	-	4	4	**4**
2-ethyl-1-hexanol	29	30	**29**	-	-	-	55	59	**57**
benzylalcohol	0.9	0.5	**0.7**	-	-	-	1	1	**1**
2-methyl-1-propanol	0	0	**0**	-	-	-	0	0.9	**0.5**
DIVALENT ALCOHOLS									
1,2-propanediol	1	0.9	**1**	-	-	-	1	3	**2**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	2	2	**2**	-	-	-	13	13	**13**
PHENOLS									
phenol	0.5	0.5	**0.5**	-	-	-	1	0.9	**1**

Table C96. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the environmental chamber test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	14	14	**14**	-	-	-	50	50	**50**
2-[2-(2ethoxy)ethoxy]ethanol	0.9	0.9	**0.9**	-	-	-	6	6	**6**
2-(2-butoxyethoxy)ethanol	35	34	**34**	-	-	-	146	151	**148**
ALDEHYDES									
benzaldehyde	1	2	**2**	-	-	-	3	3	**3**
pentanal	0	0	**0**	-	-	-	0	0.5	**0.3**
octanal	0.9	0.9	**0.9**	-	-	-	0.9	0.9	**0.9**
nonanal	1	2	**2**	-	-	-	1	0.9	**1**
decanal	1	3	**2**	-	-	-	1	0	**1**
KETONES									
acetophenone	0	0	**0**	-	-	-	1	0.5	**1**
acetone	1	1	**1**	-	-	-	4	3	**4**
ACIDS									
acetic acid	59	0	**30**	-	-	-	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	-	-	-	1	1	**1**
texanol	3	3	**3**	-	-	-	44	45	**45**
2-ethylhexyl acetate	12	12	**12**	-	-	-	18	16	**17**
2-ethylhexyl acrylate	6	6	**6**	-	-	-	8	8	**8**
2-ethyl-1-hexyl propionate	5	5	**5**	-	-	-	6	6	**6**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.5	0.5	**0.5**	-	-	-	0.9	0.9	**0.9**
4,4-dimethyl-1,3-oxazolidine	44	44	**44**	-	-	-	300	309	**305**
dimethyl perhydro-1,3-oxazine	6	6	**6**	-	-	-	30	31	**30**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	8	8	**8**	-	-	-	8	10	**9**
decamethylcyclopentasiloxane	0	0.9	**0.5**	-	-	-	0	0	**0**
Total	240	185	**212**	-	-	-	708	729	**718**
TVOC	**129**	**133**	**131**	-	-	-	**576**	**589**	**582**
non-TVOC	61	1	**31**	-	-	-	4	3	**4**

Table C97. Background emission values of adhesive A spread onto plaster C applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	7	0
SILICON CONTAINING COMPOUNDS			
hexamethylcyclotrisiloxane	20	0	0
TVOC	**28**	**35**	**13**

Table C98. Emission values of adhesive A spread onto plaster C applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-octene	0	0	**0**	-	-	-	3	0	**2**
nonane	0	0	**0**	-	-	-	0	2	**1**
decane	0	0	**0**	-	-	-	0	0.9	**0.5**
undecane	0	0	**0**	-	-	-	0.9	0	**0.5**
dodecane	0.9	0.9	**0.9**	-	-	-	0.9	0.9	**0.9**
tridecane	0.9	0.5	**0.7**	-	-	-	0.9	0.9	**0.9**
tetradecane	1	0.9	**1**	-	-	-	1	0.9	**1**
hexadecane	0.9	0.5	**0.7**	-	-	-	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0.5	0	**0.3**	-	-	-	0.9	1	**1**
ethylbenzene	0	0.5	**0.3**	-	-	-	0	0	**0**
p,m-xylene	1	1	**1**	-	-	-	1	1	**1**
o-xylene	0.5	0.5	**0.5**	-	-	-	0.5	0.5	**0.5**
toluene	0.9	1	**1**	-	-	-	0.9	0.9	**0.9**
1,2,4-trimethylbenzene	0.9	0.9	**0.9**	-	-	-	0.9	0.9	**0.9**
1,3,5-trimethylbenzene	0	0	**0**	-	-	-	0	0.5	**0.3**
MONATOMIC ALCOHOLS									
2-propanol	8	8	**8**	-	-	-	15	15	**15**
1-butanol	2	2	**2**	-	-	-	3	3	**3**
2-ethyl-1-hexanol	0	0	**0**	-	-	-	3	0.9	**2**
benzyl alcohol	1	1	**1**	-	-	-	2	2	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	15	0	**8**	-	-	-	0	0	**0**
PHENOLS									
phenol	5	7	**6**	-	-	-	9	7	**8**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	-	-	-	6	0	**3**
2-phenoxyethanol	0.9	0	**0.5**	-	-	-	1	1	**1**
ALDEHYDES									
benzaldehyde	5	5	**5**	-	-	-	8	7	**8**
n-butanal	0	0	**0**	-	-	-	0.9	5	**3**
pentanal	0	0	**0**	-	-	-	0	3	**1**
hexanal	0	0	**0**	-	-	-	3	0	**2**
heptanal	0	0	**0**	-	-	-	0	2	**1**
octanal	0	0	**0**	-	-	-	0	4	**2**
nonanal	3	2	**3**	-	-	-	3	10	**7**
decanal	5	4	**4**	-	-	-	4	14	**9**
KETONES									
acetophenone	0	0	**0**	-	-	-	0.9	0.9	**0.9**
acetone	13	14	**13**	-	-	-	19	20	**19**
4-methyl-2-pentanone	0	0	**0**	-	-	-	2	2	**2**

Table C98. Emission values of adhesive A spread onto plaster C applied onto calcium silicate brick at 1 day in the environmental chamber test. Table continues.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ACIDS									
acetic acid	0	0	**0**	-	-	-	0	50	**25**
ESTERS AND LACTONES									
propylbenzoate	2	2	**2**	-	-	-	6	6	**6**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	6	3	**4**	-	-	-	7	6	**6**
decamethylcyclopentasiloxane	0	0	**0**	-	-	-	2	0	**1**
Total	74	55	**65**	-	-	-	107	167	**137**
TVOC	**51**	**46**	**49**	-	-	-	**71**	**117**	**94**
non-TVOC	21	22	**21**	-	-	-	35	39	**37**

Table C99. Emission values of adhesive A spread onto plaster C applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	4	4	**4**	-	-	-	-	-	-
methylcyclohexane	2	2	**2**	-	-	-	-	-	-
AROMATIC HYDROCARBONS									
benzene	0.1	0.3	**0.2**	-	-	-	-	-	-
p,m-xylene	1	1	**1**	-	-	-	-	-	-
toluene	2	2	**2**	-	-	-	-	-	-
MONATOMIC ALCOHOLS									
2-propanol	0	2	**1**	-	-	-	-	-	-
2-ethyl-1-hexanol	0	1	**0**	-	-	-	-	-	-
PHENOLS									
phenol	0	2	**1**	-	-	-	-	-	-
ALDEHYDES									
benzaldehyde	0	2	**1**	-	-	-	-	-	-
n-butanal	0	2	**1**	-	-	-	-	-	-
octanal	1	1	**1**	-	-	-	-	-	-
nonanal	2	2	**2**	-	-	-	-	-	-
decanal	4	4	**4**	-	-	-	-	-	-
KETONES									
acetophenone	0	1	**0**	-	-	-	-	-	-
acetone	4	5	**4**	-	-	-	-	-	-
ACIDS									
acetic acid	0	3	**2**	-	-	-	-	-	-
Total	20	34	**27**						
TVOC	**0**	**6**	**3**						
non-TVOC	6	10	**8**						

Table C100. Emission values of adhesive A spread onto plaster C applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0.2	**0.1**	0	0	**0**	0	0	**0**
dodecane	0.1	0	**0.1**	0	0.3	**0.2**	0	0.3	**0.2**
tridecane	0	0	**0**	0	0	**0**	0.3	0.3	**0.3**
tetradecane	0	0	**0**	0.3	0.3	**0.3**	0.5	0.5	**0.5**
hexadecane	0.2	0	**0.1**	0	0	**0**	0	0.2	**0.1**
AROMATIC HYDROCARBONS									
benzene	0.1	0	**0.1**	0	0	**0**	0	0	**0**
ethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
p,m-xylene	0.5	0.5	**0.5**	0.9	0.9	**0.9**	0.9	0.5	**0.7**
o-xylene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.2	0.2	**0.2**
toluene	0.3	0.4	**0.4**	0.4	0.4	**0.4**	0.2	0.4	**0.3**
1,2,4-trimethylbenzene	0.2	0.2	**0.2**	0.2	0.2	**0.2**	0.4	0.2	**0.3**
MONATOMIC ALCOHOLS									
2-propanol	0.9	0.9	**0.9**	0.9	0.9	**0.9**	1	1	**1**
1-butanol	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
2-ethyl-1-hexanol	0.5	0.2	**0.4**	0.9	0.5	**0.7**	0.4	0.9	**0.7**
benzyl alcohol	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	1	0	**1**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0.9	0	**0.5**
ALCOHOL AND PHENOL ETHERS									
2-phenoxyethanol	0	0	**0**	0.1	0	**0.1**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0.3	**0.2**	0	0.5	**0.3**	0.9	0.3	**0.6**
n-butanal	0	0	**0**	2	0	**1**	0	2	**1**
nonanal	0.9	1	**1**	2	0.9	**1**	1	2	**2**
decanal	1	2	**2**	3	1	**2**	2	2	**2**
KETONES									
acetophenone	0.3	0	**0.2**	0	0.2	**0.1**	0	0	**0**
acetone	0.9	0.5	**0.7**	1	0.5	**1**	0.9	1	**1**
ACIDS									
acetic acid	0	0	**0**	2	0	**1**	1	0	**1**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	***9***1)	0.9	**5**	8	8	**8**	3	***14***1)	**8**
OTHERS									
unidentified	0	0	**0**	1	0.9	**1**	3	3	**3**
Total	16	8	**12**	23	17	**20**	21	31	**26**
TVOC	***0.9***1)	**0**	**0.5**	**0**	**0**	**0**	**13**	**24**	**19**
non-TVOC	2	1	**2**	6	1	**4**	4	5	**4**

1) *Italic* font indicates that the value is below the detection limit.

Table C101. Background emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
ALCOHOL AND PHENOL ETHERS			
2-(2-butoxyethoxy)ethanol	0	0	10
TERPENES AND THEIR DERIVATIVES			
Limonene	0	3	0
TVOC	**12**	**25**	**24**

Table C102. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-octene	0	5	**2**	-	-	-	2	0	**1**
dodecane	0	2	**1**	-	-	-	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	-	-	-	3	2	**3**
ethylbenzene	5	5	**5**	-	-	-	1	8	**5**
propylbenzene	0	0	**0**	-	-	-	2	3	**2**
isopropylbenzene	5	5	**5**	-	-	-	5	7	**6**
p,m-xylene	2	2	**2**	-	-	-	2	4	**3**
o-xylene	0	0	**0**	-	-	-	2	3	**2**
styrene	9	9	**9**	-	-	-	10	16	**13**
toluene	0	0	**0**	-	-	-	0.9	3	**2**
1,2,4-trimethylbenzene	0	0	**0**	-	-	-	0	0.9	**0.5**
1,3,5-trimethylbenzene	0	0	**0**	-	-	-	0.9	2	**1**
1-ethyl-2-methylbenzene	0	0	**0**	-	-	-	0	0.9	**0.5**
MONATOMIC ALCOHOLS									
2-propanol	11	12	**11**	-	-	-	11	19	**15**
1-butanol	10	10	**10**	-	-	-	10	19	**14**
2-ethyl-1-hexanol	346	373	**359**	-	-	-	477	727	**602**
benzyl alcohol	0	3	**1**	-	-	-	2	0	**1**
2-methyl-1-propanol	5	3	**4**	-	-	-	3	0	**2**
ETHERS									
bis(2-ethoxyethyl)ether	19	26	**22**	-	-	-	15	14	**15**
PHENOLS									
phenol	6	13	**10**	-	-	-	12	4	**8**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	55	68	**61**	-	-	-	23	55	**39**
2-(2-butoxyethoxy)ethanol	2400	2559	**2480**	-	-	-	1705	1736	**1720**
1-methoxy-2-propanol	0	0	**0**	-	-	-	0	3	**2**
2-ethoxyethanol	7	8	**8**	-	-	-	5	6	**5**
2-butoxyethanol	9	10	**10**	-	-	-	8	20	**14**
2-phenoxyethanol	0	0	**0**	-	-	-	1	3	**2**
ALDEHYDES									
benzaldehyde	16	22	**19**	-	-	-	20	26	**23**
n-butanal	0	0	**0**	-	-	-	1	25	**13**
pentanal	0	0	**0**	-	-	-	0	6	**3**
hexanal	0	3	**1**	-	-	-	0	0	**0**
heptanal	0	2	**1**	-	-	-	0	0	**0**
octanal	0	4	**2**	-	-	-	0	0	**0**
nonanal	0	3	**1**	-	-	-	3	6	**4**
KETONES									
acetophenone	0	0	**0**	-	-	-	0.9	4	**2**
acetone	41	44	**42**	-	-	-	42	68	**55**

Table C102. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 1 day in the environmental chamber test. Table continues.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ACIDS									
acetic acid	0	0	**0**	-	-	-	45	177	**111**
TERPENES AND THEIR DERIVATIVES									
limonene	8	10	**9**	-	-	-	12	21	**16**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	7	8	**8**	-	-	-	6	11	**9**
texanol	14	16	**15**	-	-	-	18	36	**27**
2-ethylhexyl acetate	50	50	**50**	-	-	-	59	59	**59**
2-ethylhexyl acrylate	10	11	**10**	-	-	-	10	18	**14**
2-ethyl-1-hexyl propionate	15	12	**13**				12	13	**13**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	-	-	-	8	0	**4**
4,4-dimethyl-1,3-oxazolidine	2282	2436	**2359**	-	-	-	1718	1736	**1727**
4,4-dimethyl-2-oxazolidine	7	7	**7**	-	-	-	7	7	**7**
dimethyl perhydro-1,3-oxazine	332	350	**341**	-	-	-	26	255	**140**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	0	0	**0**	-	-	-	55	0	**27**
decamethylcyclopentasiloxane	2	3	**3**	-	-	-	3	3	**3**
Total	5669	6091	**5880**	-	-	-	4346	5124	**4735**
TVOC	**4904**	**5222**	**5063**	-	-	-	**3626**	**3626**	**3626**
non-TVOC	52	56	**54**	-	-	-	100	112	**106**

Table C103. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	-	-	-	5	5	**5**	-	-	-
dodecane	-	-	-	2	2	**2**	-	-	-
methylcyclohexane	-	-	-	3	3	**3**	-	-	-
AROMATIC HYDROCARBONS									
isopropylbenzene	-	-	-	2	2	**2**	-	-	-
styrene	-	-	-	2	2	**2**	-	-	-
toluene	-	-	-	2	2	**2**	-	-	-
MONATOMIC ALCOHOLS									
2-propanol	-	-	-	3	4	**3**	-	-	-
1-butanol	-	-	-	3	4	**3**	-	-	-
2-ethyl-1-hexanol	-	-	-	50	50	**50**	-	-	-
DIVALENT ALCOHOLS									
1,2-propanediol	-	-	-	4	5	**4**	-	-	-
ETHERS									
bis(2-ethoxyethyl)ether	-	-	-	3	7	**5**	-	-	-
PHENOLS									
phenol	-	-	-	2	0	**1**	-	-	-
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	-	-	-	100	105	**102**	-	-	-
2-[2-(2ethoxy)ethoxy]ethanol	-	-	-	8	9	**8**	-	-	-
2-(2-butoxyethoxy)ethanol	-	-	-	1564	1646	**1605**	-	-	-
ALDEHYDES									
benzaldehyde	-	-	-	3	0	**2**	-	-	-
n-butanal	-	-	-	7	6	**6**	-	-	-
nonanal	-	-	-	2	0	**1**	-	-	-
KETONES									
acetone	-	-	-	9	11	**10**	-	-	-
ACIDS									
acetic acid	-	-	-	31	41	**36**	-	-	-

Table C103. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 7 days in the environmental chamber test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	-	-	-	2	2	**2**	-	-	-
texanol	-	-	-	10	11	**10**	-	-	-
2-ethylhexyl acetate	-	-	-	25	26	**26**	-	-	-
2-ethylhexyl acrylate	-	-	-	11	11	**11**	-	-	-
2-ethyl-1-hexyl propionate	-	-	-	9	10	**10**	-	-	-
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	-	-	-	196	196	**196**	-	-	-
dimethyl perhydro-1,3-oxazine	-	-	-	18	19	**18**	-	-	-
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	-	-	-	0	40	**20**	-	-	-
decamethylcyclopentasiloxane	-	-	-	2	3	**2**	-	-	-
Total	-	-	-	2076	2218	**2147**	-	-	-
TVOC	-	-	-	**989**	**1125**	**1057**	-	-	-
non-TVOC	-	-	-	50	61	**56**	-	-	-

Table C104. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-octene	0	0.9	**0.5**	-	-	-	0	0	**0**
nonane	0	0	**0**	-	-	-	0	0.9	**0.5**
decane	0	0	**0**	-	-	-	0.5	0	**0.3**
dodecane	0.9	1	**1**	-	-	-	1	2	**2**
pentadecane	0	0.5	**0.3**	-	-	-	0.5	0	**0.3**
AROMATIC HYDROCARBONS									
isopropylbenzene	0.5	0.5	**0.5**	-	-	-	0.9	0.9	**0.9**
p,m-xylene	0.5	0.5	**0.5**	-	-	-	0.9	0.5	**0.7**
styrene	0.5	0.5	**0.5**	-	-	-	0.9	0.9	**0.9**
MONATOMIC ALCOHOLS									
2-propanol	1	1	**1**	-	-	-	2	2	**2**
1-butanol	1	2	**2**	-	-	-	4	4	**4**
2-ethyl-1-hexanol	31	33	**32**	-	-	-	46	50	**48**
benzyl alcohol	0	0	**0**	-	-	-	0.9	0.9	**0.9**
DIVALENT ALCOHOLS									
1,2-propanediol	0	2	**1**	-	-	-	3	4	**4**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	4	5	**4**	-	-	-	14	14	**14**
PHENOLS									
phenol	0.9	0	**0.5**	-	-	-	2	3	**2**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	21	23	**22**	-	-	-	59	64	**61**
2-[2-(2ethoxy)ethoxy]ethanol	0.9	1	**1**	-	-	-	6	7	**7**
2-(2-butoxyethoxy)ethanol	559	596	**577**	-	-	-	1477	1518	**1498**
2-butoxyethanol	0	0.9	**0.5**	-	-	-	0	0.5	**0.3**
ALDEHYDES									
benzaldehyde	3	0.9	**2**	-	-	-	4	4	**4**
n-butanal	2	3	**3**	-	-	-	0	0	**0**
nonanal	0.5	0.9	**0.7**	-	-	-	2	2	**2**
decanal	0	2	**1**	-	-	-	3	0	**2**
KETONES									
acetophenone	0	0	**0**	-	-	-	0	0.5	**0.3**
acetone	2	3	**3**	-	-	-	4	4	**4**
4-methyl-2-pentanone	0	0	**0**	-	-	-	0	0.5	**0.3**
ACIDS									
acetic acid	5	8	**6**	-	-	-	0	4	**2**

Table C104. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the environmental chamber test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0.9	0.9	**0.9**	-	-	**-**	2	2	**2**
1-methoxy-2-propylacetate	0	0	**0**	-	-	**-**	0.5	0	**0.3**
texanol	13	14	**13**	-	-	**-**	42	45	**43**
2-ethylhexyl acetate	13	14	**13**	-	-	**-**	15	16	**15**
2-ethylhexyl acrylate	9	9	**9**	-	-	**-**	10	10	**10**
2-ethyl-1-hexyl propionate	7	7	**7**	-	-	**-**	7	7	**7**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0.5	**0.3**	-	-	**-**	0.9	0.9	**0.9**
4,4-dimethyl-1,3-oxazolidine	73	73	**73**	-	-	**-**	273	277	**275**
dimethyl perhydro-1,3-oxazine	8	9	**8**	-	-	**-**	22	23	**23**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	3	0	**2**	-	-	**-**	16	18	**17**
Total	762	811	**786**	-	-	**-**	2021	2086	**2053**
TVOC	**358**	**404**	**381**	-	-	**-**	**1126**	**1171**	**1148**
non-TVOC	11	15	**13**	-	-	**-**	6	10	**8**

Table C105. Background emission values of adhesive B spread onto plaster C applied onto calcium silicate brick in the environmental chamber test.

(µg/m³)	**RH 20 %**	**RH 50 %**	**RH 80 %**
TVOC	**6**	**9**	**15**

Table C106. Emission values of adhesive B spread onto plaster C applied onto calcium silicate brick at 1 day in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	3	0	**2**	5	0	**2**	-	-	-
tridecane	4	5	**4**	4	5	**4**	-	-	-
tetradecane	5	5	**5**	5	0	**2**	-	-	-
pentadecane	0	0	**0**	5	0	**2**	-	-	-
hexadecane	0	0	**0**	5	0	**3**	-	-	-
AROMATIC HYDROCARBONS									
benzene	0.9	0.5	**0.7**	0.5	0.9	**0.7**	-	-	-
toluene	0.5	0.5	**0.5**	0.5	0.5	**0.5**	-	-	-
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	5	0	**2**	-	-	-
1-butanol	0	0	**0**	7	7	**7**	-	-	-
2-ethyl-1-hexanol	3	4	**4**	6	6	**6**	-	-	-
benzyl alcohol	8	9	**8**	9	8	**8**	-	-	-
DIVALENT ALCOHOLS									
1,2-propanediol	13	0	**6**	0	0	**0**	-	-	-
PHENOLS									
phenol	2	3	**3**	2	0	**1**	-	-	-
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	7818	7864	**7841**	5727	6000	**5864**	-	-	-
2-butoxyethanol	11	12	**12**	11	12	**12**	-	-	-
2-phenoxyethanol	0	9	**4**	9	0	**4**	-	-	-
ALDEHYDES									
benzaldehyde	4	3	**4**	7	3	**5**	-	-	-
n-butanal	0	0	**0**	12	6	**9**	-	-	-
octanal	0	0	**0**	6	5	**5**	-	-	-
nonanal	9	10	**9**	13	11	**12**	-	-	-
decanal	0	0	**0**	11	11	**11**	-	-	-

Table C106. Emission values of adhesive B spread onto plaster C applied onto calcium silicate brick at 1 day in the environmental chamber test. Table continues.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
KETONES									
acetophenone	0.9	0	**0.5**	0.9	0	**0.5**	-	-	-
acetone	16	17	**16**	23	18	**21**	-	-	-
ACIDS									
acetic acid	214	0	**107**	73	0	**36**	-	-	-
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	16	16	**16**	17	16	**17**	-	-	-
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	15	37	**26**	46	23	**34**	-	-	-
Total	8143	7993	**8068**	6007	6132	**6069**	-	-	-
TVOC	**3273**	**3273**	**3273**	**2361**	**2406**	**2384**	-	-	-
non-TVOC	229	17	**123**	113	24	**68**	-	-	-

Table C107. Emission values of adhesive B spread onto plaster C applied onto calcium silicate brick at 7 days in the environmental chamber test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
dodecane	-	-	-	-	-	-	1	0	**0**
tridecane	-	-	-	-	-	-	1	0	**1**
tetradecane	-	-	-	-	-	-	2	2	**2**
hexadecane	-	-	-	-	-	-	1	1	**1**
AROMATIC HYDROCARBONS									
benzene	-	-	-	-	-	-	1	0	**0**
p,m-xylene	-	-	-	-	-	-	2	2	**2**
toluene	-	-	-	-	-	-	1	1	**1**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	-	-	-	-	-	-	3	2	**2**
benzyl alcohol	-	-	-	-	-	-	4	4	**4**
PHENOLS									
phenol	-	-	-	-	-	-	2	2	**2**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	-	-	-	-	-	-	2118	2186	**2152**
2-phenoxyethanol	-	-	-	-	-	-	3	3	**3**
ALDEHYDES									
benzaldehyde	-	-	-	-	-	-	3	3	**3**
octanal	-	-	-	-	-	-	2	0	**1**
nonanal	-	-	-	-	-	-	2	1	**1**
decanal	-	-	-	-	-	-	2	0	**1**
ACIDS									
acetic acid	-	-	-	-	-	-	0	6	**3**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	-	-	-	-	-	-	5	5	**5**
TXIB	-	-	-	-	-	-	2	0	**1**
HALOGEN CONTAINING COMPOUNDS									
tetrachloroethene	-	-	-	-	-	-	0	2	**1**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	-	-	-	-	-	-	18	14	**16**
Total	-	-	-	-	-	-	2171	2232	**2202**
TVOC	-	-	-	-	-	-	**860**	**860**	**860**
non-TVOC	-	-	-	-	-	-	0	6	**3**

Table C108. Emission values of adhesive B spread onto plaster C applied onto calcium silicate brick at 14 days in the environmental chamber test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
tetradecane	0	0	**0**	-	-	-	0.5	0.5	**0.5**
pentadecane	0.5	0.5	**0.5**	-	-	-	0	0.5	**0.3**
hexadecane	0	0.5	**0.3**	-	-	-	0	0	**0**
AROMATIC HYDROCARBONS									
p,m-xylene	0.3	0.3	**0.3**	-	-	-	0	0	**0**
toluene	0.4	0.4	**0.4**	-	-	-	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	-	-	-	1	1	**1**
2-ethyl-1-hexanol	0.9	0.4	**0.7**	-	-	-	0.9	0.9	**0.9**
benzyl alcohol	0	0	**0**	-	-	-	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	-	-	-	0.9	0	**0.5**
PHENOLS									
phenol	0.5	0	**0.3**	-	-	-	0	0.5	**0.3**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	-	-	-	0.5	0	**0.3**
2-(2-butoxyethoxy)ethanol	86	86	**86**	-	-	-	477	496	**486**
1-methoxy-2-propanol	0	0	**0**	-	-	-	1	1	**1**
2-butoxyethanol	0.9	0.9	**0.9**	-	-	-	0	0.5	**0.3**
ALDEHYDES									
benzaldehyde	0.9	0	**0.5**	-	-	-	0.9	0.9	**1**
octanal	0.5	0.9	**0.7**	-	-	-	0.9	0.9	**1**
nonanal	0.9	1	**1**	-	-	-	2	2	**2**
decanal	2	3	**2**	-	-	-	3	3	**3**
KETONES									
acetone	0.3	0.9	**1**	-	-	-	1	0.9	**1**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	-	-	-	0.9	0.9	**0.9**
1-methoxy-2-propylacetate	0.2	0	**0.1**	-	-	-	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	6	**3**	-	-	-	3	11	**7**
Total	95	101	**98**	-	-	-	496	523	**509**
TVOC	**35**	**33**	**34**	-	-	-	**296**	**310**	**303**
non-TVOC	0.3	0.9	**0.6**	-	-	-	1	0.9	**1**

Table C109. Background emission values of paint A in the FLEC test.

(µg/m³)			
ALIPHATIC AND ALICYCLIC COMPOUNDS			
decane	0.1		
AROMATIC HYDROCARBONS			
benzene	0.1	ALDEHYDES	
ethylbenzene	0.5	nonanal	1
p,m-xylene	0.6	decanal	2
o-xylene	0.1	ESTERS AND LACTONES	
styrene	0.2	2-(2-butoxyethoxy)ethylacetate	
toluene	2	ethylacetate	3
MONATOMIC ALCOHOLS		HALOGEN CONTAINING COMPOUNDS	0.3
2-ethyl-1-hexanol	2	trichloroethene	5
ALCOHOL AND PHENOL ETHERS			
2-(2-ethoxyethoxy)ethanol	0.3	Total	25
2-(2-butoxyethoxy)ethanol	1	**TVOC**	**27**
2-butoxyethanol	7	non-TVOC	0

Table C110. Emission values of paint A at 28 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	2	2	**2**	2	2	**2**	0	2	**1**
undecane	0	0	**0**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0.1	0	**0.1**	0.1	0.1	**0.1**	0	0	**0**
ethylbenzene	0	0	**0**	0.2	0.2	**0.2**	0.1	0.1	**0.1**
p,m-xylene	0	0	**0**	0.2	0.2	**0.2**	0	0	**0**
o-xylene	0	0	**0**	0	0	**0**	0	0	**0**
toluene	0	0	**0**	1	1	**1**	0	0	**0**
1,2,4-trimethylbenzene	0	0.1	**0.1**	0.1	0	**0.1**	0	0	**0**
MONATOMIC ALCOHOLS									
1-butanol	0.4	0.3	**0.4**	0	0	**0**	0	0	**0**
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0	0	**0**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-butoxyethanol	0	0	**0**	0	0	**0**	0	0	**0**
ALDEHYDES									
nonanal	0	0	**0**	1	0	**0**	0	0	**0**
KETONES									
2-butanone (MEK)	0	0	**0**	3	2	**3**	6	6	**6**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	0	0	**0**	0	0	**0**
texanol	0	0	**0**	0	0	**0**	1	0	**1**
HALOGEN CONTAINING COMPOUNDS									
1-bromododecane	1	1	**1**	1	1	**1**	1	1	**1**
trichloroethene	0	0	**0**	2	2	**2**	0	0	**0**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.2	0	**0.1**	0	0	**0**	0	0	**0**
Total	5	4	**4**	12	10	**11**	8	9	**9**
TVOC	**0**	**0**	**0**	**10**	**12**	**11**	**0**	**0**	**0**
non-TVOC	0	3	**2**	3	2	**3**	6	6	**6**

Table C111. Background emission values of paint C in the FLEC test.

(μg/m³)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDES	
nonane	0.7	benzaldehyde	2
undecane	0.3	hexanal	0.3
AROMATIC HYDROCARBONS		nonanal	2
ethylbenzene	0.3	decanal	3
p,m-xylene	0.3	KETONES	
toluene	1	acetophenone	1
ALCOHOL AND PHENOL ETHERS			
2-butoxyethanol	6	Total	23
HALOGEN CONTAINING COMPOUNDS		**TVOC**	**20**
trichloroethene	6	non-TVOC	0

Table C112. Emission values of paint C at 28 days in the FLEC test.

(μg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0	0	**0**	5	5	**5**	0	0	**0**
octane	0	0	**0**	0	4	**2**	0	0	**0**
decane	1	1	**1**	13	2	**8**	1	1	**1**
undecane	0.2	0.3	**0.3**	5	6	**6**	0.7	0.7	**0.7**
dodecane	0	0.4	**0.2**	1	1	**1**	0	0	**0**
tridecane	0	0	**0**	0.4	0.9	**0.7**	0	0	**0**
AROMATIC HYDROCARBONS									
ethylbenzene	0	0.2	**0.1**	0.4	0.4	**0.4**	0	0	**0**
p,m-xylene	0.2	0.2	**0.2**	0.4	0.4	**0.4**	0	0	**0**
o-xylene	0.1	0.1	**0.1**	0.4	0.4	**0.4**	0	0	**0**
toluene	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.4	0	**0.2**	0.4	0.9	**0.7**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
1-methoxy-2-propanol	0	0.9	**0.5**	4	4	**4**	0	0	**0**
2-butoxyethanol	2	2	**2**	1	1	**1**	0	0	**0**
ALDEHYDES									
benzaldehyde	0.9	0.9	**0.9**	0	0	**0**	0	0	**0**
pentanal	19	20	**19**	84	75	**79**	6	6	**6**
hexanal	66	71	**68**	229	212	**220**	23	25	**24**
heptanal	9	9	**9**	36	33	**35**	4	3	**3**
octanal	16	15	**15**	53	49	**51**	6	6	**6**
nonanal	14	14	**14**	38	34	**36**	8	6	**7**
decanal	1	2	**2**	4	3	**3**	2	0.4	**1**
KETONES									
acetofenone	0.3	0.3	**0.3**	0.4	0	**0.2**	0	0	**0**
cyclohexanone	0	0	**0**	0.9	0.9	**0.9**	0	0	**0**
ACIDS									
acetic acid	53	93	**73**	137	185	**161**	27	31	**29**
propanoic acid	17	21	**19**	75	84	**79**	0	0	**0**
butanoic acid	9	9	**9**	30	32	**31**	3	2	**3**
pentanoic acid	41	40	**40**	106	119	**112**	12	12	**12**
hexanoic acid	304	264	**284**	577	661	**619**	123	128	**126**
2-etylhexanoic acid	19	19	**19**	36	49	**42**	9	8	**8**
heptanoic acid	4	3	**4**	2	11	**6**	1	1	**1**
octanoic acid	3	4	**3**	8	14	**11**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
trichloroethene	2	2	**2**	2	2	**2**	0	0	**0**
NITROGEN CONTAINING COMPOUNDS									
2-butanone oxime	0	0	**0**	1	0	**1**	0	0	**0**
Total	583	590	**587**	1452	1590	**1521**	225	229	**227**
TVOC	**256**	**260**	**258**	**926**	**970**	**948**	**97**	**97**	**97**
non-TVOC	53	93	**73**	137	185	**161**	27	31	**29**

Table C113. Background emission values of adhesive A in the FLEC test.

(µg/m^3)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDES	
nonane	0.4	octanal	0.5
decane	0.4	decanal	2
undecane	0.5	ACIDS	
dodecane	0.3	acetic acid	30
AROMATIC HYDROCARBONS		ESTERS AND LACTONES	
benzene	0.3	dibutyl phthalate	3
ethylbenzene	0.4	NITROGEN CONTAINING	
p,m-xylene	2	caprolactam	2
o-xylene	0.6	SULPHUR CONTAINING COMPOUNDS	
toluene	0.8	benzothiazole	1
1,2,4-trimethylbenzene	0.7	SILICON CONTAINING COMPOUNDS	
C$_3$-alkyl benzene	0.4	organic Si-comp.	0.3
MONATOMIC ALCOHOLS		hexamethylcyclotrisiloxane	0.8
2-ethyl-1-hexanol	0.6	OTHERS	
2-methyl-1-propanol	0.6	unidentified	1.1
PHENOLS			
phenol	0.4	Total	52
ALCOHOL AND PHENOL ETHERS		**TVOC**	**17**
2-(2-butoxyethoxy)ethanol	0.5	non-TVOC	37
2-butoxyethanol	2		

Table C114. Emission values of adhesive A at 28 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.0	0.1	**0.1**	0.3	0.2	**0.3**	0	0	**0.2**
decane	0.0	0.0	**0**	0.3	0.2	**0.3**	0.3	0.3	**0.3**
undecane	0.0	0.1	**0.1**	0.3	0.3	**0.3**	2	2	**2**
dodecane	0.0	0.0	**0**	0	0.2	**0.1**	0.1	0.3	**0.2**
tetradecane	0	0	**0**	0	0.2	**0.1**	0	0.2	**0.1**
hexadecane	0	0	**0**	0.3	0.2	**0.3**	0	0.1	**0.1**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0.1	0	**0.1**	0.1	0.1	**0.1**
ethylbenzene	0	0	**0**	0.3	0.2	**0.3**	0.3	0.3	**0.3**
p,m-xylene	0	0	**0**	1	1	**1**	1	1	**1**
o-xylene	0.1	0.1	**0.1**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
toluene	0	0	**0**	0.4	0.4	**0.4**	0.4	0	**0.4**
1,2,4-trimethylbenzene	0	0	**0**	0.4	0.3	**0.4**	0.4	0.4	**0.4**
C$_3$-alkyl benzene	0.0	0.2	**0.1**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0.4	**0.4**	0.4	0	**0**
2-methyl-1-propanol	0.1	0	**0.2**	0	1	**1**	0	0	**0**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	2	**1**	1	1	**1**
2-butoxyethanol	0	0	**0**	1	0	**1**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0.4	**0.2**	0.4	0	**0.2**	0.4	0	**0.2**
heptanal	0	0	**0**	0	0	**0**	0	0.3	**0.2**
octanal	0	0	**0**	1	0	**0**	0.3	1	**0.6**
nonanal	0	0	**0**	2	0	**1**	1	2	**1**
decanal	0	0	**0**	4	1	**2**	2	4	**3**

Table C114. Emission values of adhesive A at 28 days in the FLEC test. Table continues.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
KETONES									
2-butanone (MEK)	0	0	**0**	1	2	**1**	9	12	**11**
acetophenone	0	0.3	**0.2**	0	0	**0**	0.2	0	**0.1**
acetone	0	0	**0**	1	1	**1**	1	2	**2**
3-methyl-2-butanone	0	0	**0**	0	0	**0**	0	1	**1**
2-pentanone	0	0	**0**	0	0	**0**	2	3	**2**
3-pentanone	0	0	**0**	0	0	**0**	2	3	**2**
ACIDS									
acetic acid	7	0	**4**	26	38	**32**	53	57	**55**
hexanic acid	0	0	**0**	0	0	**0**	0	1	**1**
ESTERS AND LACTONES									
TXIB	0	0	**0**	0.3	0	**0.2**	0	0	**0**
methyl acetate	0	0	**0**	0	0	**0**	0.3	0	**0.4**
dibutyl phthalate	1	0	**1**	0	5	**2**	8	10	**9**
NITROGEN CONTAINING									
1-methyl-2-pyrrolidinone	0	0	**0**	0	0	**0**	2	1	**2**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	2	0	**1**	0.3	0.4	**0.4**	1	2	**2**
octamethylcyclotrisiloxane	0.4	0	**0.2**	0	0	**0**	0	0	**0**
SULPHUR CONTAINING COMPOUNDS									
benzothiazole	0	0	**0**	0	0	**0**	0	0	**0**
OTHERS									
unidentified	0	0	**0**	0	0	**0**	4	5	**4**
Total	11	2	**6**	41	55	**48**	94	111	**102**
TVOC	**2**	**0**	**1**	**17**	**7**	**12**	**20**	**26**	**23**
non-TVOC	10	0	**5**	30	49	**39**	86	102	**94**

Table C115. Background emission values of adhesive C in the FLEC test.

(µg/m^{3})			
ALIPHATIC AND ALICYCLIC COMPOUNDS		KETONES	
nonane	0.4	acetone	0.4
decane	0.5		
undecane	0.4	ACIDS	
dodecane	0.3	acetic acid	38
AROMATIC HYDROCARBONS			
benzene	0.3	NITROGEN CONTAINING COMPOUNDS	
ethylbenzene	0.6	caprolactam	2
p,m-xylene	2		
o-xylene	0.8	SILICON CONTAINING COMPOUNDS	
toluene	1	organic Si-comp.	1.1
1,2,4-trimethylbenzene	0.6	hexamethylcyclotrisiloxane	0.7
C$_3$-alkyl benzene	0.3		
MONATOMIC ALCOHOLS		SULPHUR CONTAINING COMPOUNDS	
2-ethyl-1-hexanol	1	benzothiazole	0.9
2-methyl-1-propanol	0.9		
		Total	57
ALCOHOL AND PHENOL ETHERS		**TVOC**	**20**
2-(2-butoxyethoxy)ethanol	1	non-TVOC	42
1-methoxy-2-propanol	0.4		
2-butoxyethanol	3		

Table C116. Emission values of adhesive C at 28 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0.9	0	**0.5**	0.3	0.3	**0.3**
decane	0	0	**0**	0.9	0.9	**0.9**	0.1	0.2	**0.2**
undecane	4	3	**4**	23	24	**24**	0.1	0	**0.1**
dodecane	0	0	**0**	0	0	**0**	0.1	0	**0.1**
tridecane	0	0	**0**	8	8	**8**	0	0	**0**
tetradecane	0	0	**0**	12	12	**12**	0	0	**0**
pentadecane	0	0	**0**	3	3	**3**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0.9	0	**0.5**	0	0	**0**
ethylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
p,m-xylene	1	1	**1**	2	2	**2**	0.4	0.4	**0.4**
o-xylene	0	0	**0**	0.9	0.4	**0.7**	0.1	0.1	**0.1**
toluene	0	0	**0**	0.9	0.9	**0.9**	0.4	0.4	**0.4**
1,2,4-trimethylbenzene	0	0	**0**	0	0.9	**0.5**	0.2	0.2	**0.2**
C_3-alkyl benzene	0	0	**0**	0	0	**0**	0	0.1	**0.1**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0.9	1	**1**	0	0	**0**
2-ethyl-1-hexanol	0.9	0.9	**0.9**	0.9	1	**1**	0	0	**0**
2-methyl-1-propanol	2	2	**2**	2	2	**2**	0.5	0.5	**0.5**
DIVALENT ALCOHOLS									
1,2-propanediol	450	450	**450**	154	154	**154**	53	62	**57**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0.3	0.2	**0.3**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	1	1	**1**	0.9	0.9	**0.9**	0.4	0	**0.2**
1-methoxy-2-propanol	3	3	**3**	2	2	**2**	0.1	0.2	**0.2**
2-butoxyethanol	2	2	**2**	0.9	0.9	**0.9**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0.4	0.2	**0.3**
n-butanal	0	0	**0**	2	3	**2**	0	0	**0**
pentanal	0	0	**0**	0.9	0.9	**0.9**	0	0	**0**
hexanal	0	0	**0**	3	3	**3**	0	0	**0**
octanal	0	0	**0**	0.9	0	**0.5**	0	0.4	**0.2**
nonanal	0.9	2	**1**	0.9	0	**0.5**	0	0	**0**
decanal	0.9	3	**2**	2	0.9	**1**	0	1	**1**
KETONES									
2-butanone (MEK)	15	12	**14**	17	18	**17**	0	0	**0**
acetone	3	2	**2**	2	2	**2**	0.7	0	**0.4**
3-methyl-2-butanone	0	0	**0**	4	4	**4**	0	0	**0**
2-pentanone	5	4	**4**	28	30	**29**	0	0	**0**
3-pentanone	4	3	**4**	24	26	**25**	0	0	**0**
ACIDS									
acetic acid	309	419	**364**	353	357	**355**	63	41	**52**
butyric acid	0.9	0.9	**0.9**	0	0	**0**	0	0	**0**
pentanic acid	0	0.9	**0.5**	0	0	**0**	0	0	**0**
hexanic acid	2	2	**2**	0.9	2	**1**	0.4	0.4	**0.4**
ESTERS AND LACTONES									
n-butylacetate	0	0	**0**	0	0.9	**0.5**	0	0	**0**
methyl acetate	0	0	**0**	2	3	**2**	0	0	**0**
methyl butonate	0	0	**0**	4	5	**5**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
bromnitromethane	0.9	0.9	**0.9**	8	9	**8**	0.9	1	**1**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	3	3	**3**	0	2	**1**	0	0	**0**
caprolactam	0	0	**0**	1	1	**1**	0.9	1	**1**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	0	0	**0**
hexamethylcyclotrisiloxane	4	4	**4**	4	4	**4**	0	0	**0**
SULPHUR CONTAINING COMPOUNDS									
5-chloro-2-methyl-3(2H)-isotiatsolon	2	2	**2**	0.9	0.9	**0.9**	0	0	**0**
benzothiazole	0	0	**0**	0	0	**0**	0	0	**0**
Total	813	919	**866**	671	687	**679**	122	110	**116**
TVOC	**287**	**295**	**291**	**172**	**176**	**174**	**20**	**23**	**22**
non-TVOC	371	486	**428**	428	435	**432**	68	43	**55**

Table C117. Background emission values of plaster A in the FLEC test.

(µg/m³)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDES	
nonane	0.4	benzaldehyde	1
undecane	0.3	n-butanal	1
AROMATIC HYDROCARBONS		decanal	6
p,m-xylene	0.7	KETONES	
o-xylene	0.3	acetophenone	0.4
toluene	0.5	acetone	0.8
1,2,4-trimethylbenzene	0.3	ACIDS	
MONATOMIC ALCOHOLS		acetic acid	0.5
1-butanol	0.7	ESTERS AND LACTONES	
2-ethyl-1-hexanol	1	2-(2-butoxyethoxy)ethylacetate	0.5
PHENOLS		NITROGEN CONTAINING COMPOUNDS	
phenol	0.3	1-methyl-2-pyrrolidinone	0.7
ALCOHOL AND PHENOL ETHERS		caprolactam	10
2-(2-butoxyethoxy)ethanol	1	SULPHUR CONTAINING COMPOUNDS	
2-butoxyethanol	2	benzothiazole	1
SILICON CONTAINING COMPOUNDS			
organic Si-comp.	0.9	Total	30
		TVOC	**26**
		non-TVOC	2.3

Table C118. Emission values of plaster A at 29 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0.3	0.2	**0.3**	0	0	**0**	0	0	**0**
octane	0.2	0	**0.1**	0	0	**0**	0	0	**0**
nonane	0	0	**0**	0	0	**0**	0.4	0	**0.2**
decane	0.3	0.3	**0.3**	0	0.2	**0.1**	0.2	0	**0.1**
undecane	0.1	0.1	**0.1**	0	0	**0**	0.3	0.2	**0.3**
dodecane	0.4	0.4	**0.4**	0	0	**0**	0	0	**0**
tetradecane	0	0.3	**0.2**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0.2	0	**0.1**	0	0	**0**
ethylbenzene	0	0	**0**	0.4	0.4	**0.4**	0.3	0.3	**0.3**
p,m-xylene	2	2	**2**	1	1	**1**	1	1	**1**
o-xylene	1	1	**1**	0	0	**0**	0.4	0	**0**
styrene	0	0	**0**	0.4	0.4	**0.4**	0.3	0.3	**0.3**
toluene	2	1	**1**	1	1	**1**	1	1	**1**
1,2,3-trimethylbenzene	0.2	0.3	**0.3**	0	0	**0**	0	0	**0**
1,2,4-trimethylbenzene	1	1	**1**	1	1	**1**	0	0	**0**
1,3,5-trimethylbenzene	0	0.2	**0.1**	0	0	**0**	0	0	**0**
C_3-alkyl benzene	0.7	0.7	**0.7**	0.5	0.5	**0.5**	0.4	0.3	**0.4**
MONATOMIC ALCOHOLS									
1-butanol	0.1	0.1	**0.1**	0.4	0	**0.4**	0	0.2	**0.3**
2-ethyl-1-hexanol	2	1	**2**	0	0	**0**	0.4	1	**0.7**
benzylalcohol	0.3	0.2	**0.3**	0	0	**0**	0	0	**0**
2-methyl-1-propanol	1	1	**1**	1	1	**1**	1	0	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	278	291	**284**	49	44	**46**	410	423	**417**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	0.4	0.1	**0.3**	0.3	0.3	**0.3**	2	2	**2**

Table C118. Emission values of plaster A at 29 days in the FLEC test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
PHENOLS									
phenol	0	0	**0**	0.4	0.3	**0.4**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	9	8	**8**	2	2	**2**	15	19	**17**
2-(2-butoxyethoxy)ethanol	0	0	**0**	1	1	**1**	2	2	**2**
1-methoxy-2-propanol	1	1	**1**	1	1	**1**	1	0	**1**
2-butoxyethanol	0	0	**0**	0	0.3	**0.2**	0	0	**0**
dipropylene glycol methyl ether	3	3	**3**	0.4	0.3	**0.4**	2	3	**2**
bis(2-hydroxypropyl)ether	0	0	**0**	0.3	0.3	**0.3**	5	6	**5**
dipropylene glycol-isomer	0	0	**0**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0	**0**	0.4	0.4	**0.4**	1	0	**1**
n-butanal	0	0	**0**	0	0	**0**	0	0	**0**
pentanal	0	0	**0**	0	0	**0**	0	0	**0**
hexanal	4	4	**4**	1	1	**1**	1	1	**1**
heptanal	1	1	**1**	1	1	**1**	0	0	**0**
octanal	1	1	**1**	1	1	**1**	0	1	**1**
nonanal	2	2	**2**	1	0	**1**	1	0	**1**
decanal	0	1	**1**	2	0	**1**	0	1	**1**
KETONES									
2-butanone (MEK)	0	0	**0**	0	0	**0**	0	0	**0**
acetone	2	1	**2**	2	2	**2**	5	4	**4**
acetophenone	0	0	**0**	0	0	**0**	0.4	0	**0.2**
1-hydroxy-2-propanone	0	0	**0**	0	0	**0**	0	0	**0**
ACIDS									
acetic acid	0	1	**0**	0	1	**1**	0	1	**1**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0	**0**	0	0.4	**0.4**	0.3	0.3	**0.3**
α-pinene	0.2	0	**0.1**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	0	0	**0**	0.3	0.3	**0.3**
1-methoxy-2-propyl acetate	0.3	0.4	**0.4**	0.2	0	**0.1**	0	0	**0**
TXIB	0	0	**0**	0	0	**0**	0	0.2	**0.1**
n-butyl acetate	0	0.4	**0.2**	0	0	**0**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
dichloromethane	0.3	0.3	**0.3**	0.3	0	**0.2**	0.3	0.2	**0.3**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	0	0	**0**	0.2	0.3	**0.3**
caprolactam	0	0	**0**	1	1	**1**	1	1	**1**
Total	315	327	**321**	72	65	**68**	456	473	**465**
TVOC	**94**	**99**	**97**	**28**	**21**	**25**	**159**	**168**	**163**
non-TVOC	2	2	**2**	3	4	**3**	6	5	**5**

Table C119. Background emission values of plaster C in the FLEC test.

(µg/m³)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDES	
undecane	0.3	decanal	5
dodecane	0.3	KETONES	
AROMATIC HYDROCARBONS		acetone	1
ethylbenzene	0.3	ESTERS AND LACTONES	
p,m-xylene	1	2-(2-butoxyethoxy)ethylacetate	0.7
o-xylene	0.4	TXIB	0.3
toluene	2	SILICON CONTAINING COMPOUNDS	
1,2,4-trimethylbenzene	0.4	organic Si-comp.	1
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	1	Total	16
ALCOHOL AND PHENOL ETHERS		**TVOC**	**14**
2-butoxyethanol	2	non-TVOC	1

Table C120. Emission values of plaster C at 27 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	0	0	**0**	0.3	0	**0.2**	0.2	0	**0.1**
nonane	0	0	**0**	0	0	**0**	0.3	0	**0.2**
decane	0.9	0.9	**0.9**	0	0.2	**0.1**	0	0	**0**
undecane	1	1	**1**	0.4	0.4	**0.4**	0.1	0	**0.1**
dodecane	0.9	0.9	**0.9**	0.2	0	**0.1**	0.1	0	**0.1**
methylcyclopentane	0	0	**0**	0.3	0.2	**0.3**	0	0	**0**
2-methylpentane	0.4	0.4	**0.4**	0.4	0.4	**0.4**	0	0.3	**0.2**
AROMATIC HYDROCARBONS									
benzene	0.4	0.4	**0.4**	0.3	0.3	**0.3**	0.2	0.2	**0.2**
ethylbenzene	3	3	**3**	0.9	1	**1**	0.3	0.3	**0.3**
propylbenzene	0.9	0.9	**0.9**	0.4	0.3	**0.4**	0	0	**0**
p,m-xylene	11	11	**11**	4	4	**4**	0.9	0.9	**0.9**
o-xylene	4	4	**4**	2	2	**2**	0.3	0.7	**0.5**
styrene	0.9	0.9	**0.9**	0.3	0.3	**0.3**	0	0	**0**
toluene	13	13	**13**	4	4	**4**	0.9	0.9	**0.9**
1,2,3-trimethylbenzene	0.4	0.4	**0.4**	0.3	0.3	**0.3**	0	0	**0**
1,2,4-trimethylbenzene	3	3	**3**	1	1	**1**	0.3	0.3	**0.3**
1,3,5-trimethylbenzene	0.9	0.9	**0.9**	0.4	0.3	**0.4**	0	0	**0**
1-ethyl-2-methylbenzene	0.4	0.4	**0.4**	0.3	0.3	**0.3**	0	0	**0**
C_3-alkyl benzene	3	3	**3**	0.9	0.9	**0.9**	0.4	0.4	**0.4**
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	0.3	0.2	**0.3**	0.2	0.3	**0.3**
1-butanol	0.4	0.4	**0.4**	0.3	0.3	**0.3**	0	0.4	**0.2**
2-ethyl-1-hexanol	0.4	0.4	**0.4**	0.4	0.3	**0.4**	0.4	0	**0.2**
2-methyl-1-propanol	3	3	**3**	1	1	**1**	0.4	0.9	**0.7**
ETHERS									
bis(2-methoxyethyl)ether	0	0	**0**	0	0	**0**	0.4	0.3	**0.4**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
1-methoxy-2-propanol	0.9	0.9	**0.9**	0.4	0.4	**0.4**	0.3	0.2	**0.3**
2-butoxyethanol	0	0	**0**	0	0	**0**	0	0	**0**

Table C120. Emission values of plaster C at 27 days in the FLEC test. Table continues.

(μg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALDEHYDES									
benzaldehyde	0	0.4	**0.2**	0.2	0	**0.1**	0.4	0	**0.2**
n-butanal	0	0	**0**	0	0	**0**	0	0.9	**0.5**
hexanal	0.9	0.4	**0.7**	0.3	0.2	**0.3**	0	0	**0**
octanal	0	0	**0**	0.3	0	**0.2**	0	0.4	**0.2**
decanal	0	0	**0**	2	0	**1**	0	0.4	**0.2**
KETONES									
2-butanone (MEK)	1	1	**1**	5	5	**5**	0.3	0.3	**0.3**
acetone	2	2	**2**	4	3	**3**	1	2	**2**
TERPENES AND THEIR DERIVATIVES									
limonene	1	1	**1**	0.4	0	**0.2**	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	0	0	**0**	0.6	0.6	**0.6**
TXIB	0	0	**0**	0	0	**0**	0.2	0.1	**0.2**
n-butylacetate	0.9	0.4	**0.7**	0	0	**0**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
dichloromethan	0	0	**0**	0.2	0.2	**0.2**	0	0	**0**
NITROGEN CONTAINING COMPOUNDS									
caprolactam	0	0	**0**	0	0	**0**	0.9	1	**1**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	0	0	**0**
Total	55	54	**55**	31	28	**29**	10	13	**12**
TVOC	**62**	**57**	**60**	**24**	**19**	**22**	**11**	**11**	**11**
non-TVOC	4	4	**4**	9	9	**9**	2	4	**3**

Table C121. Background emission values of the gypsum board in the FLEC test.

(µg/m³)	
ALDEHYDES	
nonanal	0.8
KETONES	
acetone	0.9
SILICON CONTAINING COMPOUNDS	
organic Si-comp.	2
SULPHUR CONTAINING COMPOUNDS	
benzothiazole	1
Total	5
TVOC	**8**
non-TVOC	0.9

Table C122. Emission values of the gypsum board at 28 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
undecane	0	0	**0**	0	0.4	**0**	0	0	**0**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	1	1	**1**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0.4	**0.2**	0.4	0.4	**0.4**
hexanal	0	0.9	**0.5**	0.9	0.9	**0.9**	0.4	0.4	**0.4**
octanal	0	0	**0**	0	0	**0**	0	0.4	**0.2**
nonanal	0	0	**0**	0.9	0.4	**0.7**	0.1	2	**1**
decanal	0	0	**0**	2	0	**1**	0	4	**2**
KETONES									
2-butanone (MEK)	0	0	**0**	1	2	**2**	0	0	**0**
acetone	0.4	0.9	**0.7**	0.9	2	**1**	1	0.9	**1**
ESTERS AND LACTONES									
texanol	0	0	**0**	0	0	**0**	0.9	0.4	**0.7**
HALOGEN CONTAINING COMPOUNDS									
1-chlorononane	0	0.1	**0.1**	0.1	0.1	**0.1**	0	0.1	**0.1**
1-chlorodecane	0.1	0.2	**0.2**	0.1	0.1	**0.1**	0	0	**0**
1-chloroundecane	0	0.2	**0.1**	0.1	0.2	**0.2**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	0	0	**0**
hexamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	0	1	**1**
Total	1	2	**1**	7	6	**6**	5	11	**8**
TVOC	***3***1)	***3***1)	**3**	**6**	**6**	**6**	**3**	**10**	**6**
non-TVOC	0.4	0.9	**0.7**	2	4	**3**	1	1	**1**

1) *Italic* font indicates that the value is below the detection limit.

Table C123. Background emission values of adhesive B in the FLEC test.

(µg/m^3)	
MONATOMIC ALCOHOLS	
2-ethyl-1-hexanol	1
ALDEHYDES	
decanal	2
ALCOHOL AND PHENOL ETHERS	
2-(2-butoxyethoxy)ethanol	56
2-butoxyethanol	5
Total	64
TVOC	**41**
non-TVOC	0

Table C124. Emission values of adhesive B at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.4	0.4	**0.4**	0.4	0.4	**0.4**	0	0	**0**
PHENOLS									
phenol	0.9	0.9	**0.9**	0	0.4	**0.2**	0.4	0.4	**0.4**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	3	3	**3**	0	0	**0**	0	0	**0**
2-(2-butoxyethoxy)ethanol	2377	2501	**2439**	767	798	**782**	1080	1093	**1086**
2-butoxyethanol	1	1	**1**	3	1	**2**	0	0.9	**0.5**
ALDEHYDES									
benzaldehyde	0.9	0.4	**0.7**	0	0	**0**	0	0.4	**0.2**
KETONES									
acetophenone	0.9	0.4	**0.7**	0	0	**0**	0	0	**0**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	12	12	**12**	3	2	**2**	2	2	**2**
texanol	2	2	**2**	0	0	**0**	0	0	**0**
TXIB	0	0	**0**	0.4	0	**0.2**	0	0	**0**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	2	2	**2**	0	0	**0**	0	0	**0**
Total	2401	2523	**2462**	773	802	**787**	1082	1097	**1089**
TVOC	**1326**	**1375**	**1350**	**480**	**498**	**489**	**657**	**661**	**659**
non-TVOC	0	0	**0**	0	0	**0**	0	0	**0**

Table C125. Background emission values of primer and paint A in the FLEC test.

(µg/m^3)	
TVOC	**20**

Table C126. Emission values of primer and paint A at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	5	5	**5**	7	5	**6**	6	6	**6**
octane	0	0	**0**	0	0	**0**	0	0.9	**0.5**
nonane	0	0	**0**	0	0	**0**	0	3	**2**
decane	0	0	**0**	0	0	**0**	0	0.4	**0.2**
undecane	0	0	**0**	0	0.4	**0.2**	0.9	1	**1**
MONATOMIC ALCOHOLS									
1-butanol	0.9	0.9	**0.9**	1	1	**1**	2	1	**2**
2-ethyl-1-hexanol	0.9	0.4	**0.7**	0.4	0.4	**0.4**	0.9	0.4	**0.7**
DIVALENT ALCOHOLS									
1,2-propanediol	626	635	**630**	269	264	**267**	1252	1278	**1265**
2,2,4-trimethyl-1,3-pentanediol	0	0	**0**	2	1	**2**	0	0	**0**
PHENOLS									
phenol	0.4	0.4	**0.4**	0.9	0.4	**0.7**	0.9	0.9	**0.9**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	2	2	**2**	2	1	**2**	10	11	**11**
2-(2-butoxyethoxy)ethanol	2	2	**2**	2	3	**2**	2	2	**2**
2-(2-butoxy-isopropoxy)-2-propanol, isomers	11	12	**11**	13	12	**13**	10	10	**10**
bis(2-hydroxypropyl)ether	0	0.4	**0.2**	0.4	0.2	**0.3**	0.9	0.9	**0.9**
ALDEHYDES									
benzaldehyde	0	0.4	**0.2**	0	0	**0**	0	0.4	**0.2**
hexanal	0	0	**0**	0	0	**0**	0	0.9	**0.5**
heptanal	0	0	**0**	0	0	**0**	0	0.9	**0.5**
octanal	0	0	**0**	0	0	**0**	0	2	**1**
nonanal	0	0	**0**	0	3	**1**	0	5	**2**
decanal	0	0	**0**	0	0	**0**	0	6	**3**
KETONES									
2-butanone (MEK)	0	0	**0**	0	2	**1**	4	5	**4**
acetone	0	0	**0**	0	0	**0**	0	3	**2**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	0.4	0	**0**	0	0	**0**
texanol	1014	1049	**1031**	1111	1142	**1126**	1309	1380	**1344**
TXIB	2	2	**2**	3	3	**3**	4	4	**4**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.9	1	**1**	0.9	0.9	**0.9**	1	1	**1**
4,4-dimethyl-1,3-oxazolidine	0.4	0.4	**0.4**	0	0.2	**0.1**	3	2	**2**
dimethylperhydro-1,3-oxazine	0.1	0.1	**0.1**	0	0	**0**	0.3	0.4	**0.4**
SILICON CONTAINING COMPOUNDS									
hexamethylcyclotrisiloxane	0	0	**0**	0	0	**0**	2	2	**2**
SULPHUR CONTAINING COMPOUNDS									
2-methyl-3(2H)-isotiatsolon	0.4	0.9	**0.7**	0.9	0.9	**0.9**	2	2	**2**
Total	1666	1713	**1689**	1413	1440	**1427**	2610	2732	**2671**
TVOC	**1115**	**1128**	**1122**	**1058**	**1133**	**1095**	**1961**	**2049**	**2005**
non-TVOC	0	0	**0**	0	2	**1**	4	8	**6**

Table C127. Background emission values of primer and paint B in the FLEC test.

(µg/m^3)	
ALIPHATIC AND ALICYCLIC COMPOUNDS	
nonane	2
MONATOMIC ALCOHOLS	
2-ethyl-1-hexanol	2
ALDEHYDES	
benzaldehyde	2
nonanal	4
PHENOLS	
phenol	0.3
ALCOHOL AND PHENOL ETHERS	
2-butoxyethanol	3
ACIDS	
acetic acid	7
Total	20
TVOC	**20**
non-TVOC	7

Table C128. Emission values of primer and paint B at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	1	0	**1**	0.4	1.3	**1**
AROMATIC HYDROCARBONS									
toluene	0.3	0	**0.2**	0	0.3	**0.2**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.4	0	**0**	2	0.9	**1**	0.9	0.9	**0.9**
DIVALENT ALCOHOLS									
1,2-propanediol	66	71	**68**	22	21	**22**	71	79	**75**
PHENOLS									
phenol	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	5	5	**5**	2	2	**2**	5	5	**5**
2-(2-butoxyethoxy)ethanol	10	10	**10**	10	8	**9**	23	26	**25**
2-butoxyethanol	0	0	**0**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	0.9	0.4	**0.7**	2	1	**2**	1	2	**2**
nonanal	2	0.9	**1**	3	3	**3**	3	2	**2**
ACIDS									
acetic acid	34	45	**40**	38	38	**38**	38	49	**43**
hexanoic acid	0	0	**0**	0	0	**0**	0.9	2	**1**
ESTERS AND LACTONES									
texanol	0	0	**0**	0	0	**0**	1	1	**1**
TXIB	0	0	**0**	0	0	**0**	0.4	0.9	**0.7**
Total	119	133	**126**	80	75	**78**	145	171	**158**
TVOC	**15**	**17**	**16**	**27**	**15**	**21**	**32**	**37**	**35**
non-TVOC	34	45	**40**	38	38	**38**	38	49	**43**

Table C129. Background emission values of primer A and paint C in the FLEC test.

(μg/m^3)	
ALDEHYDES	
decanal	17
Total	17
TVOC	**57**
non-TVOC	0

Table C130. Emission values of primer A and paint C at 14 days in the FLEC test.

(μg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
hexane	2	2	**2**	0	0.9	**0**	0	0	**0**
heptane	7	8	**7**	3	3	**3**	0	0	**0**
octane	7	7	**7**	3	3	**3**	0	0	**0**
nonane	0	0.9	**0.5**	0	0	**0**	0	0	**0**
decane	2	2	**2**	1	1	**1**	0	0	**0**
undecane	12	12	**12**	5	5	**5**	2	2	**2**
dodecane	9	9	**9**	4	4	**4**	1	1	**1**
tridecane	2	2	**2**	0.9	0.9	**0.9**	0	0	**0**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	186	211	**199**	112	112	**112**	54	41	**48**
MONATOMIC ALCOHOLS									
1-butanol	4	4	**4**	0	0	**0**	0	0	**0**
2-ethyl-1-hexanol	0	0	**0**	0.9	0	**0.5**	1	0.9	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	705	688	**696**	432	480	**456**	542	560	**551**
PHENOLS									
phenol	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	4	4	**4**	5	6	**6**
2-butoxyethanol	2	2	**2**	0	0	**0**	2	0	**1**
ALDEHYDES									
benzaldehyde	0.9	0.9	**0.9**	1	0	**1**	0	0	**0**
n-butanal	9	8	**9**	6	6	**6**	3	4	**3**
pentanal	43	44	**44**	28	29	**28**	16	18	**17**
hexanal	145	145	**145**	97	93	**95**	53	57	**55**
heptanal	13	13	**13**	11	12	**11**	8	9	**9**
octanal	17	18	**17**	17	17	**17**	12	12	**12**
nonanal	17	19	**18**	17	18	**17**	13	13	**13**
decanal	0.9	0	**0.5**	3	2	**2**	0	0	**0**
2-decenal	10	10	**10**	8	8	**8**	8	8	**8**
KETONES									
2-butanone (MEK)	5	4	**4**	2	3	**3**	0	3	**2**
acetone	18	17	**17**	12	11	**12**	10	9	**10**
ACIDS									
acetic acid	53	88	**71**	30	57	**44**	32	30	**31**
propanoic acid	7	7	**7**	0	0	**0**	0	0	**0**
butanoic acid	8	8	**8**	10	11	**10**	6	6	**6**
pentanoic acid	44	44	**44**	34	37	**35**	26	29	**28**
hexanoic acid	190	190	**190**	159	181	**170**	137	154	**145**
2-etylhexanoic-acid	27	27	**27**	29	39	**34**	49	53	**51**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
texanol	216	207	**212**	287	287	**287**	498	502	**500**
TXIB	1	1	**1**	1	2	**2**	2	2	**2**
Total	1765	1797	**1781**	1318	1424	**1371**	1483	1521	**1502**
TVOC	**1000**	**987**	**994**	**815**	**820**	**818**	**892**	**927**	**909**
non-TVOC	84	117	**101**	51	77	**64**	45	45	**45**

Table C131. Background emission values of primer and paint C in the FLEC test.

(µg/m^3)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ACIDS	
nonane	0.7	acetic acid	27
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	2	Total	35
ALDEHYDES		**TVOC**	**20**
benzaldehyde	0.9	non-TVOC	27
ALCOHOL AND PHENOL ETHERS			
2-butoxyethanol	4		

Table C132. Emission values of primer and paint C at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
pentane	34	39	**36**	14	17	**15**	0	0	**0**
hexane	10	9	**10**	5	5	**5**	0	0	**0**
heptane	34	33	**34**	17	17	**17**	0	0	**0**
octane	30	30	**30**	16	16	**16**	0	0	**0**
decane	16	15	**15**	6	6	**6**	0	0	**0**
undecane	57	53	**55**	27	26	**26**	5	5	**5**
dodecane	18	18	**18**	10	10	**10**	0	0	**0**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	420	395	**407**	309	320	**314**	194	175	**184**
MONATOMIC ALCOHOLS									
1-pentanol	23	23	**23**	14	15	**14**	8	8	**8**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	6	5	**6**
ALDEHYDES									
n-butanal	12	9	**11**	8	9	**8**	7	5	**6**
pentanal	42	42	**42**	33	34	**34**	30	30	**30**
hexanal	128	128	**128**	110	110	**110**	110	106	**108**
heptanal	13	13	**13**	11	11	**11**	11	11	**11**
octanal	18	17	**17**	16	16	**16**	17	16	**16**
2-octenal	7	6	**7**	8	7	**7**	6	6	**6**
nonanal	19	19	**19**	20	16	**18**	19	19	**19**
decanal	0	0	**0**	6	0	**3**	0	0	**0**
2-decenal	11	10	**11**	11	12	**11**	13	13	**13**
undecenal	6	6	**6**	9	9	**9**	13	13	**13**
KETONES									
2-butanone (MEK)	11	10	**11**	8	8	**8**	0	0	**0**
2-heptanone	12	16	**14**	0	0	**0**	0	0	**0**
ACIDS									
acetic acid	57	88	**73**	29	38	**33**	17	14	**15**
propanoic acid	159	154	**157**	79	88	**84**	33	37	**35**
butanoric acid	43	40	**41**	25	26	**26**	12	12	**12**
pentanoic acid	119	115	**117**	84	88	**86**	57	62	**60**
hexanoic acid	489	467	**478**	410	436	**423**	326	344	**335**
2-etylhexanoic-acid	71	66	**68**	84	88	**86**	88	93	**90**
heptanoic acid	15	14	**15**	13	14	**13**	7	8	**7**
Total	1873	1835	**1854**	1382	1441	**1411**	977	980	**978**
TVOC	**1075**	**1058**	**1067**	**851**	**837**	**844**	**533**	**542**	**538**
non-TVOC	114	146	**130**	58	72	**65**	23	19	**21**

Table C133. Background emission values of filler and plaster A in the FLEC test.

(µg/m^3)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDIES	
nonane	0.8	benzaldehyde	1
AROMATIC HYDROCARBONS		nonanal	6
toluene	0.5	decanal	7
MONATOMIC ALCOHOLS			
2-ethyl-1-hexanol	1	Total	18
ALCOHOL AND PHENOL ETHERS		**TVOC**	**12**
2-butoxyethanol	2	non-TVOC	0

Table C134. Emission values of filler and plaster A at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
heptane	5	5	**5**	3	3	**3**	0	0	**0**
nonane	0	0	**0**	0	0	**0**	0	0.1	**0.1**
undecane	1	1	**1**	2	2	**2**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0.5	0.5	**0.5**
DIVALENT ALCOHOLS									
1,2-propanediol	450	454	**452**	767	789	**778**	0	0	**0**
ETHERS									
bis(2-ethoxyethyl)ether	0	0	**0**	2	2	**2**	1	0.9	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	8	6	**7**	34	35	**35**	0	0	**0**
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	5	4	**5**
1-methoxy-2-propanol	0	0	**0**	0	0	**0**	2	2	**2**
dipropylene glycol methyl ether	4	4	**4**	27	24	**26**	0.9	0.9	**0.9**
AROMATIC HYDROCARBONS									
p,m-xylene	1	1	**1**	0	0	**0**	0	0	**0**
toluene	1	1	**1**	0	0	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
pentanal	0	0	**0**	0	0	**0**	0.9	0	**0.5**
hexanal	3	3	**3**	3	3	**3**	1	2	**2**
octanal	0	0	**0**	0	0	**0**	1	2	**2**
nonanal	4	4	**4**	4	4	**4**	0.4	1	**1**
decanal	0	0	**0**	3	0	**1**	0	0	**0**
KETONES									
acetophenone	0	0	**0**	0	0	**0**	0	0.9	**0.5**
acetone	4	4	**4**	9	6	**7**	0	0	**0**
ACIDS									
acetic acid	15	16	**15**	10	10	**10**	9	6	**8**
ESTERS AND LACTONES									
TXIB	0	0	**0**	0	0	**0**	0.2	0.3	**0.3**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0	0.3	**0.2**
OTHERS									
unidentified	0	0	**0**	8	8	**8**	0	0	**0**
Total	496	500	**498**	871	885	**878**	25	22	**23**
TVOC	**132**	**132**	**132**	**291**	**304**	**298**	**15**	**17**	**16**
non-TVOC	18	20	**19**	19	15	**17**	9	6	**8**

Table C135. Background emission values of filler and plaster B in the FLEC test.

(µg/m^3)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDES	
nonane	1	benzaldehyde	1
AROMATIC HYDROCARBONS		SILICON CONTAINING COMPOUNDS	
toluene	1	organic Si-comp.	8
MONATOMIC ALCOHOLS		Total	17
2-ethyl-1-hexanol	2	**TVOC**	**16**
ALCOHOL AND PHENOL ETHERS		non-TVOC	0
2-butoxyethanol	4		

Table C136. Emission values of filler and plaster B at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
styrene	0	0	**0**	9	9	**9**	0	0	**0**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	153	153	**153**	172	172	**172**	172	176	**174**
ETHERS									
bis(2-ethoxyethyl)ether	20	20	**20**	17	16	**16**	6	6	**6**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	379	379	**379**	40	39	**39**	6	5	**6**
2-(2-butoxyethoxy)ethanol	313	313	**313**	168	168	**168**	43	39	**41**
KETONES									
acetone	0	0	**0**	19	11	**15**	10	10	**10**
ACIDS									
acetic acid	14	12	**13**	19	9	**14**	6	12	**9**
ESTERS AND LACTONES									
texanol	75	75	**75**	150	150	**150**	168	159	**163**
2-ethylhexylacetate	207	207	**207**	123	119	**121**	53	49	**51**
2-ethylhexylacrylate	79	79	**79**	38	38	**38**	12	12	**12**
2-ethyl-1-hexylpropionate	71	71	**71**	42	41	**42**	15	15	**15**
NITROGEN CONTAINING COMPOUNDS									
2-amino-2-methyl-1-propanol	12	15	**13**	20	25	**22**	19	26	**22**
4,4-dimethyl-1,3-oxazolidine	802	802	**802**	696	683	**690**	242	207	**225**
dimethylperhydro-1,3-oxazine	132	132	**132**	110	110	**110**	49	44	**46**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	85	85	**85**	23	23	**23**	9	2	**6**
Total	2342	2343	**2342**	1646	1611	**1629**	809	761	**785**
TVOC	**2073**	**2100**	**2086**	**1626**	**1569**	**1598**	**780**	**732**	**756**
non-TVOC	14	12	**13**	38	19	**29**	15	22	**19**

Table C137. Background emission values of a 6 mm layer of plaster C in the FLEC test.

(µg/m³)	
ALCOHOL AND PHENOL ETHERS	
2-butoxyethanol	12
TVOC	**39**

Table C138. Emission values of a 6 mm layer of plaster C at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
decane	0	0	**0**	0.2	0.3	**0.3**	0	0	**0**
undecane	0	0.4	**0.2**	0	0	**0**	0	0	**0**
dodecane	0.3	0	**0.2**	0.9	0.9	**1**	0.3	0	**0.2**
tridecane	0.4	0.4	**0.4**	3	3	**3**	0.3	0.4	**0.4**
tetradecane	3	2	**2**	4	4	**4**	0.4	0.4	**0**
pentadecane	1	1	**1**	1	1.3	**1**	0	0	**0**
hexadecane	1	0.9	**1**	0.9	0.9	**1**	0	0	**0**
2,2,4,6,6-pentamethylheptane	0	0	**0**	0.9	0.9	**1**	0.9	0.9	**1**
aliphatic hydrocarb.	0	0	**0**	7	7	**7**	0	0	**0**
A MIXTURE OF HYDROCARBONS									
hydrocarbon-mixture	0	0	**0**	70	62	**66**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0.4	0.2	**0.3**	0.3	0.2	**0.3**	0.4	0.2	**0.3**
ethylbenzene	0.2	0.2	**0.2**	0	0	**0**	0	0	**0**
p,m-xylene	0.9	0.9	**1**	0.4	0.4	**0**	0.3	0.3	**0.3**
o-xylene	0.3	0.3	**0.3**	0	0	**0**	0	0	**0**
toluene	1.8	1.8	**2**	0.9	0.9	**1**	0.9	0.9	**1**
1,2,4-trimethylbenzene	0.4	0.4	**0.4**	0.2	0	**0.1**	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	4	4	**4**	4	4	**4**	0	0	**0**
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0.3	0	**0.2**
benzyl alcohol	0.9	0.9	**1**	0	0	**0**	0	0	**0**
ETHERS									
bis(2-methoxyethyl)ether	4	4	**4**	0	0	**0**	0	0	**0**
PHENOLS									
phenol	2	0	**1**	0	0	**0**	0	2.6	**1**
ALCOHOL AND PHENOL ETHERS									
2-phenoxyethanol	1	1	**1**	0.4	0	**0**	0	0	**0**
2-methoxyethanol	2	2	**2**	0.4	0.4	**0**	0	0	**0**
ALDEHYDES									
benzaldehyde	2	1	**2**	1	0.3	**0.8**	1	2	**2**
nonanal	3	3	**3**	3	4	**3**	3	6	**5**
decanal	2	2	**2**	1	2	**2**	3	4	**3**
KETONES									
2-butanone (MEK)	0	2	**1**	0	0	**0**	0	0	**0**
acetophenone	0.4	0.9	**1**	0.3	0	**0.2**	0.9	0.4	**1**
acetone	5	5	**5**	4	4.4	**4**	4	4	**4**
ACIDS									
acetic acid	18	35	**26**	13	13	**13**	31	18	**24**
ESTERS AND LACTONES									
1-methoxy-2-propylacetate	0	0	**0**	0	0	**0**	0.4	0	**0.2**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.4	0	**0.2**	0	0	**0**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	7	11	**9**	20	23	**22**	13	11	**12**
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0	0.9	**0**
Total	62	82	**72**	138	132	**135**	61	51	**56**
TVOC	**70**	**71**	**71**	**137**	**115**	**126**	**15**	**20**	**18**
non-TVOC	27	44	**35**	20	21	**21**	35	22	**28**

Table C139. Background emission values of primer and paint A spread onto gypsum board in the FLEC test.

(µg/m³)	
TVOC	***50***1)

1) *Italic* font indicates that the value is below the detection limit.

Table C140. Emission values of primer and paint A spread onto gypsum board at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
AROMATIC HYDROCARBONS									
p,m-xylene	0.4	0	**0.2**	0	0.4	**0.2**	0	0.4	**0.2**
toluene	0	0	**0**	0	0	**0**	0	0.4	**0.2**
MONATOMIC ALCOHOLS									
1-butanol	0.9	0.9	**0.9**	2	2	**2**	2	2	**2**
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0	0.4	**0.2**
DIVALENT ALCOHOLS									
1,2-propanediol	269	260	**264**	176	168	**172**	771	767	**769**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	0	0	**0**	1	2	**2**
2-butoxyethanol	0	0	**0**	0.9	0.4	**0.7**	0.4	0.4	**0.4**
ALDEHYDES									
benzaldehyde	0.9	1	**1**	1	1	**1**	1	2	**2**
n-butanal	3	0	**1**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
hexanal	0	0.9	**0.5**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
nonanal	0.9	1	**1**	0.9	0	**0.5**	2	1	**2**
decanal	3	2	**2**	2	3	**2**	3	2	**3**
KETONES									
acetone	4	3	**4**	4	3	**3**	4	4	**4**
ACIDS									
acetic acid	168	5	**86**	10	4	**7**	26	21	**24**
propanoic acid	34	0	**17**	0	0	**0**	2	0	**1**
ESTERS AND LACTONES									
1-methoxy-2-propyl acetate	0	0	**0**	0	0	**0**	0.4	0	**0.2**
texanol	287	295	**291**	304	291	**298**	392	397	**394**
TXIB	0.4	0.4	**0.4**	0.4	0.9	**0.7**	1	0.9	**1**
ethyl acetate	1	0	**1**	0	0	**0**	0	0	**0**
HALOGEN CONTAINING COMPOUNDS									
dichloromethane	0.9	1	**1**	1	0.9	**1**	0	0	**0**
Total	771	572	**671**	506	476	**491**	1210	1202	**1206**
TVOC	**304**	**309**	**306**	**300**	**295**	**298**	**740**	**749**	**745**
non-TVOC	172	10	**91**	15	8	**11**	30	24	**27**

Table C141. Background emission values of primer and paint B spread onto gypsum board in the FLEC test.

(µg/m³)			
ALIPHATIC AND ALICYCLIC COMPOUNDS		ALDEHYDES	
nonane	0.9	benzaldehyde	1
decane	2	heptanal	1
undecane	3	decanal	1
dodecane	1	KETONES	
AROMATIC HYDROCARBONS		acetone	0.9
benzene	0.2	ACIDS	
p,m-xylene	0.6	acetic acid	5
toluene	2		
1,2,4-trimethylbenzene	0.2	Total	23.2
MONATOMIC ALCOHOLS		**TVOC**	***50***1)
2-ethyl-1-hexanol	0.4	non-TVOC	9.9
HALOGEN CONTAINING COMPOUNDS			
dichloromethane	4		

1) *Italic* font indicates that the value is below the detection limit.

Table C142. Emission values of primer and paint B spread onto gypsum board at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0	0.2	**0.1**	0	0	**0**
decane	0	0	**0**	0	0	**0**	0	0	**0**
dodecane	0	0	**0**	0	0	**0**	0	0	**0**
hexadecane	0	0.3	**0.2**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0.1	**0.1**	0.1	0	**0.1**	0.3	0	**0.2**
ethylbenzene	0.2	0.3	**0.3**	0.1	0	**0.1**	0	0	**0**
isopropylbenzene	0.2	0.1	**0.2**	0	0	**0**	0	0	**0**
p,m-xylene	0.2	0.2	**0.2**	0.4	0.4	**0.4**	0	0.2	**0.1**
o-xylene	0.2	0.2	**0.2**	0	0.1	**0.1**	0	0	**0**
styrene	0.2	0.1	**0.2**	0	0	**0**	0	0	**0**
toluene	0	0	**0**	0.3	0.2	**0.3**	0.2	0.2	**0.2**
1,2,4-trimethylbenzene	0	0	**0**	0	0	**0**	0	0	**0**
1,3,5-trimethylbenzene	0	0.1	**0.1**	0	0	**0**	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	0.1	0	**0.1**	0.1	0.1	**0.1**	0	0	**0**
1-butanol	0	0.2	**0.1**	0	0.1	**0.1**	0	0	**0**
2-ethyl-1-hexanol	0	0	**0**	0	0	**0**	0.1	0	**0.1**
DIVALENT ALCOHOLS									
1,2-propanediol	0.9	0	**0.5**	0	0	**0**	4	0.4	**2**
ALCOHOL AND PHENOL ETHERS									
2-butoxyethanol	0.3	0	**0.2**	0	0.1	**0.1**	0	0.1	**0.1**
ALDEHYDES									
benzaldehyde	0.4	0.4	**0.4**	0	0.9	**0.5**	2	1	**2**
pentanal	0	0	**0**	0	0	**0.0**	0	0	**0**
hexanal	0	0	**0**	0	0	**0**	0.4	0	**0.2**
octanal	0	0.1	**0.1**	0	0	**0**	0	0	**0**
nonanal	0	0.4	**0.2**	0	0	**0**	0.9	0.4	**0.7**
decanal	0.4	0.4	**0.4**	0.4	1	**1**	1	0	**1**

Table C142. Emission values of primer and paint B spread onto gypsum board at 14 days in the FLEC test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
KETONES									
acetophenone	0	0.1	**0.1**	0	0	**0**	0.4	0.1	**0.3**
acetone	0.5	0.5	**0.5**	0.2	1	**1**	1	1	**1**
ACIDS									
acetic acid	0	0	**0**	4	12	**8**	8	0	**4**
HALOGEN CONTAINING COMPOUNDS									
dichloromethane	0	0	**0**	0	0.3	**0.2**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	2	**1**	0	0	**0**	0	0	**0**
Total	4	6	**5**	5	17	**11**	19	4	**11**
TVOC	***0***1)	***0***1)	**0**	***22***1)	***22***1)	**22**	***22***1)	***22***1)	**22**
non-TVOC	0	0	**0**	4	14	**9**	9	1	**5**

1) *Italic* font indicates that the value is below the detection limit.

Table C143. Background emission values of adhesive A spread onto gypsum board in the FLEC test.

(µg/m³)	
ALCOHOL AND PHENOL ETHERS	
2-butoxyethanol	13
TVOC	***40***1)

1) *Italic* font indicates that the value is below the detection limit.

Table C144. Emission values of adhesive A spread onto gypsum board at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0	0	**0**	0.9	0	**0.5**
tetradecane	0.4	0.4	**0.4**	0.4	0.9	**0.7**	0	0	**0**
hexadecane	0	0	**0**	0	0	**0**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0	**0**	0	0.1	**0.1**	0.1	0.1	**0.1**
p,m-xylene	0	0.2	**0.1**	0	0	**0**	0	0	**0**
toluene	0.3	0.4	**0.4**	0.4	0.3	**0.4**	0.2	0.3	**0.3**
Biphenyls or their derivatives	0	0	**0**	0	0	**0**	7	5	**6**
MONATOMIC ALCOHOLS									
1-butanol	0	0	**0**	0	0.9	**0.5**	0	0	**0**
2-ethyl-1-hexanol	0.9	0.9	**0.9**	0.9	2	**2**	2	1	**2**
PHENOLS									
phenol	0	0	**0**	0	0.3	**0.2**	0.4	0.4	**0.4**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	0.9	1	**1**
2-butoxyethanol	2	2	**2**	2	2	**2**	0	0	**0**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0.4	**0.2**	0.4	0.9	**0.7**
octanal	0	0	**0**	0	0	**0**	2	0.4	**1**
nonanal	1	2	**2**	3	1	**2**	7	2	**4**
decanal	1	2	**2**	5	1	**3**	10	1	**6**

Table C144. Emission values of adhesive A spread onto gypsum board at 14 days in the FLEC test. Table continues.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
KETONES									
acetophenone	0.4	0.3	**0.4**	0.3	0.4	**0.4**	0.2	0.9	**0.6**
acetone	0.4	1	**0.9**	1	1	**1**	2	2	**2**
ACIDS									
acetic acid	0	0	**0**	8	7	**7**	17	18	**17**
ESTERS AND LACTONES									
TXIB	0	0	**0**	0.2	0.2	**0.2**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0.3	0	**0.2**
Total	7	9	**8**	21	19	**20**	50	33	**42**
TVOC	***18***1)	***18***1)	**18**	**18**	***18***1)	**18**	**10**	**7**	**8**
non-TVOC	0.4	1	**1**	9	8	**9**	19	20	**19**

1) *Italic* font indicates that the value is below the detection limit.

Table C145. Background emission values of adhesive B spread onto gypsum board in the FLEC test.

(µg/m^3)	
ALCOHOL AND PHENOL ETHERS	
2-butoxyethanol	6
TVOC	***40***1)

1) *Italic* font indicates that the value is below the detection limit.

Table C146. Emission values of adhesive B spread onto gypsum board at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
AROMATIC HYDROCARBONS									
benzene	0	0.2	**0.1**	0	0.2	**0.1**	0.1	0	**0.1**
p,m-xylene	0.3	0.3	**0.3**	0	0.3	**0.2**	0.3	0.2	**0.3**
toluene	0.4	0.4	**0.4**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
MONATOMIC ALCOHOLS									
2-ethyl-1-hexanol	0.9	0.9	**0.9**	0.9	0.9	**0.9**	0.9	0.9	**0.9**
PHENOLS									
phenol	0	0	**0**	0	0.3	**0.2**	0.3	0	**0.2**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0.9	**0**	18	17	**18**
2-butoxyethanol	0	0	**0**	0.4	0.9	**0.7**	0.9	0.9	**0.9**
2-phenoxyethanol	0	0	**0**	0.1	0	**0.1**	0.2	0.2	**0.2**
ALDEHYDES									
benzaldehyde	0	0	**0**	0	0.4	**0.2**	0.4	0	**0.2**
pentanal	0.9	0.9	**0.9**	0	0	**0**	0	0	**0**
hexanal	2	0	**1**	0	0	**0**	0	0	**0**
nonanal	1	0.9	**1**	2	2	**2**	4	2	**3**
decanal	2	0.9	**1**	3	3	**3**	4	1	**2**
KETONES									
acetophenone	0.3	0.3	**0.3**	0.4	0.4	**0.4**	0.4	0.2	**0.3**
acetone	0.9	0.9	**0.9**	0.9	1	**1**	2	1	**2**
ACIDS									
acetic acid	0	0	**0**	7	4	**6**	15	11	**13**
TERPENES AND THEIR DERIVATIVES									
limonene	0	0.4	**0.2**	0.4	0	**0.2**	0	0.4	**0.2**

Table C146. Emission values of adhesive B spread onto gypsum board at 14 days in the FLEC test. Table continues.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0	**0**	0	0.1	**0.1**	0	0.1	**0.1**
SULPHUR CONTAINING COMPOUNDS									
5-chloro-2-methyl-3(2H)-isotiatsolon	0	0	**0**	0	0	**0**	0.4	0.3	**0.4**
Total	9	6	**7**	15	15	**15**	47	36	**41**
TVOC	***0***1)	***0***1)	**0**	***18***1)	***18***1)	**18**	**22**	**20**	**21**
non-TVOC	0.9	0.9	**1**	8	5	**7**	17	12	**15**

1) *Italic* font indicates that the value is below the detection limit.

Table C147. Background emission values of primer and paint A spread onto filler and plaster B applied onto calcium silicate brick in the FLEC test.

(µg/m^3)	
TVOC	**18**

Table C148. Emission values of primer and paint A spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m^2·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	8	11	**10**	-	-	**-**	10	9	**10**
AROMATIC HYDROCARBONS									
styrene	3	3	**3**	-	-	**-**	2	0	**1**
MONATOMIC ALCOHOLS									
2-propanol	16	12	**14**	-	-	**-**	8	7	**7**
1-butanol	0	0	**0**	-	-	**-**	4	4	**4**
2-ethyl-1-hexanol	49	49	**49**	-	-	**-**	62	53	**57**
DIVALENT ALCOHOLS									
1,2-propanediol	569	577	**573**	-	-	**-**	613	582	**597**
ETHERS									
butylether	0.4	0.4	**0.4**	-	-	**-**	0.4	0.4	**0.4**
bis[2-(2-ethoxyethoxy)ethyl]ether	3	4	**3**	-	-	**-**	8	7	**7**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	28	29	**28**	-	-	**-**	39	37	**38**
2-[2-(2ethoxy)ethoxy]ethanol	0.4	0.4	**0**	-	-	**-**	0.9	1	**1**
2-(2-butoxyethoxy)ethanol	84	88	**86**	-	-	**-**	119	119	**119**
ALDEHYDES									
benzaldehyde	2	3	**3**	-	-	**-**	3	4	**3**
KETONES									
acetone	4	4	**4**	-	-	**-**	5	4	**5**
ESTERS AND LACTONES									
texanol	287	304	**295**	-	-	**-**	476	463	**469**
TXIB	0	0	**0**	-	-	**-**	2	2	**2**
2-ethylhexyl acetate	12	13	**13**	-	-	**-**	11	10	**10**
2-ethylhexyl acrylate	7	7	**7**	-	-	**-**	6	6	**6**
2-ethyl-1-hexyl propionate	7	9	**8**	-	-	**-**	5	5	**5**
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	31	28	**29**	-	-	**-**	185	172	**179**
dimethylperhydro-1,3-oxazine	3	3	**3**	-	-	**-**	16	15	**15**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	-	-	**-**	7	8	**7**
Total	1113	1143	**1128**	-	-	**-**	1581	1507	**1544**
TVOC	**564**	**582**	573	-	-	**-**	**1049**	**1000**	**1025**
non-TVOC	21	16	**18**	-	-	**-**	12	12	**12**

Table C149. Background emission values of primer and paint A spread onto plaster C applied onto calcium silicate brick in the FLEC test.

(µg/m³)	
TVOC	***20***1)

1) *Italic* font indicates that the value is below the detection limit.

Table C150. Emission values of primer and paint A spread onto plaster C applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
1-dodecene	8	11	**10**	-	-	-	10	11	**10**
pentadecane	0	0	**0**	-	-	-	0.9	0	**0**
hexadecane	1	1	**1**	-	-	-	1	1	**1**
AROMATIC HYDROCARBONS									
p,m-xylene	0	0.4	**0.2**	-	-	-	0	0	**0**
toluene	0	0.4	**0.2**	-	-	-	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	5	5	**5**	-	-	-	0	0	**0**
1-butanol	1	1	**1**	-	-	-	3	3	**3**
2-ethyl-1-hexanol	0	0	**0**	-	-	-	0.9	0.4	**0.7**
benzyl alcohol	0.4	0.4	**0.4**	-	-	-	1	3	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	238	207	**223**	-	-	-	599	599	**599**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	-	-	-	0	0.4	**0.2**
2-(2-butoxyethoxy)ethanol	4	6	**5**	-	-	-	13	13	**13**
ALDEHYDES									
benzaldehyde	0.4	0.9	**0.7**	-	-	-	0.4	1	**0.9**
pentanal	1	0.9	**1**	-	-	-	0	1	**1**
hexanal	0	0	**0**	-	-	-	2	2	**2**
nonanal	0.9	0	**0.5**	-	-	-	2	0	**1**
decanal	2	0	**1**	-	-	-	3	6	**4**
KETONES									
acetone	3	9	**6**	-	-	-	4	4	**4**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	-	-	-	0	0.9	**0.5**
texanol	326	326	**326**	-	-	-	273	282	**278**
TXIB	2	2	**2**	-	-	-	4	4	**4**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.9	0.9	**0.9**	-	-	-	4	4	**4**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0.4	0.4	**0.4**	-	-	-	0.4	1	**1**
Total	595	573	**584**	-	-	-	921	937	**929**
TVOC	**392**	**383**	**388**	-	-	-	**502**	**520**	**511**
non-TVOC	8	14	**11**	-	-	-	4	4	**4**

Table C151. Background emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick in the FLEC test.

(µg/m³)	
TVOC	***20***[1]

[1] *Italic* font indicates that the value is below the detection limit.

Table C152. Emission values of primer and paint B spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
pentadecane	0	0.4	**0.2**	-	-	-	0	0	**0**
hexadecane	0.9	1	**1**	-	-	-	1	0.4	**0.9**
AROMATIC HYDROCARBONS									
benzene	0	0.3	**0.2**	-	-	-	0	0.4	**0.2**
p,m-xylene	0.4	0.4	**0.4**	-	-	-	0	0	**0**
styrene	0	0	**0**	-	-	-	0.4	0	**0.2**
toluene	0.4	0.4	**0.4**	-	-	-	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	3	3	**3**	-	-	-	3	3	**3**
1-butanol	0	0	**0**	-	-	-	2	2	**2**
2-ethyl-1-hexanol	7	7	**7**	-	-	-	38	37	**38**
benzyl alcohol	0.9	0	**0**	-	-	-	1	1	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	24	24	**24**	-	-	-	38	34	**36**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	0	0	**0**	-	-	-	5	5	**5**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	5	6	**6**	-	-	-	40	39	**39**
2-(2-butoxyethoxy)ethanol	16	19	**17**	-	-	-	141	141	**141**
2-butoxyethanol	0.4	0.4	**0.4**	-	-	-	0.4	0.4	**0.4**
ALDEHYDES									
benzaldehyde	3	1	**2**	-	-	-	3	4	**4**
octanal	0	2	**1**	-	-	-	2	1	**2**
nonanal	2	6	**4**	-	-	-	3	0.9	**2**
decanal	3	1	**2**	-	-	-	2	0.4	**1**
KETONES									
acetophenone	0	0.3	**0.2**	-	-	-	0	0	**0**
acetone	4	4	**4**	-	-	-	5	7	**6**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	-	-	-	0.9	0.4	**0.7**
texanol	9	8	**9**	-	-	-	35	33	**34**
2-ethylhexyl acetate	1	1	**1**	-	-	-	5	5	**5**
2-ethylhexyl acrylate	0.9	0.9	**0.9**	-	-	-	4	4	**4**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.9	0.9	**0.9**	-	-	-	1	1	**1**
4,4-dimethyl-1,3-oxazolidine	0	0	**0**	-	-	-	79	79	**79**
dimethylperhydro-1,3-oxazine	0	0	**0**	-	-	-	6	5	**6**
SILICON CONTAINING COMPOUNDS									
decamethylcyclopentasiloxane	0	0.4	**0.2**	-	-	-	0.4	0.4	**0.4**
Total	81	89	**85**	-	-	-	417	404	**411**
TVOC	**26**	**28**	**27**	-	-	-	**247**	**383**	**315**
non-TVOC	6	7	**7**	-	-	-	8	9	**9**

Table C153. Background emission values of primer and paint B spread onto plaster C applied onto calcium silicate brick in the FLEC test.

(µg/m³)	
TVOC	**18**

Table C154. Emission values of primer and paint B spread onto plaster C applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	0	0	**0**	1	0	**1**
decane	0	0	**0**	0	0	**0**	0	0	**0**
tridecane	0	0	**0**	0	0	**0**	0.2	0	**0.1**
pentadecane	0.2	0.2	**0.2**	0	0	**0**	0	0	**0**
hexadecane	0.2	0.4	**0.3**	0	0.4	**0.2**	0.9	0.4	**0.7**
AROMATIC HYDROCARBONS									
benzene	0.3	0.2	**0.3**	0	0	**0**	0	0	**0**
p,m-xylene	0.2	0.2	**0.2**	0.4	0	**0.2**	0	0	**0**
toluene	0.1	0.1	**0.1**	0.4	0.4	**0.4**	0.4	0.4	**0.4**
MONATOMIC ALCOHOLS									
2-propanol	0	0	**0**	0.9	0	**0.5**	1	0.9	**1**
2-ethyl-1-hexanol	0.4	0.4	**0.4**	0.9	0	**0.5**	1	2	**2**
benzyl alcohol	0	0	**0**	0.9	0.9	**0.9**	1	2	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	3	0	**1**	3	2	**2**	16	15	**16**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	0	0	**0**	0	0	**0**	2	1	**2**
2-(2-butoxyethoxy)ethanol	2	2	**2**	6	4	**5**	29	30	**30**
2-phenoxyethanol	0	0	**0**	0	0	**0**	0.4	0	**0.2**
ALDEHYDES									
benzaldehyde	2	2	**2**	2	3	**2**	2	2	**2**
octanal	0	0	**0**	0	0	**0**	2	1	**2**
nonanal	1	2	**2**	1	0	**1**	3	0.9	**2**
decanal	0	0.4	**0.2**	3	0	**1**	5	2	**4**
KETONES									
acetophenone	0.2	0.4	**0.3**	0	0.4	**0.2**	0.4	0.9	**0.7**
acetone	1	0.9	**1**	2	1	**2**	3	2	**3**
ACIDS									
acetic acid	0	0	**0**	0	53	**26**	57	0	**29**
hexanoic acid	0	0	**0**	0	0	**0**	18	11	**14**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	0	0	**0**	0.9	0.9	**0.9**
texanol	0	0	**0**	0	0	**0**	0.4	0	**0.2**
TXIB	0.1	0.1	**0.1**	0.2	0	**0.1**	0.4	0.4	**0.4**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0.4	0.4	**0.4**	0	0	**0**	0	0	**0**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	0	0	**0**	0	0	**0**	0	5	**2**
decamethylcyclopentasiloxane	0.2	0.1	**0.2**	0	0	**0**	0.4	2	**1**
Total	11	10	**10**	20	66	**43**	146	80	**113**
TVOC	**8**	**12**	**10**	**10**	**7**	**8**	**37**	**44**	**40**
non-TVOC	14	12	**13**	3	54	**28**	62	3	**32**

Table C155. Background emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick in the FLEC test.

(μg/m³)	
TVOC	**15**

Table C156. Emission values of adhesive A spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the FLEC test.

(μg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
dodecane	0.2	0.4	**0.3**	-	-	-	0	0.9	**0.5**
pentadecane	0.9	0	**0.5**	-	-	-	0.9	0.9	**0.9**
AROMATIC HYDROCARBONS									
ethylbenzene	0.3	0	**0.2**	-	-	-	0	0	**0**
propylbenzene	0.2	0.2	**0.2**	-	-	-	0	0	**0**
isopropylbenzene	0.4	0.4	**0.4**	-	-	-	0.4	0.4	**0.4**
styrene	0.9	0.9	**0.9**	-	-	-	0.4	0.4	**0.4**
toluene	0.4	0	**0.2**	-	-	-	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	0.9	0	**0.5**	-	-	-	1	0.9	**1**
1-butanol	0	0	**0**	-	-	-	3	3	**3**
2-ethyl-1-hexanol	17	16	**17**	-	-	-	44	40	**42**
benzyl alcohol	0.9	0	**0.5**	-	-	-	0	0	**0**
DIVALENT ALCOHOLS									
1,2-propanediol	2	3	**2**	-	-	-	2	3	**2**
PHENOLS									
phenol	0.9	0.9	**0.9**	-	-	-	1	0.9	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	16	34	**25**	-	-	-	57	53	**55**
2-(2-butoxyethoxy)ethanol	36	71	**53**	-	-	-	181	181	**181**
1-methoxy-2-propanol	0	0	**0**	-	-	-	2	0	**1**
2-butoxyethanol	0.4	0	**0.2**	-	-	-	0	0.4	**0.2**
ALDEHYDES									
benzaldehyde	3	1	**2**	-	-	-	4	3	**3**
pentanal	0	2	**1**	-	-	-	0	0	**0**
heptanal	0	0	**0**	-	-	-	0	0.9	**0.5**
octanal	1	0.9	**1**	-	-	-	0.9	0	**0.5**
nonanal	2	1	**2**	-	-	-	0.9	2	**1**
decanal	3	1	**2**	-	-	-	0	2	**1**
KETONES									
acetophenone	2	0.4	**1**	-	-	-	1	0.4	**1**
acetone	2	2	**2**	-	-	-	6	6	**6**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0	**0**	-	-	-	0.9	1	**1**
1-methoxy-2-propyl acetate	0.4	0	**0.2**	-	-	-	0	0	**0**
texanol	2	5	**4**	-	-	-	49	57	**53**
TXIB	0.3	0.2	**0.3**	-	-	-	0	0	**0**
2-ethylhexyl acetate	9	8	**9**	-	-	-	14	11	**12**
2-ethylhexyl acrylate	4	4	**4**	-	-	-	7	7	**7**
2-ethyl-1-hexyl propionate	4	4	**4**	-	-	-	5	5	**5**
NITROGEN CONTAINING COMPOUNDS									
1-methyl-2-pyrrolidinone	0	0	**0**	-	-	-	0.9	0	**0.5**
4,4-dimethyl-1,3-oxazolidine	11	17	**14**	-	-	-	361	366	**364**
dimethylperhydro-1,3-oxazine	2	2	**2**	-	-	-	36	35	**35**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	4	8	**6**	-	-	-	14	53	**34**
OTHERS									
phenyl maleinic acid anhydride	2	0	**1**	-	-	-	0	0	**0**
Total	129	184	**156**	-	-	-	793	832	**813**
TVOC	**93**	**106**	**99**	-	-	-	**657**	**661**	**659**
non-TVOC	3	2	**2**	-	-	-	7	6	**7**

Table C157. Background emission values of adhesive A spread onto plaster C applied onto calcium silicate brick in the FLEC test.

(µg/m³)	
TVOC	**18**

Table C158. Emission values of adhesive A spread onto plaster C applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.9	0	**0.5**	0	0	**0**	0	0	**0**
dodecane	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
tridecane	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
tetradecane	0	0	**0**	0	0	**0**	0.4	0.4	**0.4**
hexadecane	0	0.3	**0.2**	0	0	**0**	0.4	0	**0.2**
AROMATIC HYDROCARBONS									
benzene	0.2	0.1	**0.2**	0.1	0.1	**0.1**	0	0.4	**0.2**
toluene	0.3	0.3	**0.3**	0.1	0.2	**0.2**	0.2	0.1	**0.2**
MONATOMIC ALCOHOLS									
2-propanol	20	23	**21**	2	2	**2**	2	2	**2**
2-ethyl-1-hexanol	0.3	0.4	**0.4**	0.4	1	**0.9**	1	2	**2**
benzyl alcohol	0	0	**0**	0	0	**0**	0.9	0.9	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	0	0	**0**	2	0	**1**
PHENOLS									
phenol	2	0.9	**1**	2	1	**2**	0.9	1	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	0	0	**0**	0	0	**0**	4	0	**2**
ALDEHYDES									
benzaldehyde	2	0.9	**2**	0.9	0.9	**0.9**	1	2	**2**
n-butanal	0	0	**0**	2	0	**1**	0	2	**1**
octanal	0.9	0.4	**0.7**	0.4	0.9	**0.7**	0.9	0.9	**0.9**
nonanal	2	0.4	**1**	0.9	0.9	**0.9**	1	2	**2**
decanal	3	0.9	**2**	0.9	1	**1**	2	2	**2**
KETONES									
acetophenone	0.4	0	**0**	0.4	0	**0.2**	0.4	0.4	**0.4**
acetone	3	2	**2**	3	2	**2**	2	4	**3**
ACIDS									
acetic acid	13	8	**11**	10	4	**7**	5	0	**2**
ESTERS AND LACTONES									
TXIB	0	0	**0**	0.2	0	**0.1**	0.3	0.4	**0.4**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	1	2	**2**	6	4	**5**	8	3	**6**
decamethylcyclopentasiloxane	0	0	**0**	0	0	**0**	0.4	0	**0.2**
Total	49	39	**44**	29	20	**24**	35	24	**29**
TVOC	**11**	**8**	**9**	**11**	**11**	**11**	**23**	**19**	**21**
non-TVOC	36	32	**34**	17	8	**13**	8	8	**8**

Table C159. Background emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick in the FLEC test.

(µg/m³)	
TVOC	**18**

Table C160. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0	0	**0**	-	-	-	0	0.9	**0.5**
dodecane	1	0.9	**1**	-	-	-	1	1	**1**
tridecane	0	0.4	**0.2**	-	-	-	0	0	**0**
pentadecane	0	0.4	**0.2**	-	-	-	0	0	**0**
hexadecane	0.4	0.4	**0.4**	-	-	-	0.4	0.4	**0.4**
AROMATIC HYDROCARBONS									
propylbenzene	0	0	**0**	-	-	-	0.4	0.4	**0.4**
isopropylbenzene	0.4	0.4	**0.4**	-	-	-	0.9	0.9	**0.9**
styrene	0.4	0.4	**0.4**	-	-	-	0.9	0.9	**0.9**
MONATOMIC ALCOHOLS									
2-propanol	16	15	**16**	-	-	-	8	9	**9**
1-butanol	0	0	**0**	-	-	-	3	3	**3**
2-ethyl-1-hexanol	44	44	**44**	-	-	-	38	39	**39**
benzyl alcohol	0.9	0.9	**0.9**	-	-	-	1	0.9	**1**
DIVALENT ALCOHOLS									
1,2-propanediol	5	4	**5**	-	-	-	4	6	**5**
ETHERS									
bis[2-(2-ethoxyethoxy)ethyl]ether	12	13	**12**	-	-	-	13	13	**13**
PHENOLS									
phenol	2	2	**2**	-	-	-	0	2	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-ethoxyethoxy)ethanol	57	57	**57**	-	-	-	75	75	**75**
2-[2-(2ethoxy)ethoxy]ethanol	0.4	0.9	**0.7**	-	-	-	2	2	**2**
2-(2-butoxyethoxy)ethanol	1410	1459	**1435**	-	-	-	1692	1679	**1686**
2-butoxyethanol	0	0.9	**0**	-	-	-	0.9	0.9	**0.9**
ALDEHYDES									
benzaldehyde	3	3	**3**	-	-	-	3.5	4	**4**
n-butanal	3	0	**1**	-	-	-	5	4	**5**
nonanal	4	3	**3**	-	-	-	2	3	**2**
decanal	6	3	**4**	-	-	-	0	0	**0**
KETONES									
acetophenone	0	0	**0**	-	-	-	0.4	1	**0.9**
acetone	4	4	**4**	-	-	-	5	5	**5**
ACIDS									
acetic acid	8	4	**6**	-	-	-	25	19	**22**
TERPENES AND THEIR DERIVATIVES									
limonene	1	1	**1**	-	-	-	0.9	0.9	**0.9**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	4	4	**4**	-	-	-	3	3	**3**
texanol	28	29	**28**	-	-	-	53	53	**53**
2-ethylhexyl acetate	17	18	**17**	-	-	-	17	16	**17**
2-ethylhexyl acrylate	13	13	**13**	-	-	-	12	12	**12**
2-ethyl-1-hexyl propionate	9	9	**9**	-	-	-	9	8	**9**

Table C160. Emission values of adhesive B spread onto filler and plaster B applied onto calcium silicate brick at 14 days in the FLEC test. Table continues.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
NITROGEN CONTAINING COMPOUNDS									
4,4-dimethyl-1,3-oxazolidine	84	88	**86**	-	-	**-**	322	331	**326**
dimethylperhydro-1,3-oxazine	11	11	**11**	-	-	**-**	24	25	**24**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	4	7	**5**	-	-	**-**	17	13	**15**
Total	1748	1794	**1771**	-	-	**-**	2339	2332	**2336**
TVOC	**837**	**837**	**837**	**-**	**-**	**-**	**1278**	**1278**	**1278**
non-TVOC	31	23	**27**	-	-	**-**	43	38	**40**

Table C161. Background emission values of adhesive B spread onto plaster C applied onto calcium silicate brick in the FLEC test.

(µg/m^{3})	
TVOC	**15**

Table C162. Emission values of adhesive B spread onto plaster C applied onto calcium silicate brick at 14 days in the FLEC test.

(µg/m^{2}·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
ALIPH. AND ALICYCLIC COMPOUNDS									
nonane	0.9	0	**0**	-	-	**-**	0	0	**0**
dodecane	0	0.3	**0.2**	-	-	**-**	0	0	**0**
tridecane	0.4	0.4	**0.4**	-	-	**-**	0	0	**0**
tetradecane	0.4	0.4	**0.4**	-	-	**-**	0.9	0.9	**0.9**
pentadecane	0.4	0.9	**0.7**	-	-	**-**	0.9	0.4	**0.7**
hexadecane	0.1	0.4	**0.3**	-	-	**-**	0	0	**0**
AROMATIC HYDROCARBONS									
benzene	0	0.2	**0.1**	-	-	**-**	0	0	**0**
toluene	0.4	0.4	**0.4**	-	-	**-**	0	0	**0**
MONATOMIC ALCOHOLS									
2-propanol	0.9	1	**1**	-	-	**-**	0	0	**0**
1-butanol	0	0	**0**	-	-	**-**	2	2	**2**
2-ethyl-1-hexanol	0.9	0.9	**0.9**	-	-	**-**	1	1	**1**
benzyl alcohol	0	0	**0**	-	-	**-**	2	2	**2**
DIVALENT ALCOHOLS									
1,2-propanediol	0	0	**0**	-	-	**-**	2	0	**1**
PHENOLS									
phenol	0.9	0.9	**0.9**	-	-	**-**	2	0.4	**1**
ALCOHOL AND PHENOL ETHERS									
2-(2-butoxyethoxy)ethanol	106	304	**205**	-	-	**-**	560	613	**586**
1-methoxy-2-propanol	0	0	**0**	-	-	**-**	0.9	0	**0.5**
2-butoxyethanol	0.9	0	**0.5**	-	-	**-**	0.9	0.9	**0.9**
2-phenoxyethanol	0	0	**0**	-	-	**-**	0.4	0.4	**0.4**
ALDEHYDES									
benzaldehyde	0.9	2	**1**	-	-	**-**	3	0	**1**
n-butanal	0	5	**2**	-	-	**-**	0	0	**0**
octanal	1	1	**1**	-	-	**-**	1	1	**1**
nonanal	3	1	**2**	-	-	**-**	2	2	**2**
decanal	4	3	**3**	-	-	**-**	4	4	**4**

Table C162. Emission values of adhesive B spread onto plaster C applied onto calcium silicate brick at 14 days in the FLEC test. Table continues.

(µg/m²·h)	**RH 20 %**			**RH 50 %**			**RH 80 %**		
KETONES									
acetophenone	0.4	0	**0.2**	-	-	**-**	0.9	0	**0.5**
acetone	1	0.9	**1**	-	-	**-**	3	2	**2**
ESTERS AND LACTONES									
2-(2-butoxyethoxy)ethyl acetate	0	0.4	**0.2**	-	-	**-**	2	1	**2**
TXIB	0.2	0.2	**0.2**	-	-	**-**	0.4	0	**0.2**
SILICON CONTAINING COMPOUNDS									
organic Si-comp.	2	2	**2**	-	-	**-**	19	6	**12**
Total	124	325	**225**	-	-	**-**	606	636	**621**
TVOC	**53**	**141**	**97**	**-**	**-**	**-**	**339**	**357**	**348**
non-TVOC	2	2	**2**	-	-	**-**	3	2	**2**

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