EFFECTIVE METHODS OF UTILIZING INDUSTRIAL WASTE

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This paper describes how, in addressing the effective utilization of cellulose-containing waste from the agricultural and pharmaceutical industries, the fields of application of such waste can be identified by isolating cellulose from the raw material and determining its properties.

The growth of the world’s population and of its standard of living is, in turn, causing a continuous increase in the use of natural resources. Supplying the entire population with various consumer goods generates large quantities of industrial waste. Returning this waste to the main process and creating new product ranges makes it possible to save natural resources, protect the environment of populated areas, reduce production costs, and reduce the amount of toxic gases and substances released into the atmosphere.

Most of the waste generated in the food and pharmaceutical industries consists of secondary products containing cellulose and lignin. Such waste cannot be used directly; it can be used in various branches of industry after purification and processing. To date, a number of positive results have been achieved in solving the problems of effective utilization of paper waste. However, rational solutions for the effective use of fibrous waste from the textile industry and agriculture have not yet been found. The research conducted has mainly focused on producing wrapping-grade (kraft-type) paper and paper products from this waste. However, secondary products containing lignin and cellulose can also be used, on the basis of innovative and nanotechnologies, to obtain new polymer materials [1], biocomposites [2], and thickening and finishing (sizing) compositions for the textile industry [3].

To address the problems outlined above, a research group studied the possibilities of effectively utilizing waste generated in agriculture and the

pharmaceutical industry that consists of cellulose and lignin. Glycyrrhiza, Carthamus tinctorius L., Paulownia, Heliánthus tuberósus and Yúcca were used as the objects of study. Cellulose was isolated from all of the plant waste in a solution containing 60 g/L of caustic alkali (liquor ratio 1:10) at a temperature of 150–160 °C for 1–2 hours. The whiteness of the resulting product was assessed using a “Spekol-11” laboratory instrument, its degree of polymerization according to GOST 9105-74, and its ash content according to GOST 18461-93 (ISO 1762-74).

The cellulose obtained by the soda (natron) method was dark brown (whiteness 48%). To broaden the range of its possible uses, the semi-finished product was bleached in solutions of sodium hypochlorite and hydrogen peroxide. Because lignin gives cellulose its color, the main task of the bleaching process is to break the double bonds of the lignin macromolecule and to remove from the cellulose the lignin that has degraded into low-molecular-weight fractions. According to the experiments carried out, it was found possible to raise the whiteness of the cellulose to 56–77%, depending on the type of raw material. The degree of polymerization and the ash content of the cellulose obtained from the various waste materials are shown in the figure below.

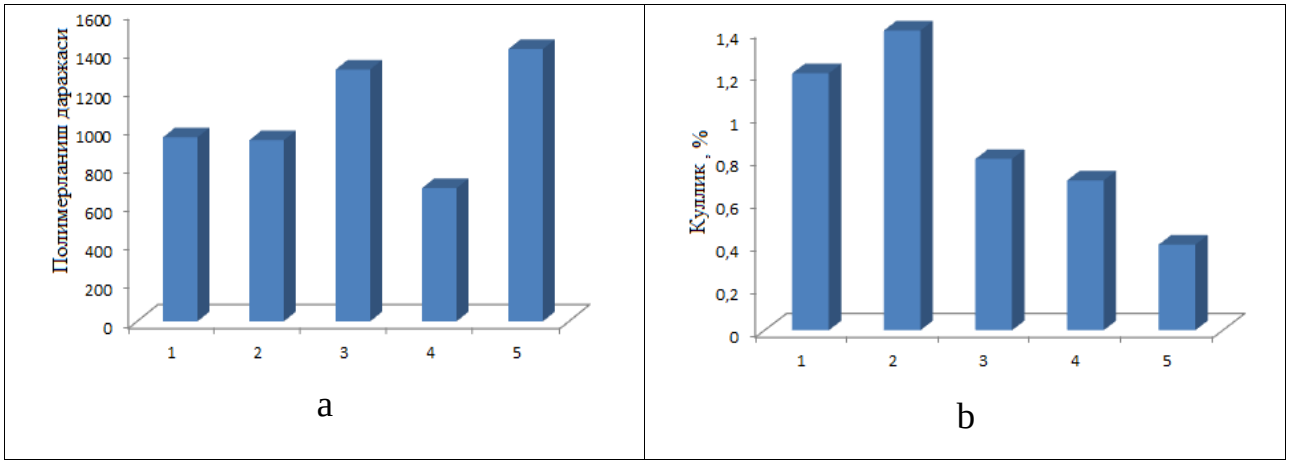


Figure. Dependence of the degree of polymerization and ash content of cellulose on the type of raw material. a – degree of polymerization; b – ash content. 1 – Heliánthus tuberósus; 2 – Carthamus tinctorius L.; 3 – Paulownia; 4 – Glycyrrhiza; 5 – Yúcca.

The resulting fibrous semi-finished product can be used to produce paper, and its ethers can be used in the textile industry as a sizing agent for sizing textile materials, as a thickener in printing, and as a finishing (sizing) composition in the final finishing processes.

References

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