The Influence of the Digital Printing of Packing on the Characteristics of the Recycled Fibres

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Abstract

This paper presents some optical properties and distribution of particle sizes of handsheet before and after flotation of Indigo prints made by using different temperature and different rubber blanket in the printing process.

Introduction

The deinking of fibres is an important step in waste paper recycling. The efficiency of this method depends on the technique and printing conditions, ink characteristics and printing substrate properties.[1,2,3]

Except the mentioned, the type and amount of chemicals used in processing stages, pH, pulp consistency, time of disintegration, slushing method and other chemical and physical operating conditions influence the efficiency of deinking operation.[4] Many authors study the hydrodynamics of the flotation and washing processes.[5] One of the problems here is the detachment efficiency and removal of ink particles.[6]

This paper presents only that part of our extensive investigations which comprise the recycling of Indigo prints made by using different offset rubber blanket on different temperature in the printing process. The efficiency of the recycling process as well as some optical properties of the recycled fibres in regard to the printing conditions are discussed in this paper.

Experimental

The printing machines Indigo E-Print1000+ was used in printing. It was printed with the offset rubber blanket which had already produced 80000 prints and with the new one. In both cases all other printing conditions were identical except the temperature of the offset rubber blanket which varied from 125-140°C in steps of 5°C .

The test form contained ECI copy composed of 210 fields of different combinations of the subtractive synthesis colour values, generated by vector graphics in the steps of 5%.

The printing substrate Century Soho for Indigo (Fedrigoni), Symbol Freelife Satin gloss White was used.

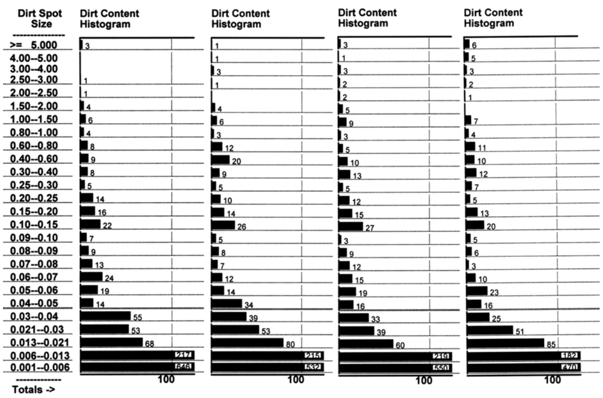
The process of chemical deinking flotation was described in previous work.[7] The handsheets were made using a laboratory sheet former, according to standard method T 205. Brightness was determined by using the standard method ISO 2469.

Other optical methods were performed by X-Rite DTP 41 spectrophotometer.

Residual ink size (dirt particles) ink number and ink areas were assessed with image analysis software Spec*Scan, Apogee System.

Results and Discussion

The dirt content histogram for hand-sheets after disintegration of prints, made on Indigo E-Print 1000 + machine by using the offset rubber blanket which had already produced 80000 prints at temperature of 125°C and 140°C, and with the new offset rubber blanket in the same temperature range is presented in figure 1.



T 125°C *T140°C* *125°C* *T140°C*

Old rubber blanket *New rubber blanket*

Figure 1. Dirt content histogram for hand-sheets after disintegration of prints

The results show that after the disintegration, the total amount of remaining particles on the handsheet is decreased by increasing the temperature in printing, as well as in the case of the usage of the new offset rubber blanket. The observed factors in printing influence the total surface occupied by the remaining particles on handsheet as it is shown in table 1.

On the basis of the presented results, especially the presence of greater ElectroInk particles after disintergration, influence on efficiency of ElectroInk removal in the flotation phase can be expected.

The efficiency curves of ElectroInk removal in flotation are presented in figure 2.

Table 1. Count and area of ElectroInk speck

Samples	Particle count totals	Area total mm^2	Area total $\geq 0{,}04mm^2$	Area total $\leq 0{,}04mm^2$
Old blanket T 125°C	1226	67, 601	68,436	8,165
Old blanket T 140°C	1114	84,651	77,014	7,636
New blanket T 125°C	1090	106,722	100,004	6,719
New blanket T 140°C	982	152,904	146,346	6,557

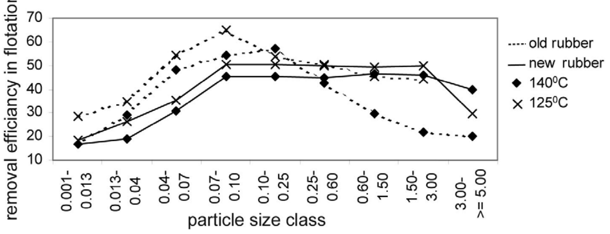


Figure 2. ElectroInk removal efficiency

It can be seen from the results, that there is somewhat better recycling efficiency of prints made with the old rubber blanket in relation to the new one in the experimental conditions The new offset blanket is obviously more suitable for the microstructure of paper, which means greater contact surface and better interaction of ElectroInk/printing substrate, which results in greater energy necessary for ElectroInk detaching in the recycling process. However, the influence of the temperature on the polymerization grade can be noticed here. The complex influence of the mentioned factors results in the size, form and surface properties of the ElectroInk particles, which is especially important for efficiency of flotation and the quality of the recycled fibers.

The presence of the macroscopic particles of ElectroInk on handsheet and the smaller number of microscopic particles, will have influence on greater brightness of handsheeta (84% for handsheet after flotation of prints, new rubber blanket, higher temperature), however, this handsheet is characterized by the optical unhomogeneity.

For better understanding and monitoring of the process, the curves of relative reflection are presented in figure 3 for handsheets before and after flotation of prints made with the old and the new offset rubber blanket at printing temperatures of 140°C.

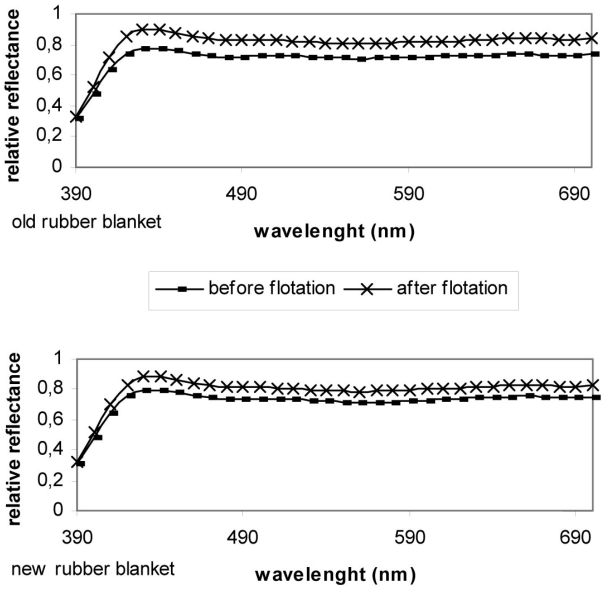


Figure 3. Relative reflection of handsheet

Handsheets show increased relative reflection in the area of shorter wave lengths which can be the consequence of the added optical whitening agents during the production of the original paper. After flotation, relative reflection is increased almost through the whole observed wave lengths interval. The growth of handsheet reflection after flotation points at the efficiency of the process itself, which in this case confirm the above mentioned results.

Conclusion

The investigation results confirm the influence of the digital printing conditions on the efficiency of the print recycling. In this case, for monitoring the usual optical parameters such as brightness, the image analysis should be used in order to determine the dimension of the optical unhomogeneity of handsheet caused by the presence of ElectroInk macroparticles with the additional monitoring and explaining the changes of number and sizes of particles in all the phases of the process.

The results of the investigation will contribute to better knowledge of the influence of mechanisms and conditions of printing process on characteristics of recycled fibres.

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