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RECYCLING OF THE AGED OFFSET PRINTS

BOLANCA MIRKOVIC, I[vana] & BOLANCA, Z[denka]

Abstract: *The investigation results of the influence of accelerated ageing conditions (dynamics of the ageing process, exposition of prints to different temperatures and air humidity) on gamut of prints and efficiency of the recycling process are presented in the paper. The characteristics of fibers in different phases of the recycling process are attended with the chromatic values a* and b* and the number and size of the remained ink particles. The investigation results are the contribution to the explanation of the influence of print ageing on detaching the ink from fibers and removing it from the suspension with the aim of obtaining the secondary raw material of adequate quality for the production of fine graphic papers.*
Key words: *offset prints, accelerated ageing, recycling*

1. INTRODUCTION

Wastepaper recycling is of growing importance both for better utilization of the natural resources and for reduction of the amount of solid waste. Today, in the paper industry, flotation deinking is the dominating process worldwide for the removal of printing inks from recovered paper (Kumar Pati et al., 2008).

Recent studies are focused on 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 which influence the efficiency of deinking operation (Liu et al., 2007; Labidi et al. 2007). One of the problems here is the detachment efficiency and removal of ink particles. Wang J.P. and others study the quality of the wastewater and the technological purification as well as evaluation of deinking by-products (Wang et al. 2007; Ait-Benichou et al. 2008).

Other consideration in deinkability of waste paper includes pulp ageing. The durability of paper depends mainly on the physical and mechanical characteristics of the raw materials, impact of microclimatic factors such as heat, humidity or emanation and on contamination by ions and gas from the environment and action of micro-organisms (Dupont et al. 2007; Lattuati-Derieux at al. 2006).

The influence of the ageing process on recycling efficiency of wastepaper is generally less studied than other unmentioned factors of the deinking flotation process. In the frame of our investigations in this area the process of natural and accelerated ageing of different formulations of the printing substrates and ink on stability of prints observed over relevant optical values as well as FT-IR spectroscopy has been studied. Characteristic properties of the recycled fibers dependent on the exposed ones of the input material in earlier described system have also been studied.

In this work, the investigation results of the prints expositions in controlled conditions (temperature and air humidity, dynamics of the ageing) before deinking flotation depending on characteristics of the recycled fibers have been presented. The specific characteristics of fragmentation in relation to the ageing conditions have been discussed and the optical properties of handsheets as the indicator and proof of the mentioned mechanism of the mentioned process have been presented as well as.

In scientific sense the investigations are the contribution to explanation of the detaching mechanism of the ink particles from the cellulose fibers and the influence of that process on the efficiency of their removing from the suspension in the flotation phase. The expected investigation results could be used in the production of the recycled papers for obtaining the printing papers of better quality.

2. EXPERIMENTAL

The samples of colour prints were obtained by the conventional offset printing. The printing form contained the standard CMYK wedges in the range from 10-100 screen value, standard ISO illustration, textual positive and negative microelements and standard wedge for the production of ICC profile and 3D gamut.

The prints were made on the fine art mat paper 115 g/m^2. One series of prints was accelerated aged in the Käterman chamber in the period from 10, 20 and 30 days at 80^o C and relative humidity of 65% and the other was aged at 100 ^{0} C and relative humidity of 80%.

Samples prepared in such a way were used in the process of alkaline deinking flotation (Bolanca & Bolanca, 2005). The handsheets were made using a laboratory sheet former, according to standard method T 205.

The optical parameters were performed by X-Rite spectrophotometer with the support of ColorShop program. The measuring results were processed by means of Data Analysis program and technical Graphic Origin Professional.

Residual ink particles size and number were assessed with image analysis-based software systems: Spec*Scan (Apogee System). Size intervals were defined according to TAPPI methods T 213 and T 437. Threshold value (100), white level (75) and black level (65) were chosen after comparing computer images to handsheets.

3. RESULTS AND DISCUSSION

Gamut represents the whole information range about colour, including the hue, saturation and brightness, which is possible to reproduce on the given medium. The two dimensional and three dimensional gamuts of the non aged and accelerated aged prints for 30 days at 80^0 C and 60 % relative humidity have been presented.

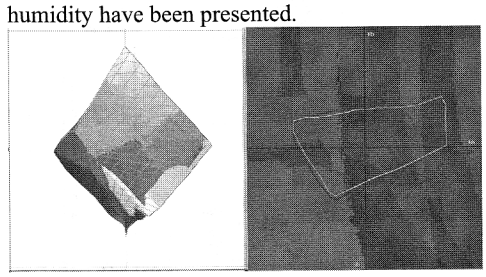

Fig.1. Comparative two dimensional and three dimensional gamut presentation of the non aged and for 30 days accelerated aged print at 80^{0}C and 65% humidity.

How the described changes, which appear during the ageing of prints, can have influence during the recycling process are presented in the investigation results which follow.

As the reflection of the print ageing somewhat weaker intensity of inking in blue and red area can be noticed (Fig.1.). In accordance with this the weaker intensity of inking, i.e. gamut ranges uniformly through the whole purple area. Smaller aberration on prints with smaller inking density, ranges in the area of cyan to green. The remaining part of the spectral area does not almost differ on aged and non aged print.

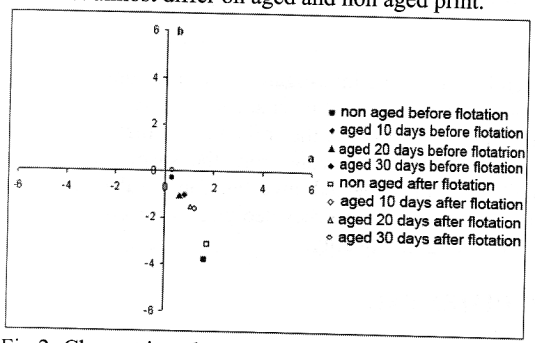

Fig.2. Chromatic values a* and b* of handsheet made from the fibers before and after the flotation of the non aged and aged prints at 80^0 C and 65% humidity.

The investigation results show almost linear shift towards the area of achromaticity for handsheets made from the fibers before and after flotation with the increasing time of print ageing.

The influence of prints ageing on the efficiency of the flotation process and on the removal of the ink particles is presented in figure 3.

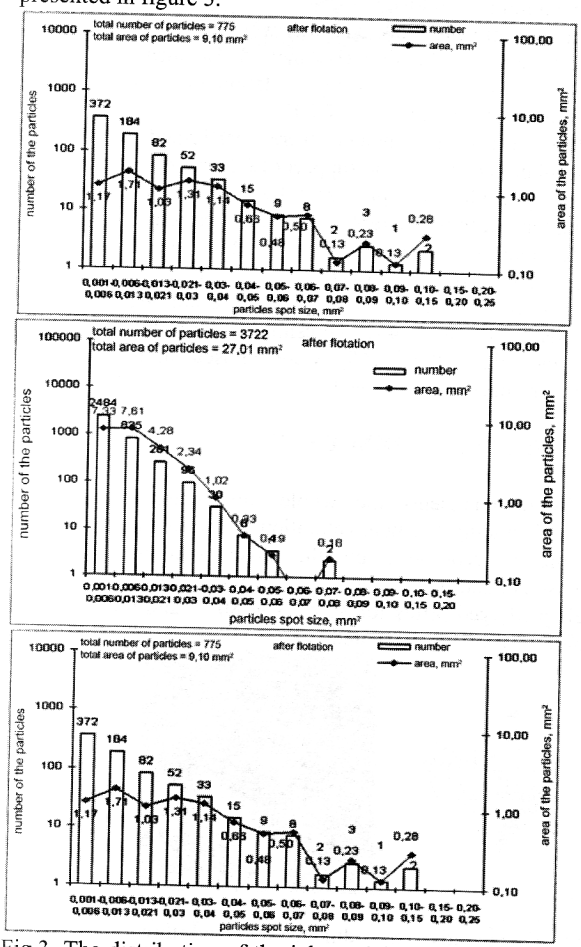

Fig.3. The distribution of the ink particles and their surface on handsheet made from the recycled fibers of the non aged and aged prints at different conditions

The investigation results show that the recycling efficiency is decreased by print ageing dependent on the conditions of their exposition. The increase of fragmentation by the increase of temperature and humidity in the process of the print ageing is observed. The greatest majority of particles after disintegration is in the first size class from 0,001-0,006 mm^2 in the shares as follows: non aged print 62,0%, aged print at 80^0C and 65,0% humidity 46.4% and in the extreme ageing conditions 50,0%. The efficiency of the particle removal with flotation, for the same class and in the same series is: 83,8%, 47,1% and 80,9%. From the basis of the results, the share of the influence on the removal of the particles concerning their size, the surface properties as well as the form can be deducted. Connected with the ageing process the specific characteristic of the particle distribution is determined with the final size class in which the particles are distributed, which, for handsheet after disintegration in the same series of samples, as earlier presented, are the following ones: 0.15-0,20 mm^2, 0,08-0,09 mm^2 and 0,25-0,30 mm^2. The removal of the whole number of ink particles by flotation is on the non aged print 86,0%, while on the aged print at the temperature of 80^0 C and the humidity of 65% it decreases at 53,5% and on handsheet made from the recycled fibers of the prints aged in more extreme conditions, it is 83,6%.

4. CONCLUSION

Only one segment of the broad investigations has been presented in this article. It comprises the study of endogenous and exogenous factors in the process of print ageing. The results of these investigations show weaker recycling efficiency of the aged prints dependent on the ageing conditions. The obtained results could be explained by the oxidation processes in which the chemical interactions between ink and paper are increased dependent on the variables of the investigated systems. In the context of the presented discussion the further investigations in combination with the experimental design and contemporary statistical methods will be continued.

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