STUDY OF THE PROPERTIES OF CELLULOSE OBTAINED FROM AMARANTH STEM

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Abstract: There is an opportunity to extract cellulose from the wastes of medicinal and agricultural plants and use them as a good raw material for making paper, which is important for non-forestry countries. Within this study, the kinetics of the process of cellulose extraction from amaranth stem was studied, and the properties of the obtained cellulose were studied. Based on the conducted experiments, a technological mode of cellulose extraction from amaranth stems is proposed.

Keywords: amaranth stem, degree of whiteness, degree of polymerization, wood cellulose, α-cellulose.

Introduction.

Since cellulose is a rigid chain polymer, various changes occur in its structure and properties. Depending on the principle of operation of the shredder, in some cases, some liquids are also added in order to carry the level of cellulose grinding deeper. The appearance of the resulting cellulose particles also depends on it. In

particular, when cellulose fibers are crushed in an aqueous medium, fragmentation occurs along the fiber direction and cellulose particles with a high degree of asymmetry are formed. When grinding in air and non-polar liquids (hydrocarbons), fragmentation goes in the transverse direction to the fiber axis, as a result, the asymmetry of the particles decreases dramatically [1].

As the cellulose particles became smaller, the amount of alpha-cellulose also decreased. If the amount of -cellulose in the original cellulose was 98%, it decreased to 89% in the fraction with particle size smaller than 315 μm. So, during the process of compression, crushing and grinding of cotton cellulose fibers in the device, the part that dissolves in 17.5% solution has gradually made up to 9%. However, the value of the molecular mass of cellulose has not decreased much, and the degree of polymerization of powdered cellulose is between 620-850, which means that it is considered sufficient to ensure its operational properties [2].

In order to carry out the mechanochemical bonding reaction with cellulose, it is necessary to place the molecules of substances with a high ability to react as close as possible to the cellulose macromolecule.

The molecular mass of cellulose is considered one of the important indicators and serves as a factor determining the quality of the products obtained from it. Cellulose is considered a linear homopolymer consisting of identical units, and is usually evaluated by the degree of polymerization, that is, the number of units in macromolecules [3].

The technological features of the local amaranth plant were studied in order to propose a technology of cheap, rational use of raw materials of local plants for the paper industry in countries where there is no forestry.

Amaranth belongs to the Amaranthus family, which includes more than sixty species. Native to South America, it has been cultivated for seed for 8,000 years. Amaranth is widespread from South America to North America, India and from

there to the world through Asian countries. Now there are many varieties of amaranth in India and China, these countries are the secondary homeland of amaranth. In these countries, the amaranth plant is widely used in local medicine, national cuisine and industry. Amaranth flower is a small flower, pink, dark pink, red and dark red, and because it reminds of a cock's crown, it is called "flower flower" among our people. Amaranth is an annual plant that is cultivated in various directions, including: vegetable (Amaranthus gangeticus, Amaranthus mangostanus), grain (Amaranthus caudatus, Amaranthus paniculatus), ornamental and (Amaranthus blitum) fodder crops [4].

Methods and methodology of the research: physic-mechanical and physic-chemical research has been done.

Creation of technology of obtaining semi-ready product from secondary resources and also to create the technology of producing papers from local raw material. It is studied to take cellulose from amaranth plant and studying peculiarities of obtained cellulose as well as to research the process of obtaining paper from amaranth’s cellulose.

Experimental results and their discussion. Alkaline production of cellulose from amaranth stems was carried out in the following sequence: amaranth plant waste was cut into 1-2 sm lengths and heated at 100^0C for 100, 120, 140, 160 minutes, with 5.0 sodium caustic; 10.0; It was boiled in 15.0, 20% solutions, the filter was washed in a sieve, and dried.

Equipment used for obtaining cellulose: autoclave, capacity 8000 ml; porcelain container with a capacity of 10,000 ml; porcelain cup, capacity 1000 ml; fine mesh strainer; drying cabinet (150^0C).

700 g of crushed sample is thoroughly immersed in 7000 ml of solution (module 1:10) containing 60 g/l of caustic alkali and 0.5 g/l of OP-10 in a porcelain

container, autoclaved and tightly closed with bolts. Then, with the help of an electric heater, the temperature rises to 150-160^{0}C, at which temperature the waste is boiled for 3 hours. During boiling, the air collected in the autoclave is released 2-3 times with the help of a valve installed on the autoclave cover. At the end of the process, the autoclave is placed in a container of cold water and the temperature is cooled to 60-70^{0}C, then the resulting cellulose is separated from the solution on a mesh strainer by opening the autoclave lid. The resulting product is unbleached cellulose, which is dried at room temperature or on a drying rack at 100^{0}C, and the yield of the product is calculated as a percentage. The amount of α-cellulose was determined.

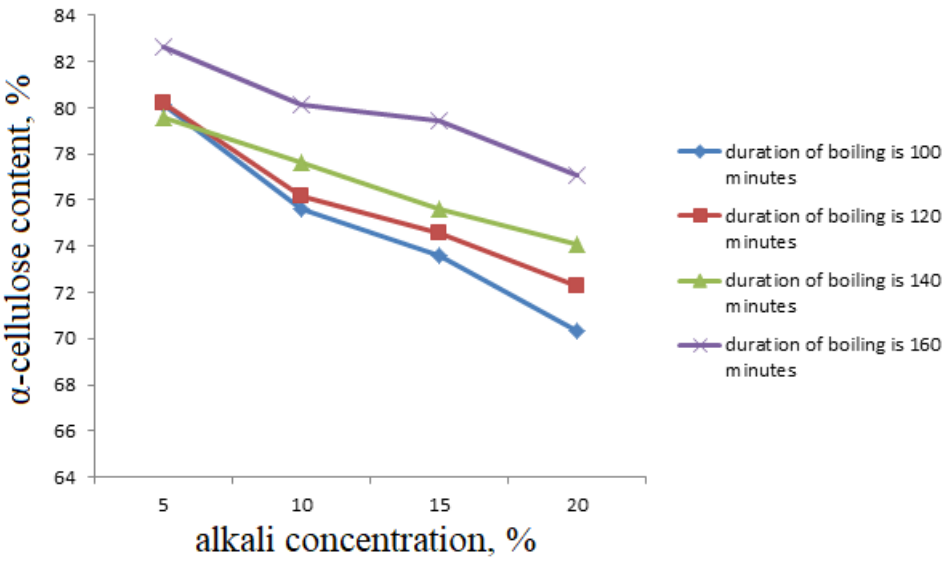

Figure 1. Effect of alkali concentration on the α-cellulose content of cellulose

The duration of boiling the amaranth stalk for 100, 120, 140, 160 minutes, 5.0 of caustic sodium; 10.0; The change in the degree of polymerization at 15.0, 20% is presented in the graphs below.

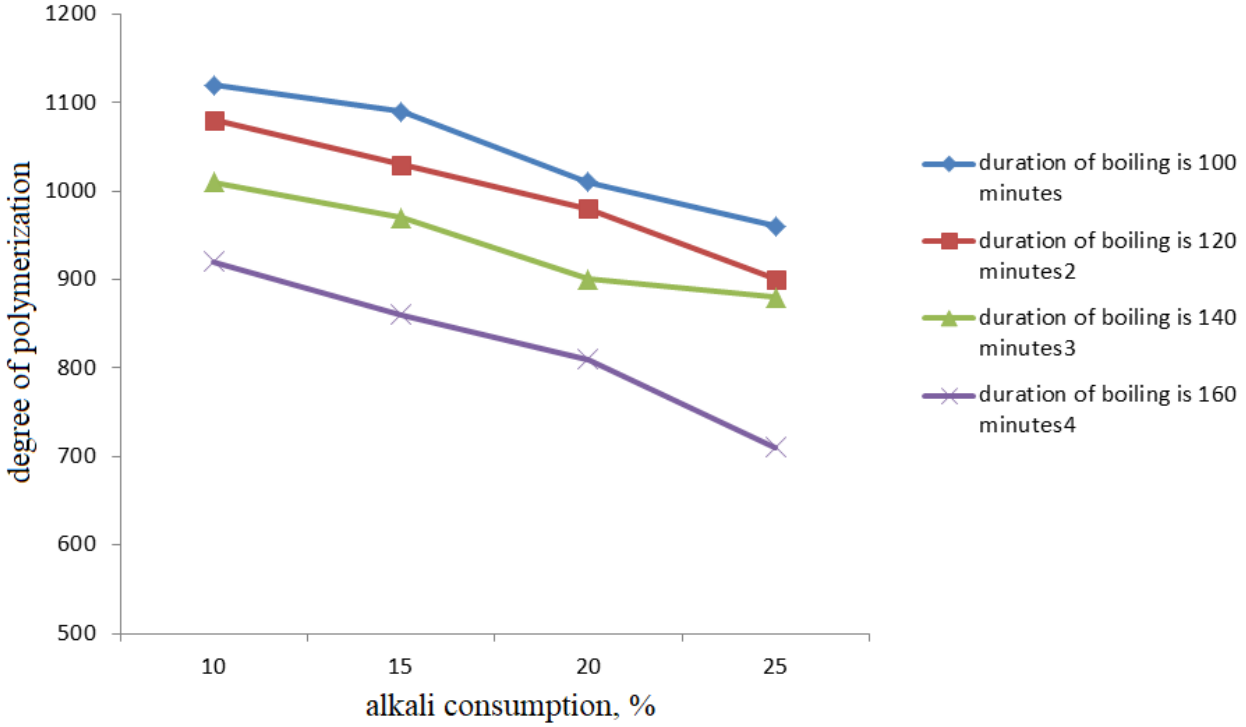

Figure 2. The effect of alkali concentration on the degree of polymerization of cellulose at different boiling times

The temperature is 130-145^{0}C, the duration of boiling is 1-3 hours, during the boiling process, non-cellulosic wastes are decomposed and become soluble, and in this process, fat and waxy compounds are removed from the fiber. The fiber is given a hydrophilic property. After the boiling process is finished, the solution is cooled to 90^{0}C, the pressure in the boiler is reduced to 1-1.5 atm. The washed cellulose is diluted with water to a concentration of 2.5-3% and transferred to the bleaching tank.

During the alkaline treatment, the yellowed vegetable cellulose undergoes a bleaching process (decolorization). The cellulose of the amaranth plant is bleached in a solution of hydrogen peroxide. Neutralization is carried out using a 0.5-4 g/l solution of sulfuric acid.

Cellulose bleaching with hydrogen peroxide depends on the amount of the reagent, the effect of temperature, and the concentration of the mass. When the mass

concentration is high, the bleaching speed increases, and the processing time is shortened.

For the bleaching process, a sample of amaranth pulp obtained from wet amaranth is selected. The table below shows the whiteness of cellulose. Note: T - 80^0C, t - 60 minutes.

Table-5

NaOH concentration whiteness of cellulose impact on the level

NaOH concentration, %	Degree of whiteness, %, H_2O_2 (8% by mass)
10	70
15	75
20	81

In high-concentration bleaching, it is difficult to prepare special equipment for dewatering and mixing the mass with the solution. Bleaching is at its highest when the hydrogen peroxide solution is at its maximum concentration. When the concentration is higher than 3%, bleaching increases to a higher level, that is, by 10-15%.

Summary. Based on the conducted experiments, it was observed that the degree of polymerization of the cellulose obtained from the amaranth stem decreased with increasing alkali concentration. The dependence of α-cellulose amount of cellulose on alkali concentration was studied. Due to the high level of whiteness at the maximum concentration of hydrogen peroxide solution, bleaching in 8% concentration of H_2O_2 in an alkaline environment was recommended.

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