



Using the Flotation Method in the Cleaning of Paper Based on Waste Paper

A. A. Abdumajidov, B. B. Karimov, A. A. Miratayev

Tashkent institute of textile and light industry

Abstract: *The article presents the results of studies on the separation of printing ink from the surface of waste paper, as well as on the conduct of bleaching processes and bleaching of paper pulp. The possibility of using the flotation method to prevent reverse sorption of a typographical ink in the paper pulp, which is why it is impossible to obtain the desired whiteness of the paper pulp.*

Keywords: *waste paper, flotation, surfactants, paper pulp.*

Introduction. It is important to establish technologies for the production of not only thick types of paper, but also writing and printing paper from paper waste collected in the republic. Also, in order to eliminate the scarcity of raw materials in the production of writing paper, the rational use of annual plants, non-wood plants and secondary resources separated from the main production is the need of the hour. According to the latest information, positive results were obtained for the production of writing and printing paper types from paper waste at leading foreign pulp and paper enterprises [1].

Waste paper is a raw material that differs not only in fiber composition, but also in printing method, conditions, drying and binding of paint. Therefore, in the preparation of high-quality pulp, as much as possible, homogeneous waste paper raw materials are used or the ratio of different waste paper is strictly maintained [2]. The period of storage of waste paper raw materials also affects the degree of separation of paint from the surface of the fiber, that is, after a certain time after printing the paint on the paper, the polymerization process of the film ends, which requires the use of chemical-mechanical effects to separate the paint from the surface of the fiber [3]. The research object consists of MC-3 waste paper, which includes books and magazines, archival papers (magazines, books, brochures, notebooks, notepads, posters, etc.).

It is known that in order to return MS-3 waste paper to the main process, it is necessary to remove the typography paint on the surface, decolorize and bleach the mass. In the first stage of the experiments, the process of removing paint from MS-3 waste paper and decolorizing was carried out in a hydrogen peroxide solution. In the second stage, the process was carried out in sodium hypochlorite solution [4].

As a result of the reabsorption of the printing ink released from the surface of the waste paper mass in both of the methods studied above, the fiber semi-finished product with the required level of whiteness was not formed, so the possibility of using the flotation method was studied in the next part of the research.

The disadvantage of the method is that the ash and paint particles are not completely removed from the mass when waste paper fiber is prepared according to one-cycle schemes based on flotation. In the three-cycle scheme, complete removal of random waste from the mass is achieved [5].

Dispersion and bleaching in two stages, as well as the flotation process in the third stage, are unique aspects of the three-cycle production technological scheme. It should be said that the



quality indicators of improved waste paper fiber made from mixed waste paper raw materials of a certain quality office according to the three-cycle scheme were found to be very similar to each other when compared with the quality indicators of primary fiber (mechanical pulp and technical cellulose).

In addition to improving the quality of waste fiber, economical use of electricity and chemicals in the implementation of the technological process is also an important factor.

The flotation method is used in the paper and food industries to separate iodine and solid particles from liquids and suspensions. In the mining industry, it is used to extract ores. One of the most important features of flotation is the removal of emulsified and dissolved substances from the liquid. The essence of the flotation process is to send air bubbles into the liquid and float the air bubbles over the liquid [6].

Methodical part. The essence of the flotation method is as follows: 1-2% amount of surfactant is added to the suspension of waste paper mass diluted to a certain concentration, and the suspension is heated to a temperature of 50-60°C. Air is injected into the heated suspension using a special device. The movement of the air bubbles, attaching the paint particles in the suspension, and their rise are visually controlled, and the optimal conditions for airing are selected. Under the selected conditions, the process takes 5-10 minutes. Then, the paint particles that rise to the surface of the solution are filtered using a special mesh filter.

Experimental results and their discussion. Usually, after the printing ink is dissolved in the waste paper mass, the ink particles are removed from the aqueous part of the suspension by washing or flotation. Due to the consumption of a large amount of fresh water (160-180 m³/t of processed mass), the generation of a large volume of wastewater, the loss of a large amount (30-35%) of fiber and filler during the washing process, the use of this method is somewhat limited in enterprise conditions. In our research, we studied the process of extracting the dye from the suspension by the flotation method [6].

The essence of flotation is the introduction of air bubbles into the suspension, which bind the dye to itself. The flotation process is affected by the concentration of the mass coming to flotation, the size of the dye separated from the fiber, the amount of air used in the flotation process, the size of the air bubbles and the speed of movement. In our research, we studied the influence of the mass concentration on the whiteness of the mass during the flotation process. The obtained experimental results are presented in Figure 1.

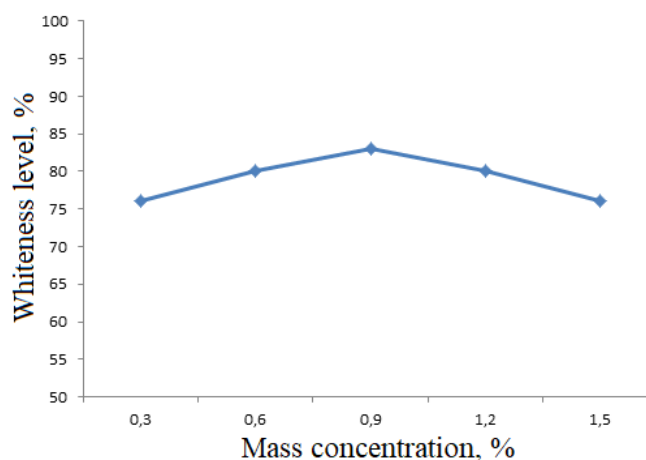


Figure 1. The degree of whiteness of the mass depends on its concentration. Process temperature 60°C, duration-10 min, Surfactant's concentration-1%.



As the mass concentration increases above 0.9%, the movement of air bubbles in the suspension slows down, so the whiteness of the mass also decreases. When the mass concentration was less than 0.9%, the air bubbles could not attach the paint particles. This is due to the fact that when the mass concentration has a low value, the paint particles are highly dispersed in the suspension. In further studies, the flotation process was carried out at a mass concentration of 9%. The influence of the duration and temperature of the flotation process on the degree of whiteness of the waste paper mass was studied, the obtained results are presented below (Fig. 2).

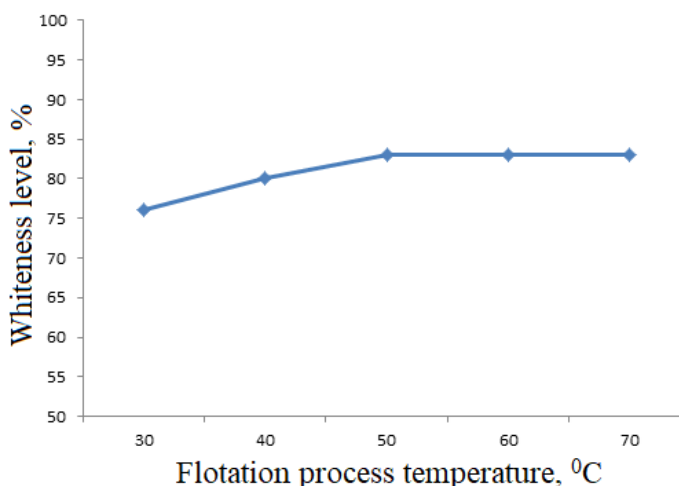


Figure 2. Dependence of mass whiteness on temperature of flotation process. Duration of the process is 10 min, mass concentration is 0.9%, SAM concentration is 1%.

Since increasing the temperature above 50°C had almost no effect on the whiteness of the mass, the temperature was taken as 50°C. As the temperature of the mass increases, the viscosity of water decreases, as a result, the movement of air bubbles in the suspension accelerates, and the breaking of paint particles into smaller pieces at a higher temperature increases the efficiency of the flotation process. When the duration of the process was studied, it was observed that the paint particles in suspension, i.e., the paint particles that have passed from the waste paper mass into the solution, quickly join the air bubbles. In the process, equilibrium was reached within 6–10 min, depending on the concentration of surfactant (Figure 3).

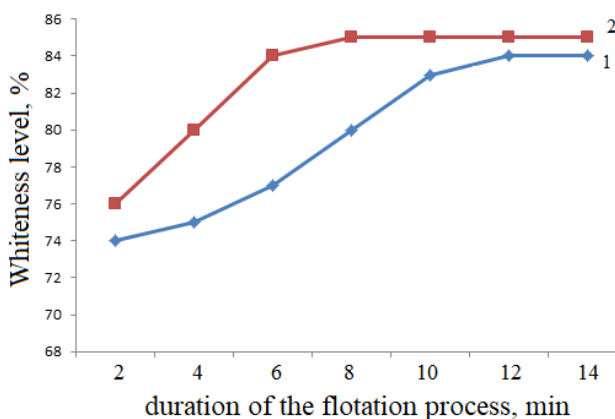


Figure 3. Dependence of mass whiteness level on duration of flotation process. 1 – surfactant’s concentration 1%; 2 – surfactant’s concentration 2%.

Note: Process temperature 50°C, mass concentration 0.9%.



Increasing the concentration of surfactant above 2% makes the process difficult to carry out. As a result of foaming of the suspension with air bubbles and SAM in the system, the air bubbles coalesce and become larger, making it difficult for the paint particles to attach to themselves. As a result of the conducted research, the following conditions are proposed for the flotation process:

- ✓ Surfactant's concentration - 2%;
- ✓ process temperature – 50⁰C;
- ✓ process duration – 6-8 min;
- ✓ suspension concentration – 0.9%.

Summary. Factors influencing the process of printing ink removal from MC-3 waste paper were studied. In order to return the MC-3 waste paper to the main process, the processes of removing the typography paint on its surface, decolorizing the mass and bleaching were carried out. In the first stage of the experiments, the process of removing paint from MC-3 waste paper and decolorizing was carried out in a hydrogen peroxide solution. In the second stage, the process was carried out in sodium hypochlorite solution. In both cases, it was found that the whiteness of the mass did not reach the required level.

In both of the methods studied above, it was determined that the mass did not have the required level of whiteness due to the resorption of the printing ink released from the surface of the waste paper mass, so the possibility of using the flotation method was studied at the next stage of research and positive results were obtained. Conditions for carrying out the flotation process were proposed.

A technological scheme for improving the quality of paper waste and paper pouring has been developed.

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