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ABRASION RESISTANCE OF PRINTS PRODUCED BY ELECTROPHOTOGRAPHIC PRINTING TECHNOLOGY (POSTER PRESENTATION)

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Abstract:
Paper reacts to moisture, heat and mechanical stress differently. Stresses affecting paper substrates are different in offset and digital printing technologies. In the digital printing technologies the fixing process of the ink or toner accompanies intensive heat effect. Therefore, the moisture content of the paper should be constant during the electrophotographic printing process. In some of the digital printing technologies requires special property of paper. Important paper properties are the grainline and the moisture content. Ones should consider that the ink or toner are applied differently in different print presses. In elektrophotographic printing presses it is also important to take into account the loading and the forwarding of the paper, the delivery technology of the toner and the temperature and the consuming of fixing. The fiber structure and surface of papers influence qualities of prints as paper smoothness, moisture content, thermo and electrical conductivity.
Sometimes the surface of dried ink or toner needs to have good resistance against mechanical effects. Therefore, abrasion resistance is important surface property of prints (GÖTTSCHING, 2007) (INTERGRAF, 2008).

In this research work we investigated the surface properties of recycled papers, and the abrasion resistance of prints produced on iGen3 electrophotographic press. We investigated the abrasion resistance of ten types of recycled paper prints obtained using a Prüfbau Quartant device. Results were compared to the abrasion resistance of conventional papers.

Keywords: *recycled paper, iGen3 press, abrasion resistace*

1 RECYCLED PAPER PRINT CARRIERS

1.1 Properties of recycled papers

Recycled papers decrease the costs of waste management, because conventional wastes consist of high proportions of paper. In each round of recycling, several fibers become damaged, which certainly leads to the deterioration of the conditions of paper. Contaminated paper cannot be recycled, and therefore fresh cellulose fibers have to be added to the system. Quality papers cannot be produced from pure waste papers. The bulk of collected waste paper originates from two sources: households and printing presses. Moreover, paper collection is becoming increasingly frequent in offices, as well. Quite often, these papers are of excellent quality, and may contain only small quantities of impurities.

1.2 Production of recycled papers

Plant-originated materials are used as the raw materials of paper production. The main ingredient of paper comes from the fibers of these plant materials. Cellulose is the chemical formation of fiber cells. The raw materials of paper manufacturing form two distinct groups: primary and secondary raw materials. Waste papers can be regarded as secondary fibers. In view of environmental requirements and economic considerations, paper industry relies on secondary fibers, and in particular waste papers,

to an increasing extent. During paper production, in the course of using secondary paper fibers, large quantities of dissolved and colloid substances enter the process water. Paper pulp may as well contain impurities, and therefore it needs to be treated. The contaminations of the paper pulp deteriorate the cleanliness, quality of the paper. The proper treatment of wastes is especially important during the processing of waste papers. Milling improves the mechanical strength of the paper. After milling, a bonding agent is filled into the semi-finished paper in order to improve the whiteness of the paper. In addition to the bonding agent, filling materials are also mixed into the paper.

2 DIGITAL PRINTING

Since their invention, digital printing technologies have witnessed an unbroken course of development, and had an expanding role in the field of printed media. They seem to be successful, because they are capable of satisfying the most recent consumer demands, that is small-series, quality and cost-efficient printing, the making of personalized products. The quality of the prints made by digital appliances using various printing technologies is substantially influenced by the types of the applied print carriers and printing inks, the method of the transfer and fusing of the ink on the print carriers. It is essential to know what quality any given digital printing technology can produce.
Employing the electrophotographic technique, DocuColor iGen3 digital printer of the Xerox company allows the production of prints of excellent quality. One of the innovative features of iGen3 is the novel type of image presentation technologies called SmartPress Imaging [1]. In the case of electrophotographic printers (*Figure 1*), the quality of prints is strongly influenced by – in addition to the surface characteristics of the applied print carriers – the characteristics and quality of the toners used in the process of printing. In this process, liquid or solid toners can be equally used. The toner layers applied to the paper are fused by a pair of heated cylinders with the use of the patented Nip-fashing technique. Xerox's new dry toners produce intense colours on the print carriers, thereby ensuring larger reproducible colour ranges than ever before.

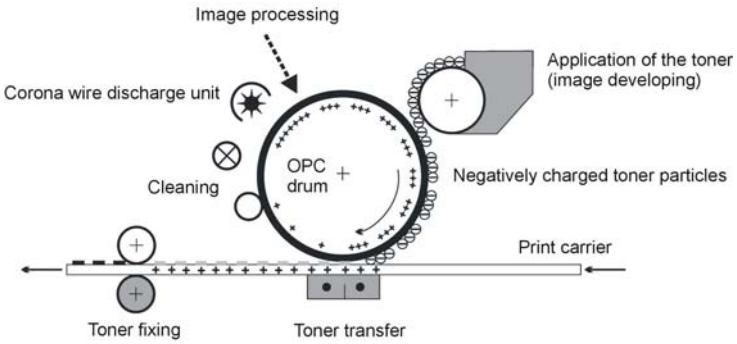

Figure 1. Principle of electrophotographic printing

Various paper print carriers respond to humidity, heat and mechanical stresses differently. In digital printing technologies, the process of fusing the ink or toner on the paper is accompanied by intensive heat effects. For this reason, in electrophotographic printing papers should always hold certain humidity. Various printer types apply the ink or toner to the surface of the print carrier differently. In the case of digital printing technologies, proper attention needs to be paid to the method of the feeding and transferring the print carriers within the printer, the technology used for the application of the toner, the temperature and time demand of fusing. Print quality is also influenced by the fiber structure of the paper and the evenness of the paper surface [2].

3 METHODS

During our studies, the abrasion resistance of prints made on paper print carriers with the use of Xerox's electrophotographic digital printer, iGen3 was tested. The ten tested paper types (*Table 1*) are all recommended by the manufacturers for the purpose of digital (electrophotographic and inkjet). Prints made on six recycled and one environmentally friendly paper print carriers were compared with the characteristics of prints made on three conventional paper print carriers.

One of the paper samples was IQ Triotec Unique, a paper described as environmentally friendly. As a key property, it was a composite paper containing both recycled and non-recycled paper fibers (*Figure 2*).

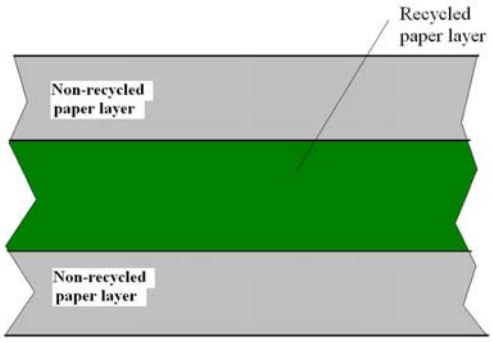

Figure 2. Cross-sectional structure of the IQ Triotec Unique environmentally friendly paper

Tonal test prints were made on the tested paper print carriers. Each of these test prints was produced in one copy with the use of an iGen3 type electrophotographic printer, under identical circumstances and conditions.

Test printing was carried out under normal operating conditions, as follows:

- location: Xerox Magyarország Kft. digitalis plant, Budapest
- printer: iGen3 type electrophotographic printer

t=21 ºC, RH 39–44%

Table 1. Properties of the tested paper print carriers

Number of the sample	Name of the print carrier	Grams per square meter	Distributor	Property of the print carrier
1	Recycled	80	Xerox	recycled
2	Recycled Pure	80	Xerox	recycled
3	Recycled Plus	80	Xerox	recycled
4	Nautilus Universal	80	Europapier	recycled
5	Nautilus Superwight	80	Europapier	recycled
6	Lettura60 Copy	80	Europapier	recycled
7	IQ Triotec unique	80	Europapier	environmentally friendly
8	Mondi premium	80	Europapier	non-recycled
9	IQ allround	80	Europapier	non-recycled
10	Color Copy Light	80	Europapier	non-recycled

Most of the media products produced by means of digital printing are exposed to large stress in day-to-day use. A fundamental requirement is that the ink or toner should adhere strongly, and the print needs to be resistant to various mechanical stresses, as well. In practice, abrasion resistance tests are used to determine resistance to mechanical stresses. The abrasion resistance of prints is determined by the characteristics of the print carriers, the printing technology, as well as the type and composition of the printing ink.

Abrasion resistance tests were performed with the use of a Prüfbau Quartant abrasion resistance tester. For these studies, the tonal prints of the four printing basic colours (YMCB) were used in 230 × 48 mm size. In addition to the print strips, from each paper sample four circular pieces of 48 mm diameter were cut to serve as a control sheet of the abrasion resistance test.

4 RESULTS

With the use of the Prüfbau Quartant abrasion resistance tester, the density of the ink adhering over to the control sheets was examined with an X-rite SpectroEye colour-measuring spectrophotometer (*Table 2*).

Table 2. Density values measured on the control sheets for each colour

Number of the sample	Name of the paper	Density values measured on the control sheets and related to the print carriers, ΔD			
		Yellow	Magenta	Cyan	Black
1	Recycled	0.02	0.02	0.02	0.01
2	Recycled Pure	0.02	0.01	0.03	0.02
3	Recycled Plus	0.04	0.03	0.03	0.01
4	Nautilus Universal	0.03	0.02	0.04	0.02
5	Nautilus Superwight	0.03	0.02	0.01	0.01
6	Lettura60 Copy	0.03	0.02	0.03	0.01
7	IQ Triotec unique	0.02	0.01	0.02	0.02
8	Mondi premium	0.02	0.02	0.02	0.02
9	IQ allround	0.01	0.01	0.01	0.02
10	Color Copy Light	0.02	0.01	0.02	0.01

In general, it can be stated that the density was under Δ=0.10 D after 50 rubbing cycles. When the three non-recycled print carriers were compared, no large differences were found among the density values of the individual colours related to the print carriers (0.01 D–0.02 D). In view of non-recycled papers, the IQ allround type paper had the smallest (0.01 D) density, whereas the density values of the prints made on the Color Copy Light and Mondi Premium paper were the largest (0.02 D) for all the four colours.

Concerning recycled papers, for the yellow print on Recycled Plus (sample 3) and cyan print of Nautilus Universal (sample 4) 0.04 D values were measured on the control sheet, meaning that on these papers the above-mentioned colours featured the smallest abrasion resistance.

The measurement results for Recycled Plus (sample 3) and Nautilus Universal (sample 4) suggested that these papers gave the largest D values on the control sheets for all the four basic colour prints. The smallest density value was found to belong to the control sheet of the Recycled (sample 1) type recycled paper distributed by Xerox; it approximated the density values measured for the prints on

non-recycled papers. The abrasion resistance values of the environmentally friendly IQ Triotec unique (sample 7) print carrier were nearly identical to the values measured for non-recycled papers *(Figure 3).*

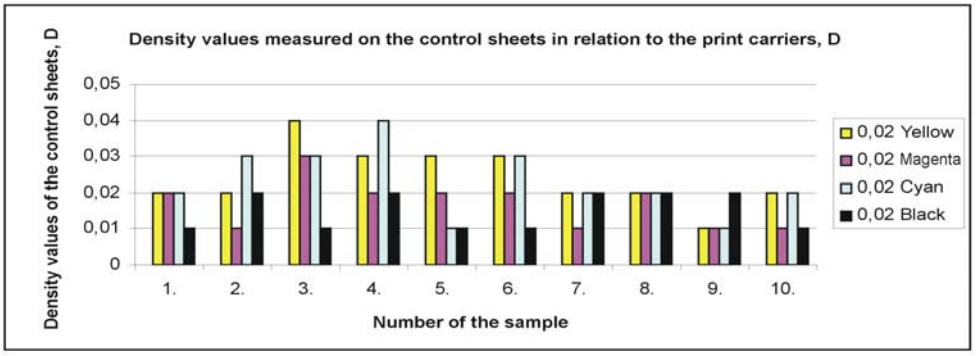

Figure 3. Density values measured on the control sheets of the tested samples for each colour

5 CONCLUSION

In the light of the test results, it could be concluded that with the exception of sample 1 the abrasion resistance values of the prints made on recycled print carriers were smaller than the abrasion resistance values of non-recycled papers, meaning that the density values measured on the control sheets in relation to the respective print carriers were – not significantly – larger than the density values of the prints made on non-recycled print carriers.
In general, it can be stated that the abrasion resistance values of the prints made with the iGen3 digital printer on the tested papers were appropriate.

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