THE INFLUENCE OF PRINTING TECHNIQUES ON THE MECHANICAL PROPERTIES OF THE RECYCLED FIBERS.
B. Lozo, I. Bolan_a, Z. Bolan_a,*
*Faculty of Graphic Arts, University of Zagreb, Getaldijaeva 2, 10000 Zagreb, Croatia

ABSTRACT
In this paper, the influence of the printing techniques and condition of deinking flotation on the mechanical properties of the recycled fibers will be presented.

INTRODUCTION
Mechanical properties and the paper strength are an important characteristic in printing and graphic finishing as well as in the usage of the product. Generally speaking, the bond strength among the fibers and with it the mechanical properties are the function of the fiber flexibility and surface condition (Nazhal M, Peszner M L, 1994).

The fiber of greater flexibility changes its shape more easily and adheres to the neighbouring fibers increasing the contact surface, on which the strength depends on. During drying the fiber irreversible loses the ability of swelling (Petel M, Trivedi R, 1994). Such fiber is less flexible, it becomes stiff and breaks easily during defibering in the recycling process. Irreversible changes of the cellulose fiber walls which are the consequence of drying are attributed to the closing of pores and joints on the fiber wall. They lead to its stiffening. The application of the definite chemicals in the production can also contribute to the fiber fragility. Apart from the, recycling can cause microcompressions, which can change the state of the fiber surface (L. Gottschang, H. Pakarinen, 2000).

The investigation results of some mechanical properties of handsheet in relation to the used printing technique and characteristic of the recycling process, are presented in this work.

EXPERIMENTAL
Multicolor prints of the conventional (printing machine Heidelberg) and digital offset printing (printing machine Indigo E Print 1000+) are used for recycling. Alkaline and enzymatic deinking process was used in investigations (Z. Bolan-a et aill 2002). Cellulose with the addition of surfactant was used in enzymatic deinking. Handsheet was made after disintegration and flotation according to TAPPI standard method T 205. For determination of the mechanical properties and brightness the standard methods ISO were used.

RESULTS AND DISCUSSION
Figure 1 presents the part of the measuring results of the mechanical properties of handsheet (tear, tensile and burst index) before and after flotation of conventional and digital offset prints.

Applying the alkaline chemical deinking somewhat lower values of burst, tensile and tear properties of handsheet were noticed during the processing of digital offset prints in comparison with the conventional ones, as it was presented in figure 1. Such results point at certain influence of the printing techniques differences and at the composition of conventional offset ink and electroink. In digital offset printing the electroink (pigmented particles of polymer dispersed in silicone oil) is sprayed onto the photoimaging drum and heat softened, and hardens on contact with the paper through a polymer cross linking process. The described specific characteristics of the digital printing will influence the shape, size and number of particles after disintegration, and some optical characteristics of handsheet as well (Z. Bolan-a, 2003).

The results of burst, tensile, tear and brightness on the deinked pulp with the enzymatic and alkaline treatments of digital offset prints are presented in table 1.

<table>
<thead>
<tr>
<th>Postup</th>
<th>Tear index</th>
<th>Tensile index</th>
<th>Burst index</th>
<th>Brightness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaline deinking</td>
<td>65</td>
<td>0.259</td>
<td>1.19</td>
<td>82.13</td>
</tr>
<tr>
<td>Enzymatic deinking</td>
<td>59</td>
<td>0.260</td>
<td>1.01</td>
<td>82.84</td>
</tr>
</tbody>
</table>

Table 1. Mechanical properties and brightness of handsheets

As it was presented in table 1 the mechanical characteristics are decreased very little by the enzymatic deinking and the brightness of the recycled fibers is increased in relation to the conventional alcali process.

Figure 2. Loss of material in flotation

In application of the enzymatic deinking in flotation, greater removal of fillers and greater loss of fibers in relation to the conventional deinking process was noticed.

CONCLUSION
Based on the obtained investigation results, one could conclude the follows:
- A certain influence of the observed printing techniques on the mechanical properties of the handsheet is noticed
- The values of burst, tear, and tensile are somewhat smaller with handsheet obtained by processing the digital offset prints in relation to the conventional one
- The obtained mechanical properties of handsheet are somewhat smaller in application of the enzymatic deinking in relation to the alcali chemical one
- In application of enzymatic deinking greater removal of filler and greater loss of fibers appear.

The study contributes to the clarification of the influence of the printing technique and conditions of deinking flotation on some mechanical properties of fi-
Figure 1. Mechanical properties of handsheet

These findings may prove useful in graphic paper production.

REFERENCES
Nazhal, M. Paszner, M. L. (1994) Tappi J.77 (9), 177
Patel, M Trivedi, R. (1994) Tappi J.77 (3), 185