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Comparative Analysis of Papers Quality in Commercial Web Offset

Purpose of the research

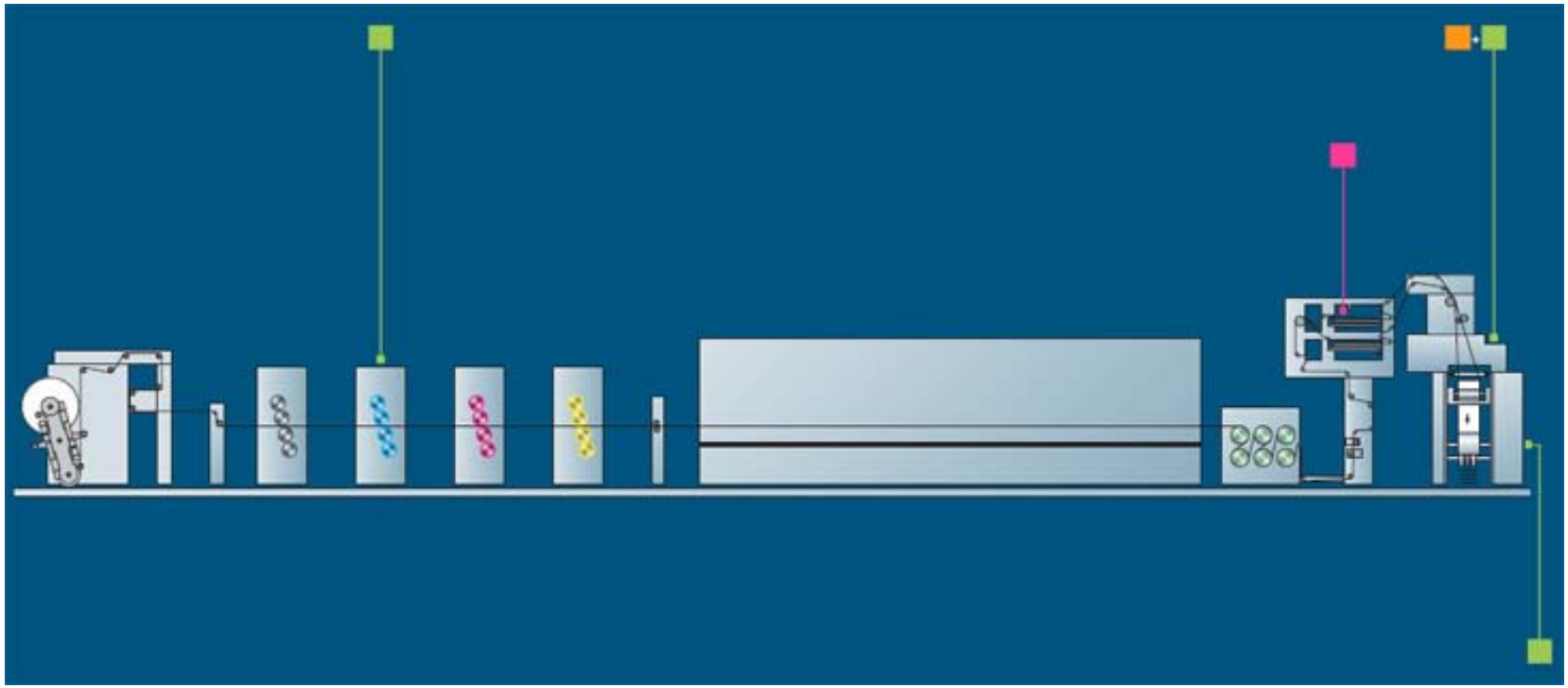
- *Commercial web offset printing technology is proactive to improve continuously printing quality using high quality different types of mechanical papers like LWC, SC, MWC, MFC, MFS and NP as well.*
- The purpose of this article is to show our results and experience in HSWO technology with different types of papers – LWC, MWC,SC, NP
- Papers were chosen which are representatively showing the whole quality spectrum of innovative and future-oriented developments.

Printing conditions

- *For this purpose was used heatset web offset printing process*

- Printing was done under industrial conditions on a 16-pages web offset press equipped with gas dryer.
- This is a horizontal configuration of 4 printing units, blanket-to-blanket system, with 8 m long gas-dryer and multifunctional folder.

General scheme of the HSWO press



Printing conditions

- *The tests were carried out under normal operating conditions (t° ~ 24°C, RH ~ 50%) according to the following:*
- Euro scale web inks Webking for HSWO, sequence : black-cyan-magenta-yellow; CMYK – AM screening, 60 line/cm, UCR;
- alcohol damping solution with 4-6% of IPA and complex Hydroweb additive with 4% concentration ;
- parameters of damping: pH 4,8-5,2; t° 10 - 12°C;
- offset blankets type Vulcan Alto ND-2, 1,96 mm thickness, and 0,14 mm underlines;
- conventional positive offset plates
- temperature interval in the dryer -185°/115°C;
- average printing speed of 36-40 thousands rph

Papers, used in this study

- Were used following types and grades of papers:

- *LWC – 57 g/m²;*
- *MWC – 70 g/m² ;*
- *SC – 57 g/m² ;*
- *Newsprint (NP) – NP for HSWO, grade 45 g/m², fully recovered content*

- In the above mentioned conditions were printed series of samples with gradual smooth change of ink consumption (ink film thickness) – from slightly underinking to overinking in order to define optimal inking through SID of four process colours, printed on the used papers.

Measurments

- Then the different samples with different inks densities have been measured through spectral coordinates in CIELab system and their corresponding color deviations as *ΔEab* according ISO 12 647-2*.

- *Among all measurements have been chosen these where solid ink densities are higher with the smallest possible colors deviations (ΔEab), providing good visual perception and keeping other important process parameters like gray balance, dot gain, trapping, color gamut.*

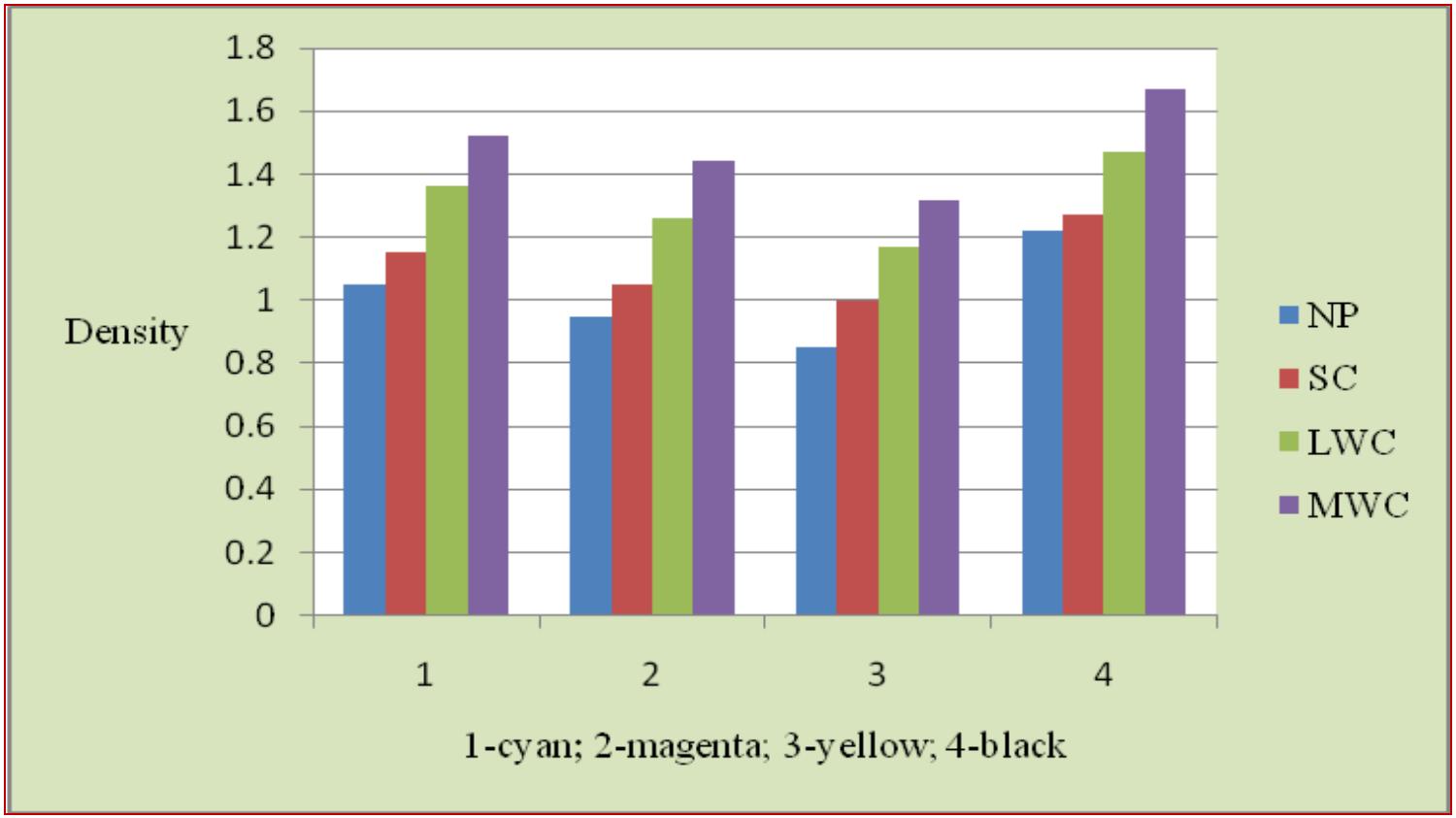
- For this has been used X-Rite spectrophotometer (SpectroEye) in the following conditions: D50 illuminant, 2° standard observer, measurement geometry 0°/45°, black backing (ISO 12 647 -2).

- First of all paper samples were checked by their physical properties

Physical properties of used papers types

Properties	LWC	SC	MWC	NP (recycled)
Finish	Coated, with light weight of coating, gloss	Supercalandered without of coating	Coated, with medium weight of coating, gloss	newsprint
End use	Magazines, catalogues, inserts, advertisings	Magazines, inserts, mailings, brochures, comics, newspapers	Magazines, advertisings, corporate publishing	Newspapers, tel directories
Composition	Mechanical, chemical pulp, fillers, coating	Mechanical, chemical, recycling fibers, fillers	Chemical and mechanical pulp, fillers	100% of recycled fibers
Grade, g/m²	57	57	70	45
Brightness,%	75-80	70-72	90-98	59-60
Opacity, %	92-93	91 – 93	93 – 95	88 – 96
Gloss, %	58 -64	43-46	62-66	-
Humidity, %	5,5 – 6,0	5,4- 6,0	5,0 - 6,0	8,0

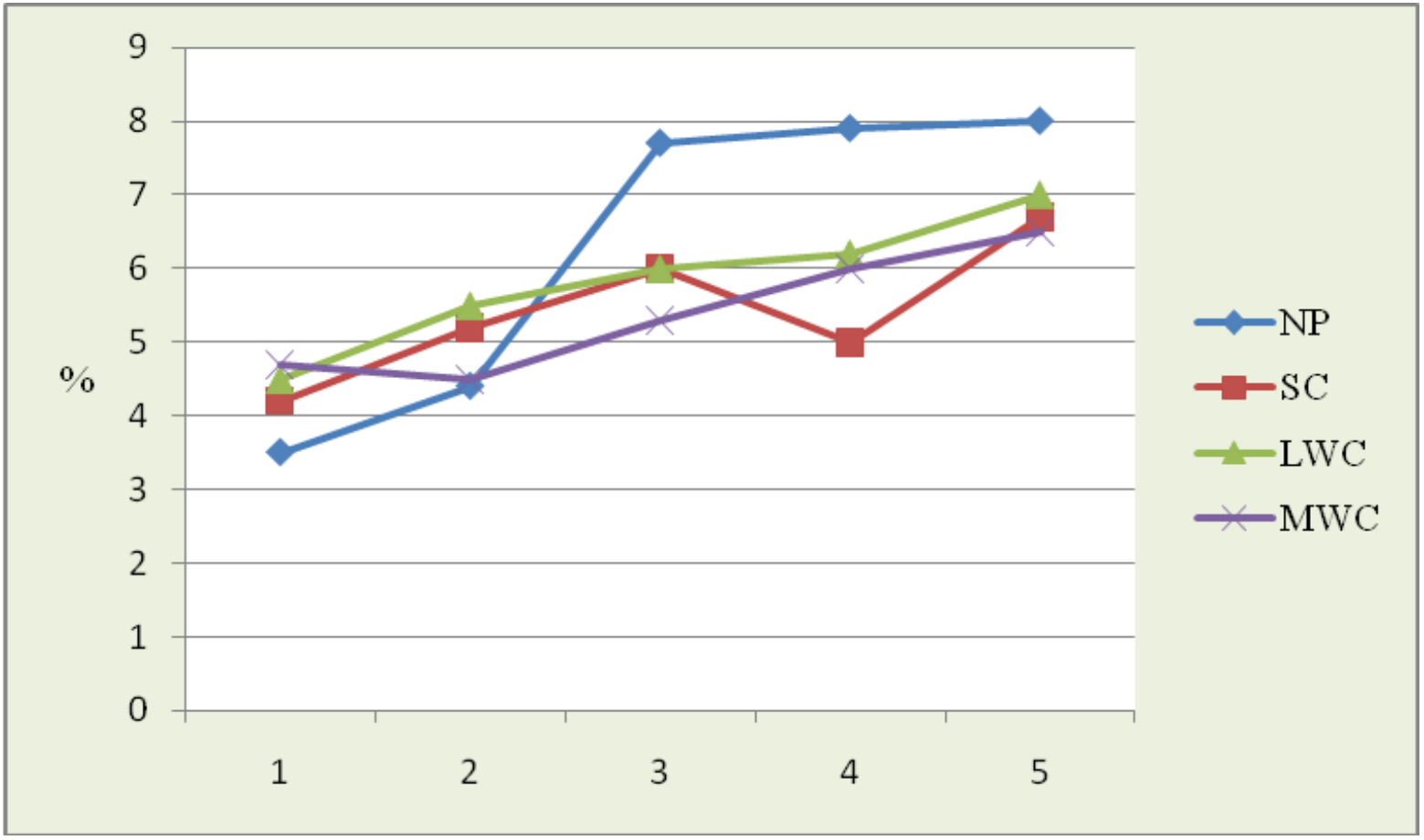
Solid Ink Densities of process inks, measured on different papers



Optimal densities and CIELAB values of printed samples

Process Inks	Solid D	L*	a*	b*	ΔE*ab
Newsprint , 45 gsm					
C	1,05	60,16	-31,66	-39,43	7,9
M	0,95	46,83	72,97	0,05	2,9
Y	0,85	84,60	-5,15	92,75	4,7
K	1,22	19,15	1,47	5,90	6,14
SC, 57 gsm					
C	1,15	60,08	-41,7	-45,06	4,3
M	1,05	53,74	70,98	1,96	6,5
Y	1,00	90,06	-3,17	91,93	2,4
K	1,27	22,75	1,65	5,06	5,9
LWC, 57 gsm					
C	1,36	49,21	-37,35	-43,40	8,7
M	1,26	50,09	70,92	-8,03	8,3
Y	1,17	86,96	-5,85	90,17	4,6
K	1,47	21,33	0,93	0,40	1,6
MWC, 70 gsm					
C	1,52	59,03	-35,2	-42,97	3,1
M	1,44	52,41	67,46	-5,05	9,5
Y	1,32	84,16	-2,69	96,82	5,7
K	1,67	21,98	1,71	0,93	2,78

Web breaks of different type of papers



Results and Comment

- Optical density is the ideal regulation basis which is extremely proper parameter for measuring and regulating the inking accordingly. The advantage of this is a stable printing process.
- The values of measured SID varied depending on the physical properties of papers types as grade, brightness, smoothness, bulk, opacity (tabl.1, 2, 3) and on papers color characteristics (they are in the allowed limits according to ISO 12 647-2, except NP).

- The results show that solid inks densities on LWC and MWC are higher than these on SC and NP (fig. 2). The results have a direct relationship to the quality of papers surface which determines the ink consumption capacity.

- For SC paper can be said that despite of very high surface quality as a result of supercalandering (high smoothness, density, gloss) SID are closed to these of NP, which indicates that lack of coating is definite reason here.

Results and Comment

- *SID for NP are compromised between visual perception and such drawbacks as smearing, marking etc. In general, this type of paper must be rarely used in HSWO, but when it is necessary, better to apply NP of fully recovered content like this.*

- *The reason for this is that such NP has a better surface for printing, compared with standard NP, with high smooth and closed pores (our previous study).*
- All these results show that the substrate is a major factor in determing the attainable full-tone density which affect the reproducible color quality.

- *In this way, controlling SID we are able to regulate CMY ink tonal values in order to achieve a proper grey balance. The great influence on the grey balance cause such important process factors like ink thickness, dot gain, trapping and color intensity. Measured tonal values (40%, 80%) of CMYK represent good results, with very acceptable dot gains, especially in case of used brand of LWC and MWC which can be explained by the coated paper surface. Dot gain essentially depends on the difference of paper surface and its absorption capacity.*

Results and Comment

- Colors are measured by their colorimetric parameters in order to evaluate what the human eye sees. The results shown in table 5 indicate the possible minimal color deviations within the received optimal solid densities. The color impression on the substrate related to the achieved ink density depends on the variety of papers. Visual fluctuations of colors have been perceived. Sometimes it makes necessary to change achieved densities to match OK sheet. This is the case when ink/water balance or some other influenced factors have been changed.

- *Depending on the nature of the used substrate (grade, thickness, opacity, brightness, absorption, color) the same inks with the same density can cause a different visual impression. And vice versa, the densities can be varied despite the colors are kept within the standard tolerances. The reason for this is primarily papers, also printing inks and other specific terms as well.*

Results and Comment

- Our colorimetric measurements and their comparison to reference values indicate different color location. Color measurement results shown in table 5 can be recognized colors out of tolerances - magenta almost for all type of papers except NP and cyan only for NP and LWC. For SC and NP papers it is valid toward black ink.
- All the rest colors values and corresponding color deviations are acceptable, including yellow color for all types of papers.

Results and Comment

- *Could be concluded that for all types of papers some of process inks have color deviations out of tolerances, more frequently these are magenta (SC, LWC, MWC) and cyan (NP, LWC). Results for yellow and black are satisfied. All this means that ink transfer of cyan and magenta units has to be at special control.*

- *Also it is essential to apply compensation curves in prepress process for different grades of papers.*

- *If we have kept color deviations in ISO tolerances, that could lead to reducing of color gamut, increasing of dot gain for tonal values of CMY and also lacking of grey balance.*

Summary

- *This study shows that despite of all standard requirements about color management, good results can be obtained only in balanced conditions in accordance with the specific printing situation.*
- *On the base of this study we made a rank of used papers depending of their printing quality, including their mechanical resistance resulted as a brakes. This range is, from down/up:*
- *NP 45 g/m², SC57 g/m², LWC57 g/m², MWC 70 g/m².*

Conclusions:

- Coated papers, like LWC and MWC are the best choice in Commercial web offset printing;
- But when must be reached low cost products it is essential to apply uncoated mechanical type of papers like SC which offers high density, sufficient opacity, good process performance and which altogether meets a good print quality.
- Also when necessary to produce high volume and low economical products, can be printed on NP, better NP which is composed of 100% recycled fibers.

Conclusions

- In commercial web offset printing there are many possibilities to apply different type of papers which can be used for different products.
- HSWO technology is a multifactor complex printing process. That is why knowledge and usage of any results are a positive way for technical control and evaluation the paper's quality.
- HSWO technology probably is the only in among of graphic arts industry where there is an endless combination of papers types and products quality. The higher the number of papers types the higher the quality product possibilities and therefore the higher the printing efficiency.

Thank you

for your attention!