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INFLUENCE OF THE PAPER COATING ON THE PRINTING PLATE'S PROPERTIES IN WEB OFFSET PRINTING

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Key words: paper coating, printing plate, web offset printing

1. Introduction

The main task of the dampening solution in the offset printing is oleofobisation of the free surfaces on the printing plate. Ink which is then applied binds only to the surfaces of the printing plate and with the damping solution, under the influence of pressure, through offset rubber sheet is transferred to the printing surface (paper tape).
In addition to its primary role, damping solutions with the passage through the printing machine also maintains the pH value of the surfaces of the machine parts with which it comes into contact. With the proper emulsifying damping solution gives a proper ink viscosity, stickiness, gloss, drying contributory and allows standardization of colorimetric parameters of the ink on the print.
Passing through the printing machine, surface of the paper and its coatings, because of the friction between the paper and offset cylinder and chemical dissolution, by the rotating machine parts based on the cross from the offset cylinder and comes to the printing plate. Ink and dampening solution with the presence of dissolved paper coatings particulate, fillers, binders, grain of the paper, traces of pigments ... alter the properties required for good performance of the press. This phenomenon is inevitable, but at the optimum temperature of the printing press (30-35 ^{0}C) additives in the wetting solution (buffer, softeners, emulsifiers ...), and additives in the ink can compensate for this phenomenon, so it does not significantly affect the quality of the printing. The most important parameter that changes with the interaction of the paper coatings, ink and damping solution is the changes of rheological properties of dyes and stickiness itself. This phenomenon is especially pronounced if the temperature of the printing machine greatly deviates from the optimum (pronounced phenomenon in the summer months due to the increase in temperature of the machine, and much less frequently in winter months due to a lower temperature.) In the web offset printing the change of the appearance of sticking ink becomes more pronounced in systems that do not use iso-propyl alcohol in the damping solution, since the additional supplement do reduce surface tension, but do not cool parts of the printing machine.
If the printing machine is warmed significantly over the optimal temperature ink becomes more viscous and, less saturated with pigment. To maintain the colorimetric parameters the automatic systems for applying ink increase the drift. Because of the larger deposits and changing the chemical composition of ink on the offset rubber canvas and strengthen the cohesion and adhesion forces, which increases the pulling surface coatings. Covered papers incorporated in the ink, of which the most common chemical are calcium carbonate and cellulose fibers, through the offset rubber sheet come into the contact with the printing plate. With the successive influence of pollution from paper into the ink tribological system becomes much more aggressive and leads to increased wasting of the printing plates.

2. Experimental

In the real web offset printing system noted the increased spending of printing plates in specific cases is noted. In the most cases, such phenomena are related to the wrong photomechanical process during the printing plate preparation (the change of, exposure energy, concentration or composition of the developers, temperature and time of developing ...). A detailed analysis of all the issues that were printed in this system over a longer period excluded this possibility. All printing plates were processed according to the manufacturer's instructions and, in the most cases, holded the expected circulation (approximately 200,000 to 300,000 prints).
In this paper eight real issues (edition) during whose printing increased spending of printing plates is noticed were analyzed, and compared with the systems where this phenomenon did not occure. Table 1. shows the observed editions, the circulations which printing plate served in the quality limits deviations and papers used as the substrates. In four cases newspaper uncoated papers produced by two different manufacturers were used, and the remaining four on the bright coated paper of the same manufacturer but different grammage.

Table 1. Overview of the publication, circulation and paper printing plates

sample	edition	served circulation	paper
1.	EN br.1,1	23 000	newspaper RN 42,5 g/m^2
2.	EN br.1,2	50 000	newspaper RN 42,5 g/m^2
3.	GL br.1,1	40 000	coated LC 65 g/m^2
4.	NEWS 1,1	40 000	newspaper SF 45 g/m^2
5.	EN br. 2,1	38 000	newspaper RN 42,5 g/m^2
6.	GL br. 2,1	50 000	coated LC 65 g/m^2
7.	GL br. 2,2	60 000	coated LC 65 g/m^2
8.	GL glam	12 000	coated LC 80 g/m^2

Ten samples of each paper (1x10cm strips) were drown in 100 ml of distilled water and realistic wetting solution for 4 seconds – as long as just melting of compounds on the surface of the paper last (the primary penetration). Prepared solutions were measured by electrical conductivity and pH value before and after treatment. By monitoring of conductivity and pH changes an indirect view to the amount of dissolved compounds from the surface of paper by chemical process and their influence on the composition of the wetting solution is got. By microscopic imaging all areas of printing forms where the damage occurred were observed and compared with the same areas on the print. All available data about factors affecting directly or indirectly on printing and printing quality (printing speed, the chemical composition of the wetting solution, the composition and supplier of the ink, the temperature of machine parts, colorimetric parameters of the image ...) were compared as well.

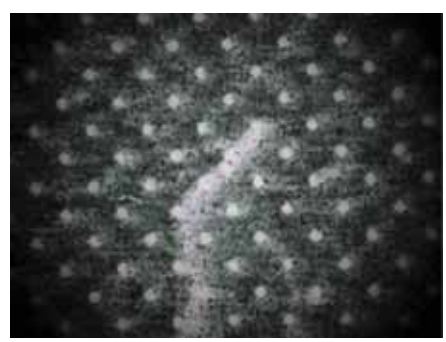
3. Research results

Table 2. presents the results for wetting solution in which surface coating of the papers are dissolved. Distilled water used for the preparation had pH value 6,78 and electrical conductivity 6 μScm^{-1} and realistic wetting solution pH value 5,12 and electrical conductivity 1425 μScm^{-1}.

Table 2. Change of pH and electrical conductivity

paper	destilled water		realistic wetting solution	
	pH	$\kappa/\mu Scm^{-1}$	pH	$\kappa/\mu Scm^{-1}$
newspaper RN 42,5 g/m^2	7,12	164	5,25	1456
newspaper SF 45 g/m^2	7,54	428	5,82	1726
coated LC 65 g/m^2	7,85	328	5,21	1502
coated LC 80 g/m^2	7,80	334	5,23	1498

Figure 1. Microscopic images of printing plate and print damages for edition EN br.1,1 (uncoated paper)



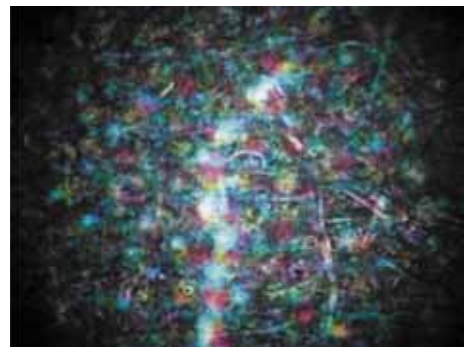


Figure 2. Microscopic images of printing plate and print damages for edition GL br.1,1 (coated paper)

Figure 3. Microscopic images of printing plate and print damages for edition EN br. 2,1 (uncoated paper)

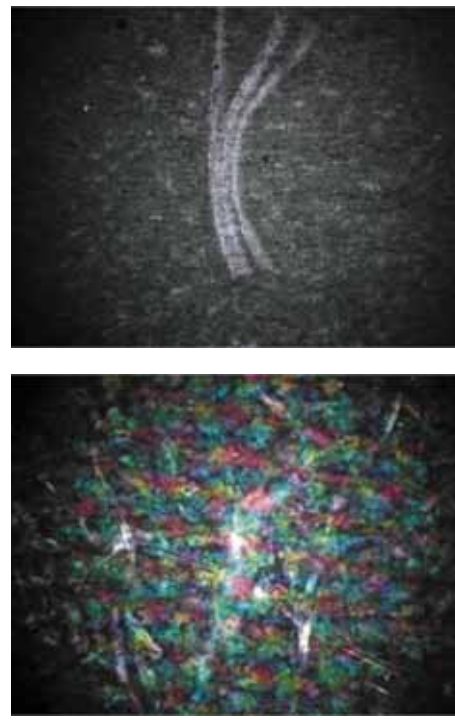


Figure 4. Microscopic images of printing plate and print damages for edition GL br. 2,1 (coated paper)

4. Discussion

By monitoring the pH and electrical conductivity of paper coatings solutions it is determined that 42.5 g/m^2 Newspaper RN shows the smallest influence of dislocated compounds in wetting solution. The greatest change in pH and electrical conductivity were measured in solutions of newspaper SF 45 g/m^2 which is a lower quality paper.

By analysis of the data and microscopic images it is noted that in the system of printing on uncoated paper deformations on the printing plates, and then on the print come largely due to the crystallization of salts and alkali (mostly $CaCO_3$, $Ca(OH)_2$, $MgCO_3$). All observed damages are coarse grained and crystalline structures, and are particularly pronounced in the full tone fields. The crystallization of salts is result of saturation of inks with dissolved surface compounds (directly or by emulgation with wetting solution), and due to the effect that buffer creates undisotiated complexes.

In the system of printing on coated paper damage on the printing platte, and than on the print are more diverse. Besides the already mentioned presence of crystalline clusters observed were filamentous structures that are attributed to tear off the paper fibers are observed. Paper and cellulose fibers are not tribologically aggressive and it is not supposed that they cause spend of printing plates, but in picking in the printing process fibers bind other tribologically aggressive chemicals from the paper coatings.

Comparing all the available parameters that affect the printing process in systems where increased spending of printing plates is noticed in systems where the printing plate withstood the intended circulation only parameter that could be correlated with the described deformations is temperature increase of the machine parts. All other observed parameters were within the standard limits for web offset printing system.

5. Conclusions

Influence of the paper coating during the printing process on the solution wetting causes the changes in the tribomechanical offset printing system, and this phenomenon is most prevalent in contact of offset and printing plate cylinder which leads to increased spend of the both cylinders.
The standardized conditions for web offset printing compounds added to the wetting solution and ink manage to compensate the influence of all components from the paper surface and maintain the printing quality parameters in the expected values.
Significant changes of printing machine, or some of its parts, temperature indirectly leads to increased sticking dyes, and therefore the usual chemical dissolution comes to mechanical plucking surface of paper. Uprooted compounds (cellulose fibers, china clay, crystal $CaCO_3$, $Ca(OH)_2$, $MgCO_3$.... through offset rubber sheet transfer on the printing plate and there are adsorbed and enhancing its spend.
The presence of coarse crystalline structures that can be attributed to $CaCO_3$, $Ca(OH)_2$, $MgCO_3$, and other hard-soluble compounds that are used as fillers in papers can be equally observed in the monitored system with all kinds of paper. Contrary to expectation, the presence of the cellulose fibers was significantly more observed in the printing on the coated papers.
Exclusively in the system printed on the newspaper SF 45 g/m^2 where the changes on the printing plates were observed in all aggregates, in all other systems the changing on the printing plate was noticed on the black aggregate.

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