Obtaining paper from composition of different fibers and its analysis

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Abstract. Cellulose and paper products are produced from cotton wool in our republic. Since 1995, the production of these products has increased several times. Nevertheless, 10% of the demand for pulp and paper products in our Republic is met. uring 1988-1993, this growth was 6%, which was 3 times higher than wood pulp production. Extraction of cellulose from annual plants is well developed in China and India. 77% of the world's cellulose obtained from annual plants is produced in these countries. The People's Republic of China gets 50% of its paper output from annual plants. Cellulose was obtained from plants containing cellulose, and their properties were studied. Paper products were obtained from the resulting pulps and its quality indicators were studied based on the standards applied to papers used in industry.

1 Introduction

Cellulose and paper products are produced from cotton wool in our republic. Since 1995, the production of these products has increased several times [1-5]. Nevertheless, 10% of the demand for pulp and paper products in our Republic is met. Increasing the production of pulp and paper products is one of the most urgent issues of today. The main way to solve this problem is to establish a method of obtaining paper from annual plants. The production of paper from annual plants in the world is increasing year by year [3-7]. During 1988-1993, this growth was 6%, which was 3 times higher than wood pulp production. Extraction of cellulose from annual plants is well developed in China and India. 77% of the world's cellulose obtained from annual plants is produced in these countries. The People's Republic of China gets 50% of its paper output from annual plants [8-11].

In Uzbekistan, thousands of tons of annual plant stalks are produced per year (mainly cottonwood, rice straw, straw, Heliánthus tuberósus, etc.). Unfortunately, pulp and paper are not produced from them. Taking this into account, in the future, a number of practical works are being carried out on the reconstruction of existing paper production enterprises and the replacement of technologies with new ones [3-6, 9]. This will help to satisfy our republic's demand for paper products. Taking these into account, we also aimed to obtain

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cellulose from the stems of Helianthus tuberosus and flax, which are annual plants, to study its physicochemical properties, to take paper samples from the composition of Helianthus tuberosus and flax cellulose and basalt fiber, and to compare it with other types of paper. Cellulose and paper were obtained from Helianthus tuberosus and flax in laboratory conditions, and its physical and mechanical properties were studied [11, 12].

It was requested to study the influence of various factors in the process of obtaining cellulose from Helianthus tuberosus and flax. Because the quality of cellulose is at a high level, it can be widely used in chemical processing and in various fields [1-3].

2 Materials and Methods

Helianthus tuberosus and flax cellulose, basalt fiber, chemical reagents and fillers used in the production of cellulose were taken as research objects [2-4].

Experiments on making paper from Helianthus tuberosus and flax plant cellulose and basalt fiber composition and all quality indicators of the obtained samples were carried out in the laboratories of "Key laboratory of carbon fiber and functional polymers Ministry of Education", "National carbon fiber engineering research center" of Beijing University of Chemical Technology. We crushed 3% cellulose pulp in a roll-22.5 machine to get paper. Mass index: degree of grinding 56 oShr, average length of fibers 45 empirical units in "slick" unit (the method was developed by the Swedish researcher Slick). We took the paper samples on the LA-3 paper casting machine. We took paper samples from pure Helianthus tuberosus and flax plant cellulose and its basalt fiber composition mixture. Proportions of Jerusalem artichoke and flax cellulose mixture: 100/0; 80/20; 60/40; 20/80; 0/100.

3 Results and Discussion

In order to obtain cellulose, we took it from air-dried Helianthus tuberosus stem, cut it into 4-5 mm size, then took 500 g and hydrolyzed it in 3% nitric acid at room temperature for 24 hours. Then we cooked in different concentrations of alkali. Washed, brought to pH 10-12, bleached with 4% hydrogen peroxide for 4 hours at room temperature, washed again and dried in an oven at 105 ^{0}C. The obtained results are presented below in the form of a table (Table 1).

Table 1. The effect of alkali co-concentration on cellulose quality parameters during cellulose extraction from Helianthus tuberosus and flax.

#	NaOH, g/l	Helianthus tuberosus plant pointers						
		Cooking time τ, minute	Cooking temperature, ^{0}C	Quality indicators of cellulose				
				Cellulose product,%	Moisture, %	Amount of ash, %	α – cellulose, %	DP
1	10	60	130	18.2	4.01	1.33	-	-
2	15	60	130	30.2	3.09	1.20	-	-
3	20	60	130	45.4	3.06	0.89	90.4	1200
4	25	60	130	42.6	3.05	0.82	90.6	1050
5	30	60	130	39.1	3.06	0.78	91.4	890
Indicators for the flax plant								
1	10	60	130	Quality indicators of cellulose				
				22.2	4.12	1.30	-	-

2	15	60	130	37.2	3.19	1.19	-	-
3	20	60	130	52.4	3.16	0.85	91.6	1270
4	25	60	130	46.6	3.56	0.80	91.7	1150
5	30	60	130	43.1	3.63	0.77	92.5	893

As can be seen from the table, both the increase and decrease of the alkali concentration have a negative effect on the yield of cellulose. Cooking the stem in a low concentration of alkali makes it difficult to form cellulose, resulting in an increase in the amount of hemicelluloses. On the contrary, an increase in the alkali concentration leads to the destruction of the formed cellulose.

The next table shows the results of the study of the effect of the concentration of H_2O_2 in the bleaching process on the quality indicators of cellulose obtained from Heliánthus tuberósus stems (Table 2).

Table 2. Heliánthus tuberósus cellulose quality indicators.

#	H2O2, g/l	Heliánthus tuberósus cellulose quality indicators				
		Cellulose product,%	**Amount of ash,%**	**Whiteness level,%**	**α – cellulose, %**	**Degree of polymerization (DP)**
1	2.0	18.2	1.33			
2	2.5	30.2	1.20			
3	3.0	45.4	0.89	78	90.4	920
4	3.5	42.6	0.82	80	90.6	840
5	4.0	39.1	0.78	84	91.4	800
Quality indicators of flax cellulose						
1	2.0	22.2	1.30			
2	2,5	37.2	1.19			
3	3.0	52.4	0.85	81	91.6	1020
4	3.5	46.6	0.80	83	91.7	940
5	4.0	43.1	0.77	86	92.5	900

In Table 2, it can be observed that the bleaching process was carried out at different concentrations of H_2O_2. The results of our experiments show that with the increase in the concentration of the bleaching reagent, the whiteness level of cellulose and its α-cellulose content increase positively, and the amount of ash content decreases significantly. On the contrary, the degree of polymerization of cellulose is decreasing, that is, it is moving in the negative direction. In the next step, we studied the paper production from Heliánthus tuberósus cellulose and basalt fiber composition and its quality indicators. Physical and mechanical properties of paper samples are presented in Figures 1 and 2.

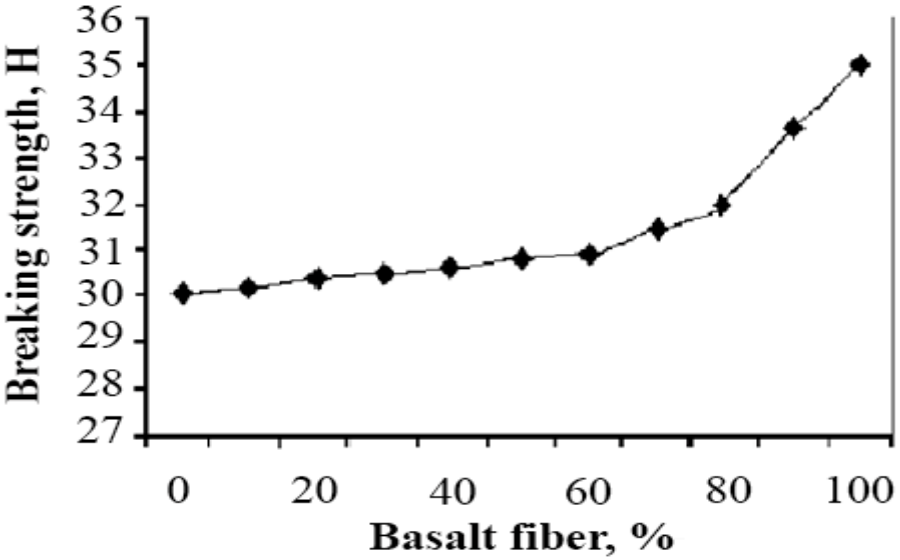

Fig. 1. The effect of increasing the amount of basalt fiber in the paper on its tensile strength.

It is observed that when the amount of basalt fiber in the paper content increases to 60%, the tensile strength increases from 30 to 32 N, and when it increases from 60 to 100%, it increases from 32 to 35 N. We believe this is because Heliánthus tuberósus and flax cellulose fibers are short and interspersed with basalt fibers, resulting in a denser arrangement of fibers on the surface of the paper. It is known that an increase in paper hardness leads to a decrease in its breaking length (Fig. 2).

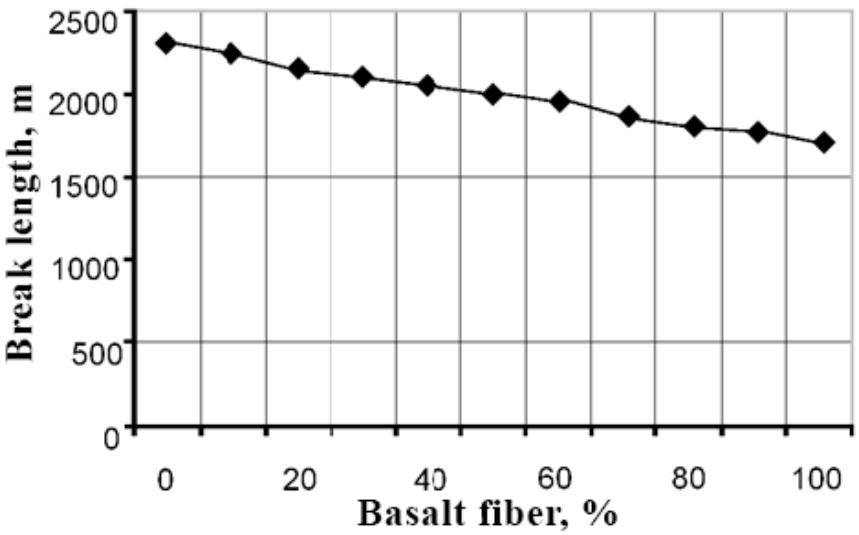

Fig. 2. The effect of increasing the amount of basalt fiber in the paper on its breaking length.

As can be seen from the figure, the increase in the amount of basalt fiber in the paper leads to a decrease in its breaking length.

4 Conclusion

In conclusion, it can be said that, firstly, in the process of extracting cellulose from Heliánthus tuberósus and flax plant, various factors (degree of polymerization, amount of ash, etc.) significantly affect the quality of the obtained product. Because the quality of cellulose is at a high level, it can be widely used in chemical processing and in various fields.

Secondly, an increase in paper hardness leads to a decrease in its break length, which does not adversely affect the quality of the paper. The increase in the amount of basalt fiber in the paper increases its tear resistance.

In general, we achieved our goal, at least partially, because the strength of our paper increased as a result of adding basalt fiber to the composition. We can recommend this paper for packaging, corrugation and packaging applications.

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