*Journal of Mining and Metallurgy, 43 A (2007) 33 - 41*

# SEPARATION OF INK PARTICLES FROM WASTE NEWSPAPER BY DEINKING FLOTATION

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*(Received 16.7.2007; accepted 27.11.2007)*

## Abstract

*Because of changed printing technologies and increased recycling quotas in the paper industry, demands on flotation deinking have increased considerably, particularly in the last few years. Today, in the paper industry, flotation deinking is the dominating process worldwide for the removal of printing inks from recovered paper. The focus of this paper will be the deinking flotation process. The deinking process includes a number of processes in succession dipending on the particle size of the ink particles liberated from the newsprint. Experimental studies have been conducted to evaluate different operating conditions, including temperature of liquid phase, concentration of solid in flotation, etc. The efficiency of the process is evaluated in terms of brightness and filthiness. The paper shows results of investigation the influence of the temperature of liquid phase on quality of recycled waste newspaper and on efficiency in removing the ink from newspaper by flotation.*

**Key words:** *Newspaper recycling, flotation process, deinking.*

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## 1. Introduction

The deinking of wastepaper includes several operations. These include pulping, screening, centrifugal cleaning, washing, flotation, bleaching and kneading. The focus of this paper will be the flotation process. In the flotation process, air is bubbled through the low consistency pulp stock. Hydrophobic particles, such as ink, attach to the bubbles and are lifted away from the stock. A foaming agent is added to create foam. The foam is scraped away as a reject stream, producing cleaner fibers in an accept stream. The process in industrial practice is continues, having a constant feed, accepts and rejects flow[1].

## 2. Material and the methods of work[2,3,4]

### *2.1. Pulping*

The wastepaper, 11g and 22g old news print (ONP), was used in these experiments. The pulp stream is mixed with 1 % NaOH and 1 % $Na_2SiO_3$. All reagents are related to dry paper weight. The pH in this stage is about 8,5-12,1. The control of pH values was done using pH-meter, type MA 5705 Iskra Kranj with combined electrode, type sentix 50. For calibration of pH meter, the buffer solvate was used whose pH value at the temperature of 25 °C is 9,18. The reagents are added during the pulping stage, which is carried out at room temperature and at the temperature of 45 °C in blender running at the highest speed for 15 minute pulping time at 5 % solids by weight (pulp consistency). The sample prepared that way was left for 24 hours on stand, after adding 100 ml of water so the celulose fibers could swell and easen ink removal.

### *2.2. Flotation*

After pulping, the pulp is then transferred to the flotation machine, which could be a flotation column or a mechanical flotation cell. In this study, a Denver flotation machine DR-12 is used, cell volume of 2,2 l, manufactured by english manufacturer. The number of rotations of rotor per minute is 1250. Density of the pulp is decreased to 0,5% and 1 % of the solid. The temperature of the pulp is 20 °C. Follows adding of the reagent

(0,4 % of surface active substance, colector-olein acid, foamer) and conditioning for 3 min. The time of floating is 17 min. Unlike the conventional reagent schemes, which can handle only 0,5 - 1 % solids loading during flotation, this method can handle up to 2 % solids loading efficiently. The froth was collected and periodically scraped off the top of the flotation cell with a small paddle. The ink and pulp deposited on the sides of the cell and the stand pipe were frequently washed down with water. Water was continuously added to keep the froth level constant and at the lip of the cell. This is needed for efficient froth removal. It should be mentioned that the amount of added water was kept as low as possible (about 3 - 5% of the cell volume) to minimize dilution of the chemicals present in the suspension. Floated ink particles were discarded and pulp left in the cell was separated from the water using 35 mesh screen. In order to measure the temperature of the pulp it was filtered on filter paper and the the filtered product was dried for 8h at 50 °C. The brightness was measured using lightmeter, which was used for measuring the percentage of reflection of the blue light from the samples at wavelength of 452 nm, according to standard Tappi T 452[5]. In order to measure dirtiness of the paper, analysis of samples was done using Image Analyzer V 1,25 2006 MeeSoft, which was used to determine the number of black dots of ink per square unit[6].

Figure 1 shows the flow diagram of the deinking process used in this study. The results of esamintation are given in the table.

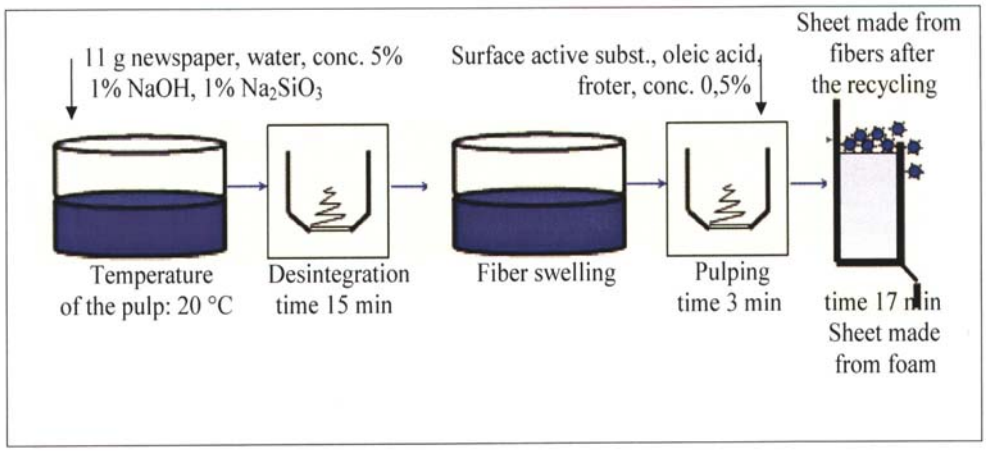


**Fig. 1.** Sheme of the print recycling flow

### 3. The results of work

Brightness of white non-printed paper is 45,81 %, and filthiness is 0,058 ‰

**Fig. 2**. Sample of unprinted paper

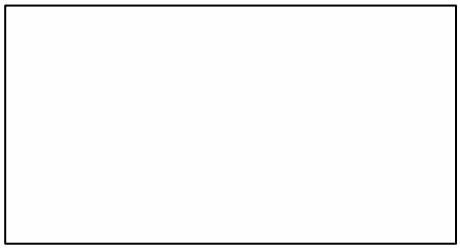

**Fig. 3**. Sample of unprinted paper using Image Analyzer

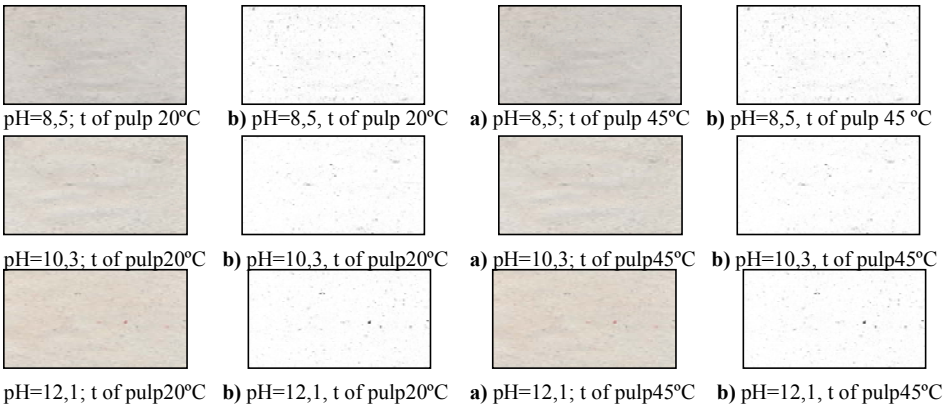


**Fig. 4**. **a)** samples of experiment after desintegration
**b)** samples of experiment after desintegration using Image Analyzer

### *3.1. Results of analysis I series of floating*

**Table 1.** Results of I series of floating
(temperature of liquid phase while preparing is 20°C, colector-olein acid)

| Exp. No. | pH value of pulp | Concentration of solid in flotation,% | Mass recovery Im, % | Brightness after desintegration B, % | Filthiness after desintegration, ‰ | Brightness after flotation B, % | Filthiness after flotation, ‰ |
|---|---|---|---|---|---|---|---|
| Ia | 8,5 | 0,5 | 94,27 | 41,81 | 2,423 | 44,86 | 0,107 |
| Ib | 10,3 | 0,5 | 90,00 | 41,98 | 2,406 | 44,44 | 0,043 |
| Ic | 12,1 | 0,5 | 85,12 | 41,50 | 2,379 | 45,81 | 0,040 |
| IA | 8,5 | 1 | 88,27 | 41,81 | 2,423 | 44,78 | 0,196 |
| IB | 10,3 | 1 | 83,48 | 41,98 | 2,406 | 44,04 | 0,056 |
| IC | 12,1 | 1 | 76,87 | 41,50 | 2,379 | 44,50 | 0,021 |

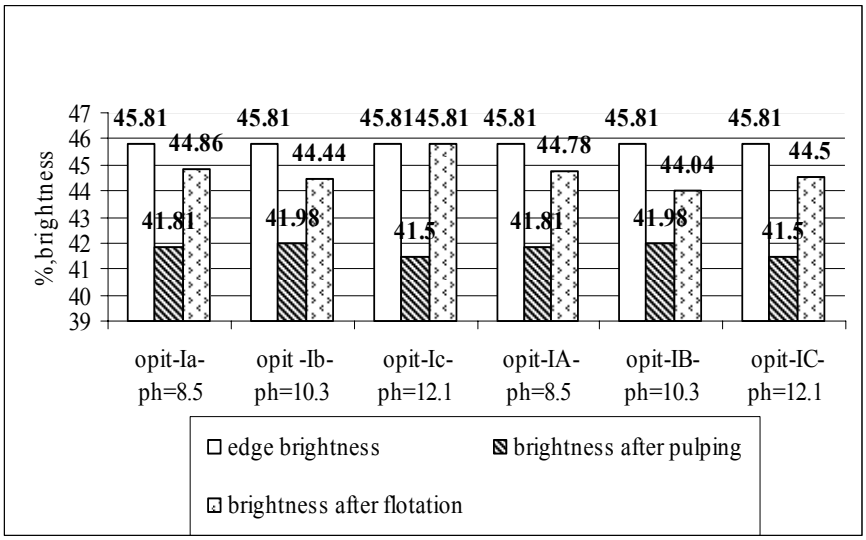


**Fig. 5**. Influence of pH value on brightness of the laboratory sheets

The brightness after desintegration with rise of pH values is insignificantly changed, and filthiness of them is almost the same which shows the representivity of the samples while preparing pulp.

From the table can be seen that with the rise of pH value mass recovery is decreased for 4-5 %.

In the experiment Ia with pH=8,5 the highest mass exploitage of 94,27 % was reached, better brightness compared to the Ib experiment, but larger filthiness, which could be seen visualy too. At the experiment Ic the brightness of 45,81 % of unprinted newspaper paper was reached, meaning that there's no loss of brigthness and that the filthiness is less compared to filthiness of the start unprinted paper od 0,040 ‰. At this experiment, mass recovery is the least 85,12 %, but the required value of brightness and filthiness was achieved.

In the experiments IA, IB, IC concentration of solid in flotation were 1 %. Experiments IB and IC had filthiness less compared to filthiness of the start unprinted paper od 0,040 ‰, but the required value of brightness wasn't achieved.

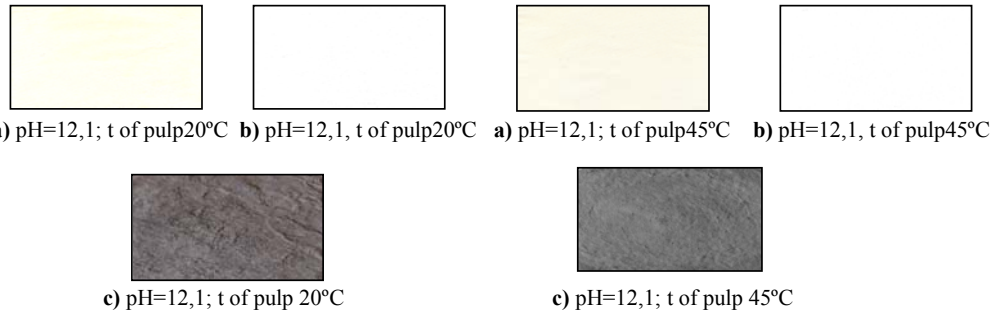


**Fig. 6**. **a)** samples of experiment after flotation
**b)** samples of experiment after flotation using Image Analyzer
**c)** samples of tailings

### *3.2. Results of analysis of II series of flotation*

In this series of flotation the temperature of liquid phase was 45 °C. From the table can be seen that with the rise of pH value, the change of the value of mass recovery happens. The highest recovery was reached with pH=8,5 for the experiment IIa and has the value of 90,12 %.

The brightness after desintegration with increase of pH value is insignificantly changed, and the filthiness of them is almost the same showing the representivity of the sample while preparing pulp.

**Table 2.** The results of II series of flotation
(the temperature of liquid phase while preparing is 20°C, no colector)

| Exp. No. | pH value of pulp | Concentration of solid in flotation,% | Mass recovery Im, % | Brightness after desintegration B, % | Filthiness after desintegration, ‰ | Brightness after flotation B, % | Filthiness after flotation, ‰ |
|---|---|---|---|---|---|---|---|
| IIa | 8,5 | 0,5 | 90,12 | 41,81 | 2,423 | 44,33 | 0,414 |
| IIb | 10,3 | 0,5 | 84,83 | 41,98 | 2,406 | 44,07 | 0,271 |
| IIc | 12,1 | 0,5 | 79,98 | 41,50 | 2,379 | 44,05 | 0,021 |
| IIA | 8,5 | 1 | 83,11 | 41,81 | 2,423 | 44,40 | 0,313 |
| IIB | 10,3 | 1 | 77,96 | 41,98 | 2,406 | 44,94 | 0,244 |
| IIC | 12,1 | 1 | 71,44 | 41,50 | 2,379 | 44,48 | 0,040 |

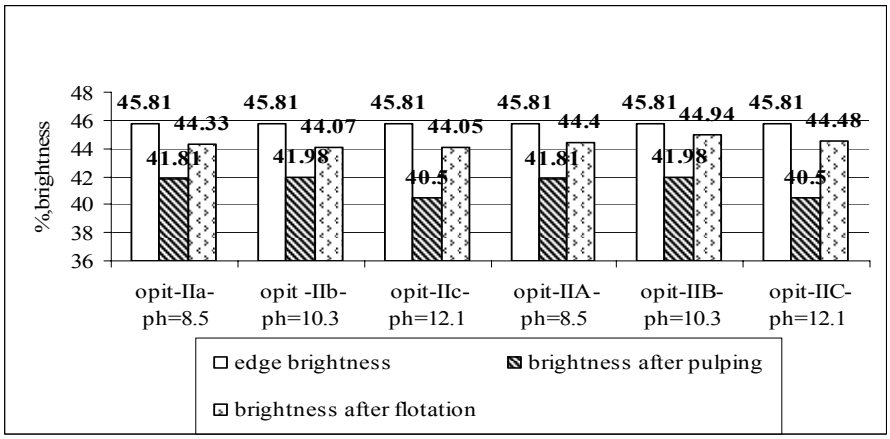


**Fig. 7**. Influence of pH value on brightness of the laboratory sheets

Values of the levels of brightness of all samples after flotation were almost the same, so in all experiments there was the loss of brigthness campared to the brightness of margin. The brightness of margin was 45,81%.

In the experiments IIc and IIC the less filthiness was reached compared with filthiness of margin. At this experiment, mass recovery is 79,98 % on the experiment IIc and 71,44 % on the experiment IIC but the required value filthiness was achieved.

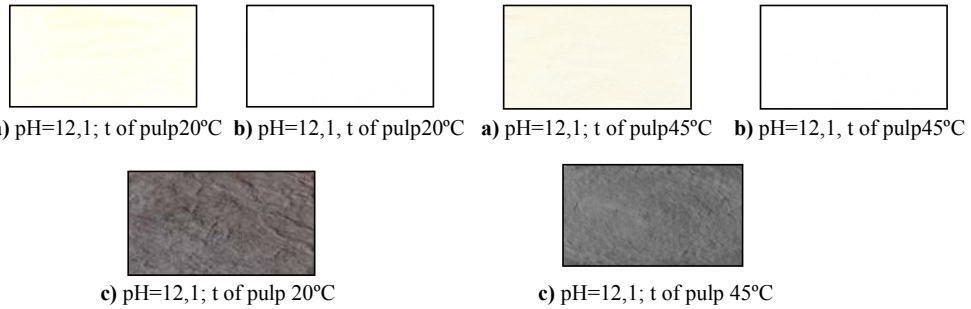


**Fig. 8**. **a)** samples of experiment after flotation
**b)** samples of experiment after flotation using Image Analyzer
**c)** samples of tailings

## 4. Conclusion

Process of deinking floation today is a dominant process in the world of paper industry that is used for ink removal from old paper.

Labarotory researches of implementation of flotation concetration in ink removal from newspaper, in this work, have given the results that show that with the process of deinking flotation old paper can be recycled and that it's quality complies standard market requirements.

The best results considering the paper quality (brightness, filthness, purity and colorness, just as the mass exploitage) were got in the I series of experiments of flotation.

Analysing this series of floating we can come to the following conclusions:

- With th pH value of 12,1, temperature of liquid phase in the preparation of pulp of 20 °C, the concentration of solid in pulp of 0,5 % and using olein acid as colector in the process of flotation, it is possible to get the required standard values that describe the quality of paper, and those are: brigthness B = 45,81 % and filthiness = 0,040 ‰. The problem is mass recovery which is only 85,12 %.
- At other pH values, 8,5 and 10,3, non-satisfying values of brightness and filthiness were achieved.

In the other series of floating the wanted results describing the quality of recycled paper were not achieved, just as the levels of recovery of the cellulose mass.

From these series of experiments the following can be concluded:

- mass recovery was about 85-90%
- when temperature of liquid phase in preparation of pulp was 45 °C, the reagents in flotation didn't allow getting recycled paper of required values of brightness.

Further researches should be directed to optimization of reagent doses in order to achieve the highest mass exploitage and to adding brightness chemicals.

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