THE EFFECT OF CHITOSAN WITH AVERAGE MOLECULAR WEIGHT ON THE QUALITY OF PAPER

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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.

Keywords: chitosan, paper, cellulose, water absorption, strength, smoothness.

Chitosan is a natural polymer obtained from the hard shells of crustaceans. Today, in European countries, chitosan is obtained from sea creatures, i.e. crustaceans. In Uzbekistan, a number of leading scientists are extracting chitosan from Bombyx mori mulberry silkworm sponge and Apis Mellifera dead bee. The chemical structure of chitosan is similar to cellulose, where the hydroxyl (OH) in the glucose molecule in cellulose is replaced by an amine (-NH2) in chitosan. According to its chemical structure and properties, chitosan can be used as a filler and adhesive to replace traditional materials, and it has a number of properties such as increasing paper strength, reducing water absorption, increasing smoothness, and possibly fighting bacteria and mold. improves its properties. The use of chitosan in paper production can reduce the harmful impact on the environment, because chitosan is a natural biodegradable polymer. In this study, chitosan is used to replace the filler in paper processing, and also as an adhesive to improve paper properties. The experiment was carried out using 1% low molecular weight chitosan to solve the problems of reducing paper water absorption and increasing paper strength and paper smoothness. Paper and cardboard are packaging materials that are very easy to scratch; because they are made from cellulose fibers, which are considered renewable materials. However, paper and paper products should consider the use of environmentally friendly materials. Wrapping papers are used for food packaging, they are required to have the required strength, water and oil resistance. Paper has a number of disadvantages with some positive properties in relation to moisture and oil. Because the surface of the paper is treated with hydrophobic reagents such as paraffin and polyethylene to increase resistance to moisture, oxygen, odor and oil. This limits the areas of use of the finished product. As we know, paper is a bundle of cellulose fibers, and the fibers are hydrogen bonded to form mass, but this bond is weakened by the large amount of water molecules that compete with the hydrogen bonding in the fibers. While maintaining this strength, the use of chitosan, which has a unique molecular structure containing hydroxyl and amine groups at the same time, can overcome the above-mentioned disadvantages [1-5].

The fibers in paper are connected by hydrogen bonds, and this bonding affects the distance between the fibers. The presence of more water can reduce the strength of the paper. To date, several resins and polymers have been used to improve paper strength, including urea, phenol, melamine, and formaldehyde. Today, a number of scientists are conducting research on the use of biodegradable and non-toxic substances. As a continuation of these studies, we used chitosan and starch as a natural glue for the production of wrapping papers for the food industry based on the cellulose of annual plants. Our goal was to replace starch glue with chitosan, which is used in large quantities in paper factories.

Chitosan samples (medium 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 1).

Table 1

Result of medium molecular weight chitosan treated paper

№	Change (diversity)		Grammage (g/m²)	Asperity (mL/menit)	Hardness (mNm)	Water resistance(g/m²)
	Filler % (basalt fiber)	Chitosan (%)				
1	-	1	100	288	0.40	21.69
2	-	2	100	325	0.42	19.11
3	25	1	100	300	0.42	18.90
4	25	2	100	325	0.49	22.58
5	35	1	100	320	0.45	16.55
6	35	2	100	345	0.57	18.74

The analysis of the above table showed that the paper with a concentration of 1% chitosan and basalt fiber can reduce the water absorption level from about 21.69 to 18.90% 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. If we summarize the analyzed tables 2-3, it was found that the samples containing 1% chitosan with low molecular weight and 25% basalt fiber are the most optimal option.

The molecular weight of chitosan affects the properties of treated paper. This can be explained as follows. The connection must correspond to the distance between the segments between the fibers, because they form an inter-fiber connection area. Even if the water molecule is separated from the organic bond with the fibers or not, a large amount of water destroys the bond state of the paper. It can be explained that the hydrogen bond on the fiber surface is mainly monopolized by the water molecule, because the fiber forms a macroscopic liquid bridge. The weakness of this bridge indicates the wet tensile strength of the paper. 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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