STUDYING THE INFLUENCE OF LOW MOLECULAR CHITOSEN ON THE QUALITY OF PAPER

Zokirova Zilola Qaxramon qizi
Toshkent davlat texnika universiteti
1-bosqich talabasi magistr
E-mail: zilolazokirova515@gmail.com

Iskandarov Adham Isroil o‘g‘li
Toshkent davlat texnika universiteti
1-bosqich talabasi magistr
E-mail: iskandarovadham3@gmail.com

Sattarkulov Lazizbek Abror o‘g‘li
Toshkent davlat texnika universiteti
3-bosqich talabasi
E-mail: lazizbeksattarkulov@gmail.com

ABSTRACT

The study examined the use of low and medium molecular weight chitosan to reduce the water-absorbing properties of paper and increase its strength and smoothness.

Key words: chitosan, paper, cellulose, water absorption, strength, smoothness.

Chitosan is also widely used in the paper industry to improve paper production and paper properties. In fact, the molecular structure of chitosan is similar to cellulose, which helps to form a strong bond. Due to the presence of functional groups in chitin ($-NHCOCH_3$) and chitosan ($-NH_2$), these groups are insoluble in water, but soluble in chitosan acid solution with a degree of deacetylation higher than 60%. On the contrary, chitin does not dissolve. Chitin and chitosan are insoluble in alkali and organic solutions under normal conditions. In general, a higher percentage of amine (NH_2) in chitosan determines the degree of deacetylation (DD). DD is an important parameter affecting solubility, chemical activity and biodegradability.

Chitosan occurs in different molecular weights and degrees of deacetylation. Molecular weight and degree of deacetylation are the main factors affecting particle size, particle formation and aggregation. These factors are important in the paper industry. To improve paper properties, chitosan is added to paper and used to improve

its derivatives. In both cases, chitosan mainly improves the strength of paper sheets. By using chitosan and its derivatives in the paper industry, a number of quality indicators have been improved. In particular, it was shown that it leads to improvement of strength properties of old paper sheets. When adding chitosan and its derivatives to the cellulose mass, the breaking length of the obtained fibers increased several times. On the other hand, when the paper was immersed in solutions of chitosan and its derivatives, the opposite trend was observed for the tearing factor. In general, it was shown that the mechanical properties were improved by using chitosan in paper production. Chitosan and its derivatives also improve electrical, printing, barrier and antibacterial properties of paper.

Nowadays, paper and paper products are used in many cases for packaging various items and products. Therefore, it is important to obtain papers with high dry and wet strength, low water absorption and high tear resistance properties.

The purpose of the work is to study the effect of chitosan with different molecular weight on the quality indicators by introducing it into the paper. First, chitosan of two different molecular weights was determined and analyzed. The results are presented in the table below (Table 1).

Table 1

№	A type of chitosan	Quality indicators					
		Color	The smell	Moisture %	Ash content %, (550^0C)	Molecular weight (g/mol)	Degree of deacetylation
1	Low molecular weight chitosan	colorless	odorless	7.5-8.5	±1	0.85	95
2	Medium molecular weight chitosan	colorless	odorless	5.5-6.5	±3	2.45	95

Chitosan samples (low molecular weight) were characterized for their ash content, molecular weight and degree of deacetylation for paper production. It was known from previous experiments that the higher the level of diacetylation of chitosan, the faster it reacts. Taking this into account, the chitosan diacetylation level of 95% was selected for the experiment. During the research, samples were obtained by adding low molecular weight and medium molecular weight chitosan to paper pulp. Paper samples were taken on the basis of cotton wool and basalt fiber. 1% and 2% solution of chitosan was used. A number of important quality indicators such as grammage, roughness,

hardness, water absorption of paper samples were studied and analyzed. The results are presented in the following tables (Table 2).

Table 2

Result of paper treated with low molecular weight chitosan

№	Change (diversity)		Grammage (g/m^2)	Asperity (mL/menit)	Hardness (mNm)	Water resistance(g/m^2)
	Filler % (basalt fiber)	Chitosan (%)				
1	-	1	100	240	0.32	18.49
2	-	2	100	305	0.42	17.80
3	25	1	100	255	0.38	15.44
4	25	2	100	315	0.49	16.74
5	35	1	100	295	0.41	13.99
6	35	2	100	335	0.52	15.01

The analysis of Table 2 above showed that the paper with a concentration of 1% chitosan and basalt fiber can reduce the water absorption level from about 18.49 to 15.44% compared to other samples. A better result was achieved in the sample treated with chitosan 1% and 35% basalt fiber, which in turn had a negative effect on other quality indicators. However, the increase in chitosan concentration (2%), in turn, reduced the water absorption, but also increased the roughness and hardness of the paper sample. Exceeding these two indicators (curvature, hardness) does not meet the requirements for wrapping paper.

The use of chitosan improved the dry strength of the paper, especially by adding 1% low molecular weight chitosan. But the increase in concentration reduced its dry strength. To conclude this research work, they found that low molecular weight chitosan was more effective than medium molecular weight chitosan in all cases of using chitosan in the papermaking process.

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