THE "GHOSTING" DEFECT AS THE RESULT OF INTERACTION OF THE PAPER AND PRINTING INKS, ITS PRECLUSION POSSIBILITIES IN THE SHEET-FED OFFSET PRINTING TECHNOLOGY

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Abstract
The ghosting defect occurs frequently, both in the sheet and web offset printing. It increases the costs of production and negatively influences the quality of the printed products, this is why customers complain and refuse to pay.
Keywords: *"ghosting defect", sheet offset printing, the interaction of paper, printing ink, varnish, physical and chemical properties, experimental printing.*

Introduction

Ghosting defect can be described as an increase in lightness or tonal change on one side of a print which corresponds to the motif printed on the reverse side. The ghosting defect is the appearance of darker areas on one side of the print sheet what corresponds to the shape which appears on the other side of the sheet immediately after the printing.

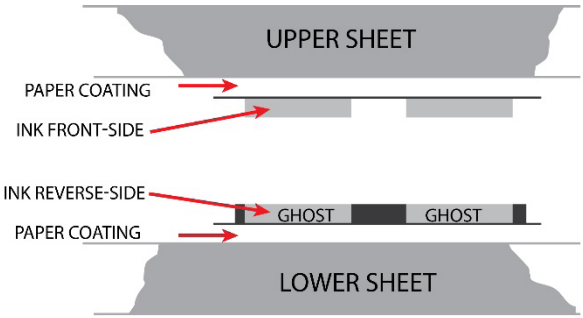

Fig.1. *GH defect*

For the study of problem, the printing company *LivoniaPrint* provided the material technical basis and implementation of the research results in the manufacturing process.

Process of the Experimental Study

Ghosting defect in sheet-fed printing originates through the interaction of paper, the printing ink, printing-press, print-related technological parameters and printed motif. To establish the interaction of factors that cause the ghosting defect the following steps were carried out:

1. Potential experimental materials and printing technology were studied at *LivoniaPrint Ltd.* as well as information of manufacturer's datasheet on papers, inks and varnish.
2. Test printing schedule was determined, and the materials and technological equipment were prepared for test printing.
3. The experimental sheet offset printing was carried out in a controlled microclimate in the printing company. Printing parameters (printing speed, technology, printing sequences etc.) where measured.
4. The study of printed sheet, inks and paper samples was carried out in the State Institute of Wood Chemistry: (evaluation of ghosting defect intensity; inks drying speed and dryness; paper optical, physical and mechanical properties).
5. The results of the study were collected in a SPSS database and a three-factor analysis of variance was applied to determine the influence of different factors.

For the study of the ghosting defect 7 sorts of 130 g/m2 coated papers were selected; all of them are used in regular production at *Livonia Print.* Each of the paper sorts was produced by a different manufacturer; the samples had differences in furnish composition and were covered with different coating. For the experimental printing 4 different printing inks (CMYK) were used in two printing-presses − *Heidelberg Speedmaster SM-102-8P* and *XL-106-10P*. The experimental printing resulted in 77 printed samples that provided the required measurements for the research.

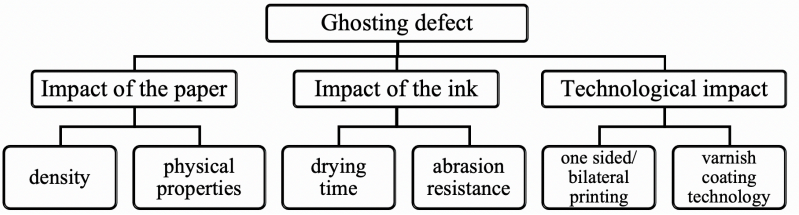

Fig.2. Research work structure

The study was conducted in three directions. The impact of paper, ink and technology on the occurrence of the GH defect was studied. As shown in Figure 2 measurements of density and physical properties were conducted for paper, drying time and wear resistance (abrasion resistance) for printing ink, technological effects – one sided or bilateral printing and with lacquering or without lacquering.

The assessment of materials and the defects of obtained printed samples

There were involved three independent experts of State Institute of Wood Chemistry to assess the quality of the printing under equal conditions, paying special attention to detecting GH. The experts rated the intensity of the GH of all the printed samples on either side of the top (front) and the bottom (back)

Graduation by their intensity:

0 – Invisible

1 – Visible

2 – Highly visible

SPSS database was used for statistical evaluation of the results. The three-factor analysis of variance was applied to determine the influence of factors and assess their relevant impact.

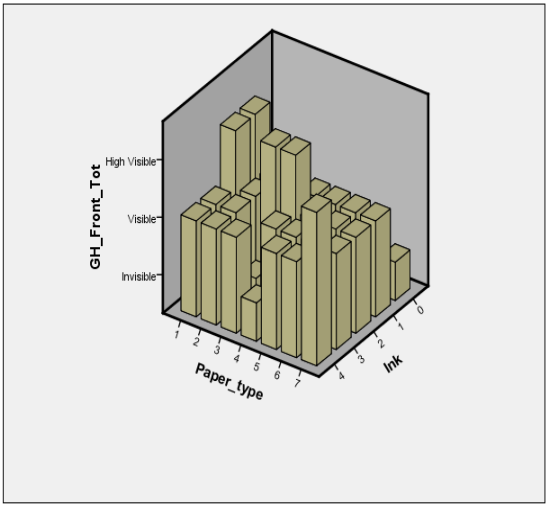

Fig.3. *Overview of results*

The statistical analysis of the data shows that the greatest risk of ghosting defect is to apply varnish on still drying ink; supposedly the ink is not completely dry and thus after the application of the upper layer of the varnish drying of the basic ink has been discontinued.

On the other hand, varnish coating on the wet paint provides a two component chemical interaction, which enhances the solidification of the ink, and thus reduces ghosting defect of printing.

Paper and inks laboratory test results and printing parameters were entered in a database (the program SPSS) in order to analyze the correlation of the factors and to find the causes of defect. As a result, the package of suggestions will be developed for the company's possible technological solutions and correction of the physical-chemical processes in order to eliminate the causes of the defect.

There was carried out an acquisition of the results of technical measurements for the source materials, laboratorial study of the interaction of the physical and chemical properties of both paper, inks and varnish for the experimentally printed sheets, determination of the physical and chemical changes comparing to conditions of the references.

Separate ink/paper combinations differently present the ghosting defect. Its increase is observed at the increase of the thickness of the printing ink layers, as well as on print of both sides of sheets, when ink drying on sheet one side can affect the lower side of the paper. The origin of the ghosting defect in the sheet offset printing could be catalyzed by the different existing drying speeds of paper printing inks. The conclusions will become the basis for the output of the recommendations packet for the manufacturers of the printing and publishing industry.

Based on the summary of the results and the conclusions, it is possible to provide the suggestions and recommendations for the minimization of the ghosting defect and probably, its elimination in print production. Ghosting defect cannot be exterminated completely at once, but it is possible to reduce the risks and find the best combinations of paper and ink. In relation to ghosting defect, certain ink/paper combinations have different properties. It is clear that the defect increases significantly with thicker layers of paint. Even more, the defect increases noticeably from the top and lower side printing to the reuses lower side printing. The last one shows the possible pre-conditioning of paper what can be caused by drying paint on the upper side of paper to the empty side of paper.

Therefore, there is possible to make conclusion that paper effect to ghosting happens throughout the speed of paint drying and following the

fast printing of lower side can minimize ghosting defect at the critical material combinations.

Thus, we can conclude that the ghosting defect occurs during the drying of printing inks and, after printing the underside of the sheet, the ghosting defect can be minimized with critical material combinations. To eliminate the appearance of a defect, it is necessary to ensure the same rate of drying of the printing ink on the printed sheet of paper.

Conclusions

1. In the experiment, ghosting defect was observed on every paper sample tested and the extent of the defect differs significantly. A higher risk of getting a "ghost" was on paper samples #1 and #4; lowest risk – on paper samples #2, #3 and #5.
2. During the experiment, it was observed that no natural based Magenta ink sample of any manufacturer was completely dry after 72 h.
3. The statistical analysis of the data shows that there are significant differences in the ink causing the ghosting defect. Highest risks were related to ink sample #1 and #2, medium risk – with the ink sample #4, while the lowest risk of producing ghosting defect occurred using ink sample #3.
4. The statistical analysis of the data revealed that the greatest risk of ghosting defect is to apply varnish on the ink "drying" because presumably the ink is not completely dry and thus after the application of the upper layer of the varnish, drying of the basic ink is stopped. On the other hand, varnish coating on the wet ink from the two component chemical interaction enhances ink solidification, and thus reduces ghosting defect of printing.
5. It has been observed that varnish application and ink factors interact in 3 inks. The smallest ghosting defect is observed directly by applying the "dry ink", inks which shows 3 inks particular differences which do not occur in other applied in the test. Consequently, 3 inks would be suitable "by applying dry" technology.
6. Without changing the printing technology directly for the printing of the works described above, it won't be possible to avoid from the potential appearance of the Ghosting defect. A recommendation for this type of printed materials to choose technology that ensures in an instant drying and strengthening of printing ink.

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