THE EFFECTS OF WASTE PAPER CLEANING PROCESSES ON PAPER QUALITY INDICATORS

SCHOLASTICO-2021

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Annotation:

The presence of typographic ink in the waste paper of MS-3 brand has limited its use in the production of printing paper. Maximum separation of the dye in it, discoloration of the fiber and increasing a whiteness level is a vital issue. In these studies, the stages of processing the waste paper mass in an alkaline environment in order to convert the printing ink to a soluble state have been studied. It was observed that the waste paper first swells, then absorbs the alkali, and then a chemical reaction takes place between the abrasive alkali and the oily substance. It was found that at high temperatures in an alkaline environment, a waste paper becomes very swollen, the size of the pores increases, and the diffusion of fatty substances in the printing ink is facilitated. Alkaline substances have been shown to hydrolyze waxy substances to form sodium salts of fatty acids. The efficiency of printing ink from the mass of waste paper under the influence of alkali was evaluated by the degree of polymerization and capillaryity of paper castings made from it.

Keyword

Waste paper, Alkaline substances

It is known that 68% of the world's newspaper is made from secondary raw materials. At the same time, 68% of all paper produced worldwide is a packaging paper, and its composition consists of 50% recycled paper, ie waste paper. However, waste paper is almost never used in the production of printing and writing paper. Even in the US, only 6% of waste paper is used for this purpose. This means that almost 90% of the production of printing and writing paper uses primary fiber, ie; cellulose from wood. This means shrinking forests. MS-1, MS-2 or MS-3 waste paper can be used in the production of printed paper. Although there is no problem in using MS-1 and MS-2 waste paper, the presence of printing ink in MS-3 waste paper limits its use for the above purposes. In particular, the problem of maximum separation of dye on the fiber surface in the processing of waste paper, its removal from the cellulose suspension, decolorization process of dyed fiber and raising the whiteness of the secondary fiber is currently being studied in all developed countries [1].

An analysis of the literature revealed that the printing ink is a multi-component system. It is required that the printing ink does not to penetrate deep into the paper and to dry quickly. For this purpose, typographic inks are mainly prepared on the basis of typographic olifs. The composition of the paint may vary depending on the purpose for which it is used. For example, when printing a newspaper, liquid paint is used, taking into account the rapid drying of the paint, and when printing books, some darker colors are used. In the preparation of all types of printing paints, wood resin and soap are added to the oil. It is drying oil that acts as a curtain, a kind of a buffer. In order to remove the printing ink from the waste paper mass, it is first necessary to break down the curtain-forming component. This means that the drying oil in the paint is an oily-waxy substance, and by converting it to a soluble state, the waste paper mass can be removed from the printing ink. When reusing all types of packaging materials, it is important to remove the dye while maintaining the physical and mechanical properties of the fibrous material. Studies have suggested 3.5% maleic anhydride and 15.8% specific polymer as the optimal content for dye removal [2]. Another alternative method of removing printing ink from waste paper is currently proposed by G. Tofa. To do this, it is burnt at 5750C and bleached with sodium dithionite to remove the dye from the paper precipitate

formed during the flotation cleaning process, which is currently being studied as being economically viable for reuse in paper production as a filler from the resulting ash [3].

In the present study, the printing ink was extracted from the waste paper mass, but the capillary capacity of the paper samples prepared on its basis demonstrated low values. This is due to the fact that in addition to the coloring pigment in the printing ink contains various excipients, including oil-wax substances – drying oil, the presence of which in the waste paper mass, adversely affects the printing properties of the formed paper.

In the present study, the waste paper was exposed in an alkaline environment in order to render the printing ink into soluble state. In this case, in the first stage of the process, the paper - waste paper first swells, then absorbs the alkali, and in the next stage, a chemical reaction takes place between the abrasive alkali and the oily substance. At high temperatures, in an alkaline environment, the waste paper becomes very thick and the average size of its pores increases several times, which facilitates the diffusion of fatty substances in the printing ink. Under the influence of alkali, waxy substances hydrolyze to form sodium salts of fatty acids:

$$R - COOH + NaOH \rightarrow R - COONa$$

The efficiency of extraction of a printing ink from the mass of waste paper under the influence of alkali was evaluated by the degree of polymerization and capillary content of castings made from it. For this purpose, MS-3 waste paper was treated at different concentrations of alkali at a temperature of 900C for 50-60 minutes. The results of the studies are presented in Table 1.

1- table

Influence of alkali concentration on waste paper quality indicators

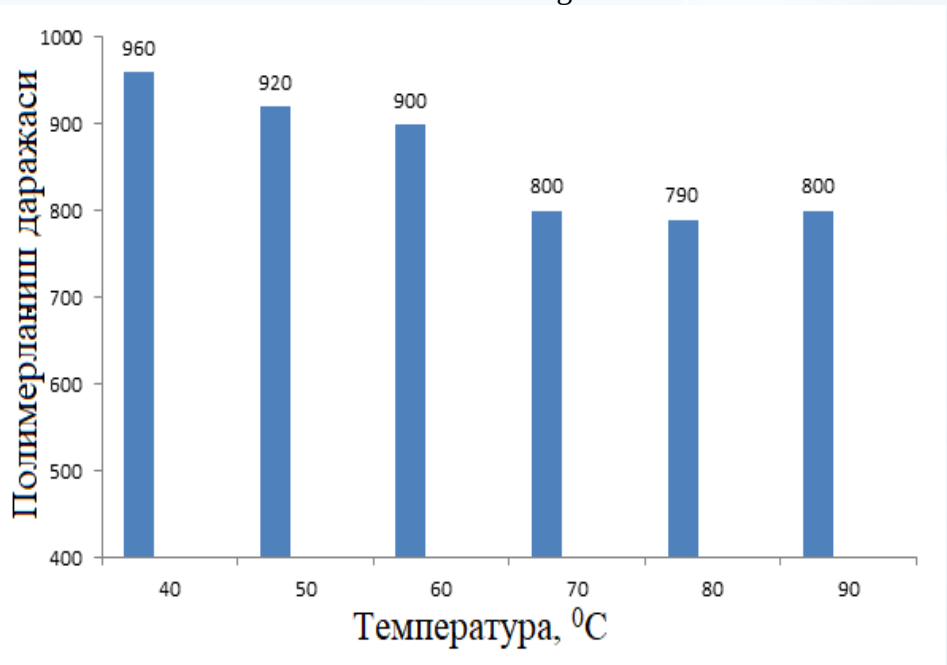
№	NaOH concentration, %	Polymerization level	Capillaryity of paper castings, mm
1	1,0	850	4
2	1,5	820	6
3	**2,0**	800	8
4	2,5	740	9
5	3,0	710	10

Specifications: $t = 90^0C$; $\tau = 50$ minutes

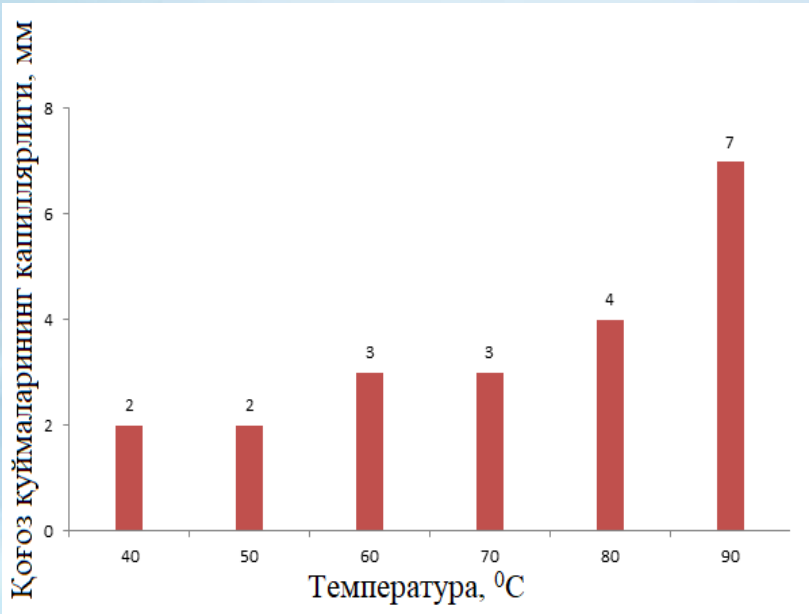
From the data given in the table, a slight decrease in the degree of polymerization of cellulose is observed when increasing alkali concentration, and an increase in capillary. Repeated recycling of paper will result in lower quality of the collected paper, which will again increase the demand for primary fiber. In addition, a number of studies have shown a sharp decline in the quality of paper during dye production [4, 5]. Since an increase in the alkali concentration of more than 2% led to a sharp decrease in the degree of polymerization of the cellulose, an amount of 2% was accepted as the acceptable concentration.

The increase in the capillary capacity of the samples can be explained by the fact that the film-forming agent (a curtain) in the printing ink is destroyed by alkali. The capillary rise of the liquid in the samples occurred as a result of the transfer of oligo-oily-waxy substances from the paper to the solution with increasing concentration of alkali. Although the decomposition of typographic dye was achieved with increasing alkali concentration, a sharp decrease in the degree of polymerization of cellulose was also observed. This is due to the rupture of hydrogen bonds in the cellulose macromolecule under the influence of alkali at high temperatures. Therefore, in order to reduce the alkali processing temperature, the effect of temperature on the process was studied, while maintaining the alkali concentration of 2%.

The results are shown in Figures 1 and 2.



X axe – polymerization degree
Y axe- temperature
Figure 1. The effect of temperature on the degree of polymerization of waste paper



X axe - Paper casting capillarity level in mm
Y axe - Temperature Comment: C_{NaOH} = 2.0%; τ = 50 minutes
Figure 2. The effect of temperature on the capillarity level of paper castings

The results presented in the diagrams show that the degree of cellulose polymerization is high at low temperatures of alkaline treatment, but the capillary rise of liquid in the samples is observed only when the process is carried out at a temperature of 80-900 ° C.
Thus, the hydrolysis of oily-waxy substances under the action of alkali at high temperatures was confirmed. The optimum temperature was 800C.

Conclusion.

According to the research results, in order to clean the MS-3 waste paper from oily-waxy oily substances in printing ink, it is necessary to process it with alkali. To preserve the degree of polymerization of cellulose and the capillarity of paper castings, it is recommended to treat them with a 2% (by weight) alkaline solution at a temperature of 800 ° C for 50 minutes.

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