Paper III

Can better printing surface enhance the CSWO printing industry to adapt to the change of its business environment?

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ABSTRACT

Europe's newspaper industry is facing major challenges on its way to the new business environment of 21st century. Challenges like declining circulation and diminishing readership, continuing loss of classified advertisements and increasing free distribution of content are reflections of the changes in the business environment. /1/

Adaption to new business environment requires creation of new business models. Innovations and sensitiveness to reader's needs are key factors in successful creation of new business models. Daily free commuter newspapers are a good example of profitable new business model. New business models can as well shift products at growth stage (direct mail, sales promotion) to existing assets of cold set industry from other printing industries (HSWO). Further examples of successful reshaping of the newspaper are changes of daily newspaper's format to tabloid (closer to magazine format) and creation of "magazine" like supplements.

The potential of most of these new business models is seriously limited by technical barriers in optical print quality of the cold set printing process. The main limitations are print gloss, density levels, dot-gain, contrast, reproducibility of colours, set-off and evenness when compared to heat set quality

The experimental part of this study evaluates if changes in printing surface improve the optical print quality of cold set printing so much that the technical obstacles can be exceeded.

In the first part of this study change in printing surface is created by application of a coating layer with film coating technique. The print quality potential of this printing surface is then compared to other commercially available, but uncoated surfaces. In the second part of the study coating layer of the commercial product is then further optimized for best potential print quality. As well a simple comparison between the improvement potential of print quality created by printing surface modifications compared to modifications in cold set machinery is presented.

The work is formulated under two hypotheses. First hypotheses is that commercial light weight coated matt (unprinted hunter gloss <15) papers improve the print quality achieved with the cold-set web offset printing over the commercial uncoated paper grades so much that it makes it possible to exceed the technical obstacles in creation of new business models.

Second hypothesis is that when optimizing the print quality of matt LWC grades for CSWO printing, coating pigments play major role.

Results of this study showed that some of the technical obstacles (set-off, dot-gain, contrast, evenness, colour gamut) in optical print quality of cold set process can be exceeded when using commercially available coated paper grade. The coated paper grade offers further an excellent tool for reshaping the newspapers by designing print quality wise magazine like supplements. The technical obstacles (gap to HSWO quality) remain in gloss of the printed surface and in density levels. Smaller variations in ink pigment film thickness on coated printing surface (74%) compared to uncoated surface (156%) was found to be one of the factors explaining the difference in optical print quality. Hereby the first hypothesis is proven to be largely correct; the improvements in optical print quality on coated paper surface allow the printers to exceed most of the technical obstacles limiting the potential of new business models.

Optimization of coating pigments further improved the relative contrast. On the other hand the structure of coating does not seem to have big influence on the set-off, print through and print evenness. It is suggested that the print through and evenness of the print are more influenced by base paper properties.

The total pore volume (cm^3/kg) seems to be the most important factor influencing relative contrast in the final product. There was no influence of the pore size or quantity to the relative contrast. It is suggested that ink pigments are spreading in x-y direction on the coated surface when empty pore volume is available. It can be concluded that this spreading is typical for cold set printing and is a dominant factor influencing the final print quality instead of the fractionation of multi component ink during absorption into coating as proposed in previous work studying absorption of off set ink on coated paper /5/. This seems to be a fundamental difference in the behaviour between heat set and cold set processes.

The second hypothesis was hereby proven to be partially correct, but there is not enough evidence to say what is the level of importance (major or not) of coating pigments in optimizing the optical print quality of the coated paper grade. More investigations are needed in order to define the level of importance of the different variables.

The printing trials of this study showed that the limited flexibility of the cold set printing process today is creating a technical obstacle for full exploitation of the new business models.

KEY WORDS: Coated paper, cold set print quality, coating structure, pore structure, cold set printing media, new business models, business environment of cold set industry, ink pigments

INTRODUCTION

Europe's newspaper industry, which is world's largest in terms of daily circulation, is facing major challenges in its transition to the 21st century. Challenges like declining circulation, as seen from Figure 1 and diminishing readership particularly among young people, continuing loss of classified advertisements to the internet and ever increasing free distribution of content are reflections of the changes in the audience of newspapers. European newspaper readers are growing older, spending less time in reading and will represent a decreasing percentage of the whole population. /1/

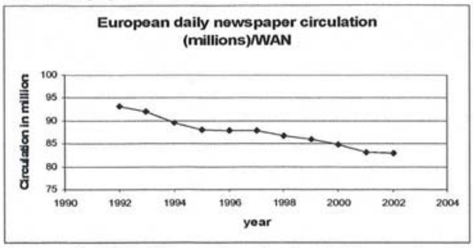

Figure 1. Development of circulation rates of European Newspapers /1, 2/

Figure 2 takes a closer look at one of the main challenges; the development of reading habits in different age groups. The trend indicates that the newsprint industry has increasing difficulties in attracting younger readers in one of its main markets, the UK.

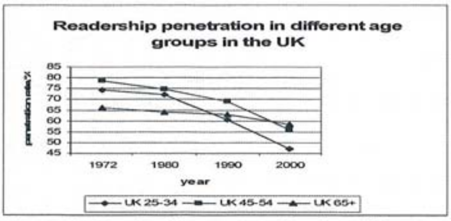

Figure 2. Readership penetration in different age groups in the UK as function of time /2/

In the traditional business model of a newspaper publisher the business is based on attracting a mass audience and transmitting various advertisement messages to this audience. As well today's advertisers seek mass audience, but the declining readership rates indicate that newspapers can no longer offer a contact to this mass audience. Since reading habits are not much influenced by economical cycles, it means that from newspaper's point of view "business as usual" will in many cases not come back at next up-turn. New business models are needed in order to adapt to this new business environment.

Based on the socio-geological changes it is no surprise that life cycle analyses of paid for daily newspapers show that they have reached their full maturity as such products and are approaching their decline, as can be seen from Figure 3./4/

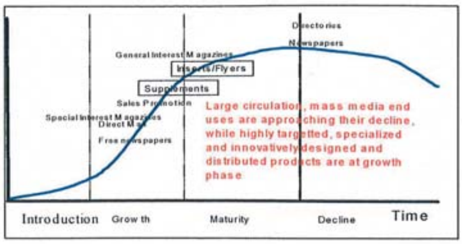

Figure 3. Life cycle analyses of Newsprint and some other products. Time is on x-axes and Sales volume in y-axes /3/.

Innovation in redesigning the newspaper concept and increased sensitiveness to reader's needs are essential in order to create new business models, which will stop the current declination rate of readership and reshape the life cycle of newspapers./1,2/

Sensitiveness to reader's needs can lead to changes in the design of existing newspapers. Examples of new business models created by new design can be found in Swedish daily newspapers. Some of them have very successfully transferred from traditional newspaper format to magazine like tabloid format. Another example of new business model, driven by sensitiveness to reader's needs, is creation of "magazine" like supplements, which usually are printed in 4+ 4 colours, with high densities, big contrasts and have magazine like lay-outs (example: Helsingin Sanomat Nyt-supplement). Third good examples of very successful new business models are daily free commuter newspapers.

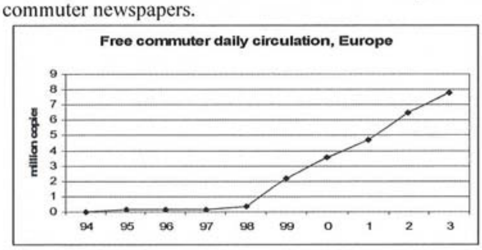

Figure 4. Development of the circulation rate of free commuter newspapers in Europe. Total circulation has grown from zero to 7.8 million copies daily during the last ten years /1/

As illustrated in Figure 4, the daily circulation of free commuter newspapers has exploded during the last ten years. New business models can as well shift products at growth stage (direct mail, sales promotion, etc. shown in Figure 3) to existing assets of cold set industry from other printing industries, if innovations are created to over come technical barriers.

Closer analyses show, that some kind of technical barriers are hindering the full exploitation of the economical potential of all the new business models mentioned here. The technical barriers are often connected to the print quality of the cold set printing. Further comparison of some inserts, supplements, sales promotion and direct mail material printed in heat set show that more preciously the technical limitations are related to too high set-off, print-through, dot-gain, unevenness and to too low contrast, too low density levels and poor reproducibility of colours in the cold set printing. Therefore innovations to improve the optical print quality of cold set would enhance the industry's adaption to its new business environment.

Today's technical possibilities to improve the print quality in cold set printing are: changes in printing technology (machinery), changes in printing surface (paper) or changes in other printing consumables. The first option requires normally a major investment and time. If a publisher has fairly new printing machines, it is unlikely that he could justify a financial investment in new printing machinery only to gain the potential to develop new business concepts requiring better final print quality. Therefore the changes in paper surface, together with optimization of other printing consumables remain economically the most potential technical tool for generating rather quickly relatively big visual improvements in the final products.

The experimental part of this study evaluates if changes in printing surface improve the print quality of cold set printing so much that the technical obstacles confronted in new business models can be exceeded. In the first part of this study change in printing surface is created by applying a coating layer with film coating technique. The print quality potential of this printing surface is then compared to other commercially available, but uncoated surfaces. In the second part of the study coating layer of the commercial product is further optimized for best potential print quality. As well a simple comparison between the improvement potential of print quality created by printing surface modifications vs. modifications in cold set machinery is presented.

The work is formulated under two hypotheses. First hypotheses is that commercial light weight coated matt (unprinted hunter gloss <15) papers improve the print quality achieved with the cold-set web offset printing over the commercial uncoated paper grades so much that it makes it possible to exceed the technical obstacles that new business models are confronted by.

Second hypothesis is that when optimizing the print quality of matt LWC grades for CSWO printing, coating pigments play major role. This second hypothesis is based on the condition that print quality of coated paper grade in off set process is, according to earlier studies believed to be largely determined by fractionation of ink during absorption, where pore structure of coating play key role /5/ and initial ink transfer process /6/ (ink film thickness and splitting).

EXPERIMENTAL

In order to test the hypothesis about the print quality and the influence of coating pigments in film coating to it, different coating structures were produced on constant base paper, printed in commercial printing machine and the print quality of the final product was evaluated. Main emphasis during the experiment was in industrial scale trials.

In first part of the experiment, 18 similar base paper reels were film coated at a pilot plant with 6 different pigment mixtures (three reels per coating recepy). The used pigments are coded with numbers C06 to C11. Table 1 shows a summary of the variables in the first experiment. While pigment mixtures varied, other coating colour components and base sheet were kept stable.

Table 1. Summary of variables used in the experiment. Binders, additives and base sheet were kept constant.

Pigment	Particles < 2 µm [w-%]	Trial point	Mixture
A	97	C06	100 % ref.
B	16	C07	75 % ref./25 % A
C	46	C08	75 % ref./25 % B
D	46	C09	25 % D/75 % C
E	30	C10	40 %E/60 % F
F	98	C11	20 %A/40 %E+F
Ref.	65		

Selected pigment mixtures represent different physical dimensions, as shown in Figure 5.

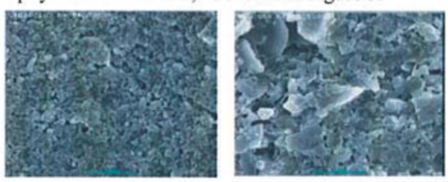

Figure 5. SEM images of pigment mixtures C06 (left) and C10 (right).

After coating the trial papers were calendered to same target roughness and trimmed at winder for printing.

In the second part of the experiment commercial trial papers and pilot coated trial reels were printed in commercial Wifag OF790 printing machine. Appendix 1 shows a schematic drawing of the printing machine. A special test format, using 4+2 colours, was created for the printing trials. The test format, which is shown in Appendix 1, was used for all print quality evaluations in cold set. The "mailing room" testing was as well used in some trial points. In this configuration the samples were transported from folder through the mailing room with "clippers" and finally into piles at compensating stacker. The effect of mailing room operations to print quality was studied. Table 2 summarizes the commercial trial papers used. Trail papers A-E are sold in the market to cold set printing and grade C in addition as well to HSWO and rotogravure printing (multipurpose). Grade F is MFC paper to heat set printing.

Table 2. Summary of the commercial paper grades evaluated in printing test

Trial Paper	Descri./Printed in	D65 Bright.	CIE Whiten.	Bendtsen Roughness
A	Coated grade,in CSWO	80	>90	<200
B	uncoated in CSWO, RCF containing medium filler content	70	60	>200
C	uncoated, multipurpose, printed in CSWO, virgin fiber,low filler content	73	65	<50
D	uncoated in CSWO, RCF containing, high filler content	76	80	<200
E	uncoated in CSWO,virgin fiber based low filler content	76	70	<150
F	Coated (MFC), in HSWO, virgin fiber, high filler content	72	66	<150
E	Grade F printed in waterless cold set (KBA Cortina)	72	66	<150

In the third part of the experiment trial papers A, D and E were printed in commercial waterless CSWO machine (KBA Cortina). Same test form layout was used as in the first printing trial at Wifag OF 790. Standard printing conditions and same target densities as in conventional CSWO machine were used. At last trial grade F was printed at heat-set using a standard test format and printing conditions (app.1). Appendix 1 summarizes in detail the printing test procedures at Wifag OF 790, KBA Cortina and the HSWO press. The printing conditions were kept as close as possible to normal conditions for newspaper (and magazine in HSWO) printing.

Evaluation of print quality

Print quality was evaluated from commercially printed samples. An evaluation of the "optical" print quality was carried out. Other factors influencing the over all quality perception of the final printed product (like surface feel, smell, touch, etc.) were not considered.

The test format was set-up so that densities, contrast, dot-gain, print-through, set-off and unevenness (mottling) could be measured. Measured values studied in this paper include only black surfaces. In addition to the numeric evaluation a visual evaluation was carried out by trained evaluation team using a standard evaluation technique.

Characterization of coating structure and ink film layer

Coating structure was characterized by mercury porosimetric analyses, coating coverage and SEM and light microscopic images.

RESULTS AND DISCUSSION

As discussed earlier in this paper there are clearly two technical ways (paper and other printing consumables or machinery) to improve the final print quality at CSWO printing. As Figure 6 shows there are huge print quality differences among the tested commercial cold set papers available in the market today. Coated printing surface clearly improves the optical print quality of the final product, as Figure 6 shows.

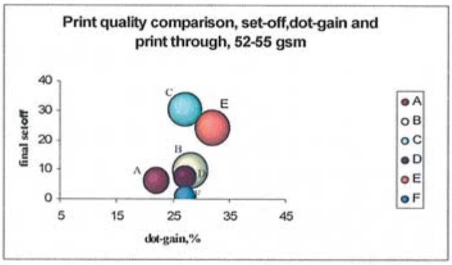

Figure 6. Print quality positioning of 52-55 gsm commercial MFS papers in conventional CSWO. Print quality is at its best at origo and the size of the ball is corresponding to print-through (small=less print-through).

Converting from conventional CSWO to waterless CSWO (KBA Cortina) seems to improve the over all print quality particularly sharpness and contrast. The difference between uncoated and coated printing surface become smaller as Figure 7 illustrates. During the printing test at KBA Cortina unexpected smearing in the front page occurred at the mailing room operations. This disturbed the final print quality particularly on the margins of the front page, but does not show in the set-off comparison of Figure 7, because the print quality evaluation routine included set-off analyses (visual and numeric) in inner pages and middle areas of the outside pages of final sample. An arrow has been placed in the Figure 7, as a remainder of this set off problem in Cortina samples.

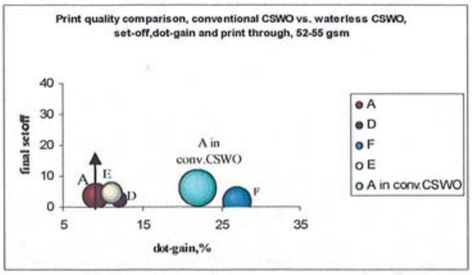

Figure 7. Print quality comparison, coated and uncoated printing surface, conventional cold set vs. waterless cold set (KBA Cortina), set-off and dot gain. The arrow points out the over-all set off level in Cortina samples. Size of the bubble corresponds to print-through; the smaller the less print-through

Figures 8 and 9 show that the potential to reproduce original colours of a model picture (colour gamut), contrast and visual evenness of the compact printing surfaces are clearly improving when coated printing surface is used. It can be further concluded from Figures 8 and 9 that changing from conventional to waterless cold set printing the contrast slightly improves and that the improvement is bigger in uncoated printing surfaces.

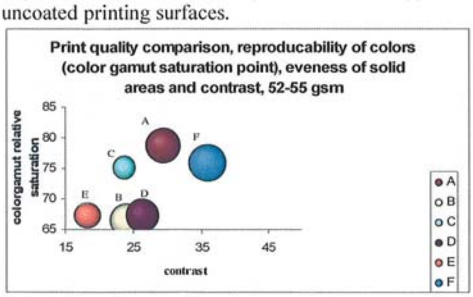

Figure 8. Print quality comparison in conventional CSWO, coated and uncoated commercial paper grades, colour gamut and contrast. Size of the bubble corresponds to evenness of compact surfaces, the bigger the more even. Contrast is measured from 75% raster area.

Interestingly it can be seen from these results that when using coated grades (like commercial grade A) the cold set printing technology can reach final print quality, which is comparable to certain heat-set end qualities (paper gloss below 20, PPS roughness>3). Only density range and gloss of printed surface are in cold set clearly below the heat-set level.

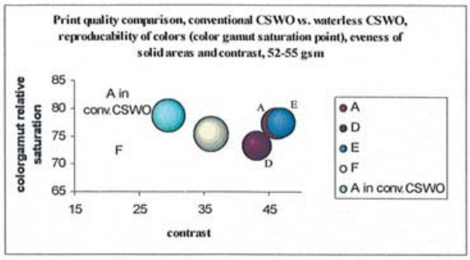

Figure 9. Print quality comparison, conventional cold set vs. water less cold set (KBA Cortina), colour gamut and contrast. Size of the bubble corresponds to evenness of compact surface, the bigger the more even. Contrast is measured from 75% raster area.

Why does the coated printing surface give better optical print quality? Earlier studies /5/ suggest that ink pigments stay on the surface of the coating layer forming an even film and this could explain better print quality on coated surface. There were some contradictory findings as well /7/, suggesting, that the pigments of the cold set inks penetrate through the coating layer. As microscopic images in Figure 10 show, the magenta ink pigment layer is partially sitting on the top of the coating and partially inside it. Occasionally the coating layer is not homogeneous and there can be big pores in the surface. The ink pigments accumulate in these pores and enter inside the base paper's fibre network and as well move in x-y direction below the coating layer.

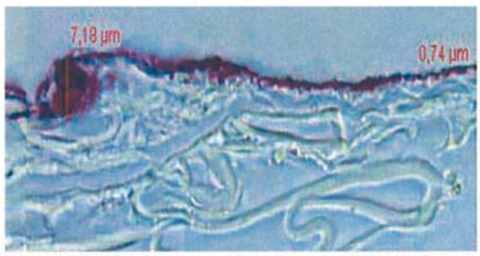

Figure 10. The cross cutting image of the printed paper A by the light microscope. Cross cutting was taken from compact magenta area (shows as darkest areas in the image). Ink pigment layer thickness varies from 0.75 to 7.2 microns at density level of 0.82.

Calculations from SEM images show that the thickness of the coating layer of the samples in this experiment varied between 4.6-5.8 microns. The ink film thickness on printed samples, when calculated from light microscopic images varied from 0.75 to 7.2 microns on the coated sample (A). Average ink pigment film thickness (visually calculated from images of the cross cuttings) was 3.6 microns and standard deviation was 2.6 microns, on the coated sample. These results confirm well the results of earlier studies /7/ of ink pigment and coating layer thicknesses and analysed by Raman technique (Ink pigment layer 1.6-4.2 microns, coating layer 2.7-7.0 microns). As well these results confirm that the ink pigment particles enter inside the coating structure, as shown earlier with Raman technique /7/. Figure 11 shows a cross cutting image of the printed paper D obtained by the light microscopy. The whole image can be seen in Appendix 2. In this sample the ink pigment layer thickness varied from 0.55 to 13.1 microns, average thickness was 3.6 microns and standard deviation 5.5 microns.

This comparison shows that the variation of the ink pigment film thickness (74 %) on coated paper surface is half of the variation of the film thickness on uncoated paper surface (156%). The result partially explains the better optical print quality of the coated paper surface. There are although relatively big variations in ink film thickness on the coated surface as well and there for it is suggested that the ink pigment film thickness alone can not explain the superior print quality of the coated grade A. It could be that as well the differences in dominating setting mechanisms of oils and resins of cold set ink, elasticity or compressibility, homogeneity of the physical structure and the micro scale surface roughness between uncoated and coated surface contribute to the final print quality.

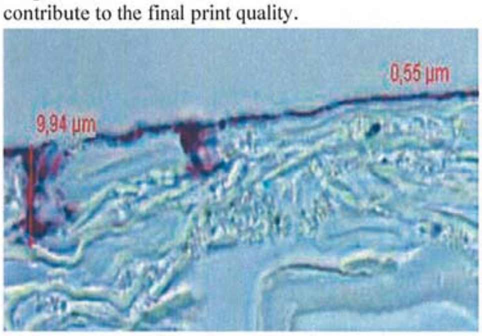

Figure 11. The cross cutting image of the printed paper D by the light microscope. Cross cutting was taken from compact magenta area (darkest areas in the image). Ink pigment layer thickness varies in the sample from 0.55 to 13.1 microns at density level of 0.9.

As table 3 shows, the experiment was successful in creating various coating structures. Mercury porosimetric analyses indicate that the pore structure of trial points C06-C11 is really varying.

Table 3. Results of mercury porosimetric analyses of the coated paper samples.

Trial point	Pore volume [cm³/kg]	Pore size [µm]	Number of pores [pores/µm²]
C06, ref.	89	0.39	16.3
C07	64	0.16	81.8
C08	89	0.30	28.1
C09	76	0.20	57.1
C10	68	0.10	212
C11	78	0.11	192

As Figures 12 and 13 show by choosing an optimal pigment and thereby creating an optimal coating pore structure, the dot-gain and density-contrast combination can be improved. On the other hand the structure of coating does not seem to have big influence on the set-off, print through and print evenness. It is further suggested that the print through and evenness of the print are more influenced by base paper properties, which can not be "masked" by application of coating pigments with film coating technique.

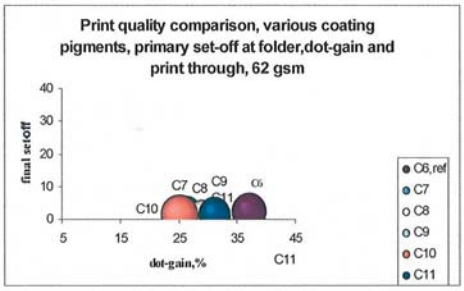

Figure 12. Influence of coating pigment to Set-off, dot gain and print through in CSWO printing of coated paper surface. Bubble size corresponds to print through, the smaller=less print through

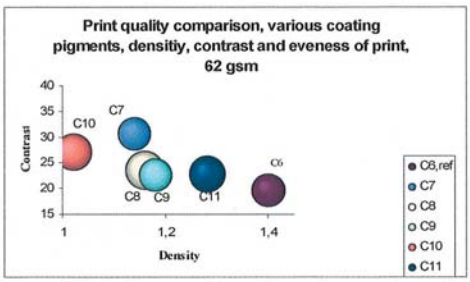

Figure 13. Influence of coating pigment to print density-contrast combination and evenness of solid print areas. Bubble size corresponds to print evenness, the bigger=better. Contrast is measured from 75% raster area.

From Figure 14 it can be seen that there are two groups of papers, if relative contrast between 75% raster and compact black surface is considered: trial papers which reached contrast above 25% and second group were contrast stayed below 25%. It seems to be so that samples with high pore volume did not reach high contrast levels, even if density of compact surface was increased, as can be seen from Table 4.

Table 4. Measured relative contrast values (75% raster) of black, densities of compact surfaces, pore volume and number of pores

Trial point	K rel [%]	Densities of compact surface	Pore volume [cm^3/kg]	Number of pores [pores/μm^2]
C06	20	1.4	89	16
C07	31	1.1	64	82
C08	24	1.2	89	28
C09	23	1.2	76	57
C10	27	1.0	68	212
C11	23	1.3	76	192

There was no influence of the pore size or quantity (for example, in samples C6 and C11, number of pores per μm^2 are respectively 16/192) to the contrast, dot-gain or print evenness of the final product. This result could be explained by the fact that the ink pigments are spreading in x-y direction in the paper surface if there is empty pore volume available in the surface. This spreading is not related to the size of the pores in the coating, it happens with small and big pores in equal way. It can be further concluded that this spreading seems to be typical for cold set inks and it is a dominant factor influencing the final print quality instead of the fractionation of ink during absorption into coating as proposed in previous work studying absorption of off set ink on coated paper (S.Rousu). This seems to be a fundamental difference in the behaviour between heat set and cold set processes.

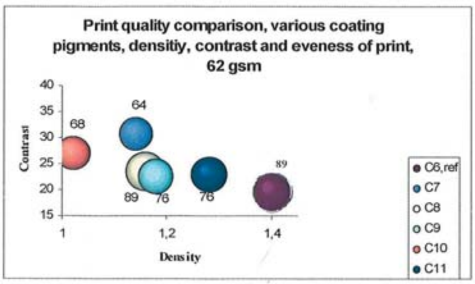

Figure 14. Print density-contrast combination, bubble size is corresponding to pore volume (cm^3/kg) of the sample. Contrast is measured from 75% raster area.

Coating coverage does not seem to have influence in the relative contrast, since the trial points C08 and C09 had very different coating coverage values (respectively 68% and 84% on BS) and still same relative contrast (23.6% and 22.6% respectively).

High relative contrast is one of the desired properties of the high quality end products in cold set printing. In order to approach the heat set print quality, it is essential to be able to reach for still higher density levels of compact surfaces, while increasing the relative contrast as well (maximization of NLI, normal colour intensity function /8/).

Printing surfaces in this trial were so different, that the printer had difficulties to reach the target densities within his normal operating window, as Table 4 shows. One explanation to the big differences in ink consumption resulting in unstable final densities of the compact black surface, could be that the trial points with different pore structures have different surface reflection and scattering properties which influence the intensity of the light and thereby the density of the compact surfaces.

The control possibility of the printing process as such is a real problem in practise. If in the future the essential question for the newspaper printers is how to reach for higher end quality, further achievements can be reached by developments in the conventional CSWO machinery (wetting and inking devices, process control systems, web leads, etc.). These developments will allow wider operating windows and therefore more flexibility in the printing process.

CONCLUSIONS

The European newspaper industry and the traditional newspaper today is at its cross roads. The socio-geological environment in Europe has permanently changed during the last decades and this change has reflected to a permanent change in the business environment of the European newsprint industry.

The evaluation of the optical print quality potential of cold set process in this study has shown that by changing the printing surface from uncoated to coated such a level in dot-gain, set-off, evenness and reproduction of colours can be reached that it allows the printer to exceed the technical obstacles by which the new business models are often confronted. The main differences which remain between heat set matt qualities and cold set are lower printed gloss, lower density levels and therefore slightly lower contrast in cold set.

The results from new machine technology, KBA Cortina, show that it is possible to still improve the dot-gain, contrast and even have some gloss in the final product by investing in new machine technology. The coated printing surface seems to keep slight advantages over the uncoated surface in waterless technique as well. The quality potential of waterless concept was disturbed by higher set-off than in conventional cold set process. The financial comparison of new machine investment against improved coated printing surface as a tool for better exploitation of new business models is not included in this study. In general it is likely that utilization of coated paper grade brings new costs when compared to utilization of uncoated grades. These costs must be evaluated against the increased profit potential of new business models. That evaluation is not beloning to the scope of this study.

The coming years will show, how the coated printing surface resulting in improved optical print quality will change the future of newsprint industry in Europe. Figure 15 shows 3 different scenarios of the coming 10 years in the life cycle of newsprint product. Even if improved printing surface solves technical obstacles related to new business models, there are other factors remaining, which will shape the life cycle as well. The market will continue to develop with significant regional and publisher specific differences. It is up to the publishers to make their choice; they can either extend the lifecycle of their product indefinitely if they change its content, presentation and delivery in important ways. Or they can lead it into the dustbin of history if they continue to operate according to "business as usual"./1/

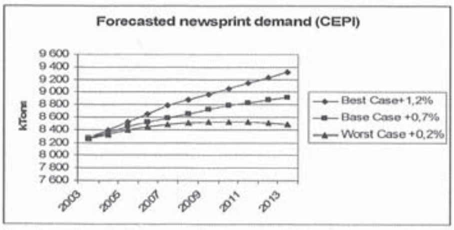

Figure 15. Forecast of Newsprint demand in Europe up to 2013,Cepiprint by amec /1/

Further investigations showed that differences in the evenness of the ink pigment film between coated and uncoated printing surface partially explain the differences in optical print quality. Variation of the ink pigment film thickness (74 %) on coated paper surface is half of the variation of the film thickness on uncoated paper surface (156%). Thickness of the ink pigment layer as such did not explain the differences.

Due to the relatively large variations of ink film thickness on the coated surface, it is suggested that the ink pigment film evenness alone can not fully explain the superior print quality of the coated paper grade. It is suggested that as well other factors like the differences in ink penetration properties, elasticity or compressibility of the paper web, homogeneity of the physical structure of the paper sheet and the micro scale surface roughness of the paper web contribute to the differences in final print quality between the coated and uncoated printing surface.

It is further shown in this study that by choosing an optimal coating pigment mixture and thereby creating an optimal coating pore structure in the paper surface, the relative contrast can be improved. On the other hand the structure of coating does not seem to have influence on the set-off, print through nor print evenness. It is further suggested that the print through, set-off and evenness of the print are more influenced by base paper properties, which can not be masked by application of coating pigments with film coating technique.

The total pore volume (cm^3/kg) seems to be most important factor influencing relative contrast in the final product. The bigger the pore volume is the lower the relative contrast. It seems to be so that there is no influence of the pore size to the relative contrast of the final product. This result could be explained by the fact that the ink pigments are spreading in x-y direction in the paper surface if there is empty pore volume available in the surface. This spreading is not related to the size of the pores in the coating, it happens with small and big pores in equal way. It can be further concluded that this spreading seems to be typical for cold set inks and is a dominant factor influencing the final print quality instead of the fractionation of ink components during absorption into coating as proposed in previous work studying absorption of off set ink on coated paper (S.Rousu/5/). This seems to be a fundamental difference in the behaviour between heat set and cold set inks.

Printing surfaces in this trial were so different, that the printer had difficulties to reach the target densities within his normal operating window. This is an indication that the lack of control possibilities of the printing process today is a real problem in practise. Further developments in CSWO machinery are needed in order to enlarge the operating window of the process and to increase the flexibility of it.

Further studies are needed to understand better the influence of base paper properties to the final print quality of coated cold set products. In order to fully optimize the quality potential of coated paper grade in cold set printing more information is as well needed about the ink penetration properties and the variables influencing evenness of the printed surfaces. Since the whole research area of coated paper grades in CSWO printing is relatively new and narrow, there are no ready made models or solutions existing today. A continuous research effort in this area is needed in order to be able to offer the improvement of print quality via a better printing surface to wider sector of CSWO printers.

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APPENDIX 1.
PRINTING TRIAL SET UP INFORMATION

CSWO PRINTING TEST PROCEDURE

Press parameters

The press conditions were measured with UPM Technical Service Toolbox equipment. The press parameters were kept stable during the whole trial.

Press:	Wifag OF 790, stacked satellite-type, nine-cylinder satellite (page 1 / reel out side) over ten-cylinder satellite (page 2). Four back two color sequence in use. Distance between Satellite 1 and 2 = 6.5 m.
Plates:	AGFA N71 neg. conventional (all pages)
Blankets:	Rollin Scoop
Ink sequence:	Cyan, magenta, yellow, black, page 1; and cyan, magenta, yellow,black, only cyan + black in use, page 2
Ink:	Sun Chemical 'WK 93326 polar, black' on the first printing unit, BASF "Newsking" black # 3585, C= # 4R390, M= # 2R390, Y= # 1R390 on the other units.
Ink unit config:	all overshot
Fount. solution:	Controlled conditions, pH=5.2-5.4, Conductivity 1600-1750 1780 µS/cm, Temp. 14-18°C,Varn Journal or Sun Classic fount, 3 %, no alcohol.
Damp. unit:	Conf "brush"
Speed:	25'000 copies/cylinder rev. ; 6.5 m/s (collect run, cut-off 470 mm, cyl. 940 mm)
Density targets:	Black 1.25, CMY 1.0

LAY OUT OF THE STANDARD TEST FORMAT IN CSWO

HSWO PRINTING TEST PROCEDURE

Press parameters

The press conditions were measured with our UPM Technical Service Toolbox equipment. The press parameters were kept stable during the whole trial day. The press is equipped with an online colour (solid density) and register control device from GMI (Graphics microsystems Inc.)

Press:	MAN Rotoman, 4 backing 4, 16p. (5 units, blanket-to blanket press)
C&R control:	GMI, online colour&register control
Plates:	CTP AGFA LAP-V
CTP specs:	25% plate dot area = 26% 50% plate dot area = 50% 75% plate dot area = 76%
Blankets:	Aeroprint QR, Grapholine S.A. (compressible)
Wash device:	Oxy dry
Ink sequence:	black, cyan, magenta, yellow, void (fount only)
Ink manufact.:	Sun Chemical (B: 5633; C: 3945; M: 2745;Y:1542)
Fount. solution:	pH-value 5.0 conductivity 2950 µS/cm; additive 3-4% Sun Fount 6550L; IPA 0%; temp.11 °C
Drying cond.:	"MAGTEC Dual Dry TNV" Chamber #1: 238°C #2: 177°C Web exit temp. 100°C (Raytek 90°C)
Silicone:	Silicone 20% Rhodorsil Emulsion E1P
Web tension:	Reel stand/1st. unit: 27 daN
Speed:	30'000 copies/h; 5.3 m/s
Identification:	Page 1 "SD Top" (see layout on every page) = paper reel outside

KBA Cortina

Test format as in conventional CSWO. Other conditions and consumables according to standard parctise.

Appendix 2

Cross cutting images of magenta printed UPM Matt (coated grade) on left and UPM Brite A (improved newsprint, uncoated) on right obtained by the light microscopy.