WEB OF SYNERGY:
International Interdisciplinary Research Journal
Volume 2 Issue 2, Year 2023 ISSN: 2835-3013
https://univerpubl.com/index.php/synergy

Study of the Processes of Obtaining Several Brands of Cellulose Based on Local Raw Materials

Muradov Muzaffar Murodovich
Doctor of medical sciences, professor, Director of Tashkent Scientific Research Institute of Innovative Chemical Technology

Rakhmatov Eldor Raykhonovich, Eshonqulov Mansur Nasim ugli
Junior researcher at the Tashkent Scientific Research Institute of Innovative Chemical Technology

Article Information

Received: December 26, 2022
Accepted: January 27, 2023
Published: February 28, 2023

Keywords: *cellulose, degree of polymerization, amount of basic substance, fibrous waste of textile mills, turbidity, macromolecule, elemental composition, degree of alkalinity, concentration, boiling time, optimal parameters, critical point, yield of cellulose, simple esters of cellulose, low-volume products, lignin, pentosans, degree of whiteness.*

ABSTRACT

The need for cellulose and its simple and complex ethers, as well as for paper and paper products, as well as composite materials based on them, is increasing day by day. In order to eliminate this gap, the need to create innovative technologies and speed up the production system several times over before remains one of the urgent problems of the present day. When obtaining cellulose and its products, which are suitable for chemical processing, on the basis of fiber waste, it is necessary to determine the modes of chemical processing. Because during the synthesis of cellulose from fibrous waste, it is required to use methods that do not affect its quality indicators and do not harm the environment.

The amount of industrial production of cellulose, as well as its application in various fields, is several times higher than the indicators of all synthetic polymers. Hydroxyl groups of cellulose undergo all chemical reactions characteristic of simple low molecular weight alcohols [1].

They form alcohol groups under the influence of alkalis, such as lower molecular alcohols, and aldehyde and carboxyl groups under the influence of acids. In production, various new derivatives of cellulose are obtained on the basis of the above-mentioned types of reactions, and they are used in many sectors of the economy as artificial fibers, products of various composition, explosives, insulating materials, glues and plastics [2-3].

The molecular weight of cellulose can be from tens of thousands to several millions. Cellulose occupies a special place among all polysaccharides due to the stereo-ordered structure of its macromolecule and the stability of the conformational state of its elementary molecules. It is distinguished from other polysaccharides by its positive physical-mechanical properties and resistance to various chemical effects.

Cellulose is a polycyclic high molecular compound containing many polarized hydroxyl groups, so its macromolecule chain is not flexible, and because the macromolecule is highly ordered, it is densely packed. Therefore, cellulose dissolves only in certain solvents, which are concentrated solutions of copper-ammonia complex and lattice quaternary ammonium bases.

Its degree of polymerization will be less than 150. Cellulose with a degree of polymerization of 50-150 is β-cellulose. Cellulose with a polymerization degree of less than 50 is called γ-cellulose. The content of cellulose sulfite in cellulose should not be less than 90 percent, and in the content of cotton cellulose it should be 98-99 percent. The density of cellulose is equal to 1.4-1.55 g/m^2, and its molecular mass has different values depending on the growing conditions and type of plant. All types of cellulose are flammable. Cellulose is in a glassy state under normal conditions; the transition temperature to the high elastic state is higher than the decomposition temperature.

Therefore, when cellulose is heated up to 200°C, it does not soften and disintegrates [4-5]. Cellulose dissolves well in saturated solutions of mineral acids zinc, bismuth, antimony, titanium, mercury and lead chlorides. However, macromolecules are destroyed and the molecular mass of cellulose is significantly reduced. Such negative conditions limit the possibility of more widespread use of cellulose. The fact that the cellulose macromolecule is well oriented and forms a more mature fiber is also due to the influence of hydrogen bonds. The reactivity of cellulose macromolecules also depends on the amount of hydrogen bonds in it. As the density of arrangement and degree of orientation of macromolecules increases, the effect of hydrogen bonds in it also increases. If the effect of hydrogen bonds between macromolecules is reduced, the reactivity of cellulose increases.

In practice, to reduce the effect of hydrogen bonds, cellulose is soaked in different liquids or some of the hydroxyl groups in it are replaced by other groups. It is known that the density of the polymer decreases as a result of the formation of large networks in linear macromolecules. Esterification of cellulose with alcohol or carboxylic acids, on the one hand, leads to the porous structure of the macromolecule, and on the other hand, leads to a decrease in the amount of hydroxyl groups that can interact with hydrogen bonds. Therefore, cellulose derivatives are easily soluble in most liquids, and as the temperature rises, they gradually soften, first becoming highly elastic, and then moving to a viscous-flow state. Reduction of hydrogen bonds of macromolecules also depends on the amount of replaced hydroxyl groups and the size of new functional groups formed. An increase in the size or number of functional groups reduces the number of hydrogen bonds and weakens the strength of interaction between molecules. Cellulose fibers are strong due to the dense arrangement of cellulose macromolecules in the fibers. Such durable fibers are widely used in many sectors of the manufacturing industry and in life.

The need for cellulose and its simple and complex ethers, as well as for paper and paper products, as well as composite materials based on them, is increasing day by day. In order to eliminate this gap, the need to create innovative technologies and speed up the production system several times over before remains one of the urgent problems of the present day.

Global production of cellulose products increased by 10% and demand for it increased by 11%. At the same time, the demand for composite polymer materials based on cellulose and paper and paper products increased by 7%, and their export increased by 16.3%. In particular, the export of writing and toilet paper increased from 11720 thousand tons to 32260 thousand tons. The major producing countries are USA, Brazil, Japan, Finland, and Russia.

In order to expand the reserves of cellulose and its esters, in addition to cotton lint, there are various types of fibrous waste from cotton ginning plants and fibrous waste from industrial enterprises. The main factors are the high molecular weight of the cellulose produced during their chemical processing and the high quality indicators of the composite polymer materials obtained on its basis. Processes aimed at eliminating the influence of various factors on its destructive states during the extraction of cellulose, the study of the influence of several parameters affecting them is considered the main basis of the research.

Reprocessing the fiber waste of the cotton ginning industry (lint, cyclone fluff and other waste) into high-quality cotton cellulose of various brands, which is a raw material of the chemical, light and textile industries, to increase the production efficiency of the cotton industry enterprises and to improve its impact on the environment in a positive way. The creation of innovative technology of improvement is one of the important tasks to be solved. In the process of extracting cellulose from fibrous waste, it is distinguished by its high advantage over existing technologies, and by the fact that it does not differ from the physico-chemical and mechanical properties of sulfated, sulfided, bisulfided celluloses obtained from deciduous and coniferous trees.

On the basis of the research - the synthesis of the cellulose products obtained on the basis of the waste of cotton ginning enterprises into assortments according to different sectors is envisaged. The technology created on the basis of the project is distinguished by its simplicity and high precision control of its modes according to the required quality indicators, that is, by changing the concentration, time, temperature, it is possible to obtain cellulose brands suitable for chemical processing with the desired productivity, degree of polymerization and α-cellulose.

When obtaining cellulose and its products, which are suitable for chemical processing, on the basis of fiber waste, it is necessary to determine the modes of chemical processing. Because during the synthesis of cellulose from fibrous waste, it is required to use methods that do not affect its quality indicators and do not harm the environment.

Currently, cellulose is mainly obtained from cotton lint in the Republic. However, the vastness of the field of use of cotton lint, as well as its high cost, cause the cost of cellulose and its products to increase. Currently, only 10-12% of the production of cellulose, cellulose esters and paper products in the Republic meets the demand.

Currently, in countries with developed cellulose industry, various researches are being conducted to reduce the participation of factors that cause various destructive conditions in the process of extracting cellulose from various plants containing natural polymers. Because the quality indicators of the obtained cellulose are required to be at a level that will allow it to be widely used in the future. Taking into account the above points, some simplifications have been made in the process of extracting cellulose from fibrous wastes of industrial enterprises containing cellulose. Fibrous waste was first separated into fractions, and step-by-step mechanical crushing and chemical processing were carried out in a boiler equipped with a special defibrator.

The table below shows the effect of alkali digestion time on the pulping process.

Table -1. Effect of time of alkaline digestion of fibrous waste on quality indicator of cellulose (digestion speed 1000 m/min).

№	NaOH, g/l	Stage I		Stage II		Cellulose quality indicators				
		crushing τ, minutes	crushing, t^0C	Boiling τ, minutes	Boiling, t^0C	cellulose yield, %	Humi-dity, %	ash quantity, %	α – cellu lose, %	PD
1	20	10	98-100	60	98-100	-	-	-	-	-
2	20	20	98-100	60	98-100	-	-	-	-	-

3	**20**	**30**	**98-100**	**60**	**98-100**	**96.4**	**3.6**	**-**	**96.4**	**1200**
4	20	40	98-100	60	98-100	91.6	3.5	-	97.6	1050
5	20	50	98-100	60	98-100	87.1	3.6	-	98.4	890

It can be observed in the table that the alkaline digestion process from the first stage causes the reduction of various parameters in the next chemical processing stage.

The first-stage fiber raw material sample was carried out at high speed with the presence of a fixed alkali concentration and a specific temperature for different grinding times. The presence of temperature and alkali in the stage allows chemical hydrolysis of fibers, i.e. delignification occurs, and high-speed grinding allows mechanical hydrolysis, i.e. separation of the natural semi-fibers in the fibers.

In parallel with the first stage, the parameters of the second stage are also given, and both stages are carried out sequentially in one system. In this case, the following parameters can be mentioned as the optimal conditions of the first stage in obtaining cellulose based on fiber, that is, the process of dissolving 98-100^{0}C in 20 g/l alkaline solution for 30 minutes.

Table – 2. Effect of Alkaline Boiling Time on the Quality of Cellulose Based on Textile Fiber Waste

NaOH g/l	Boiling time, t, minutes	Cellulose yield, %	α - cellulose, %	Degree of polymerization, PD	Flexibility, g
0,5	5	93,8	96,0	850	121
0,5	10	91,6	98,2	830	145
0,5	15	91,5	98,5	810	145
0,5	20	91,4	98,6	810	146
0,5	25	91,2	98,8	800	147
0,5	30	91,2	98,8	800	147

Alkaline boiling process was carried out at different time intervals and NaOH concentrations, and alkaline boiling in 0.5 g/l NaOH solution for 10 minutes was chosen as the most optimal condition. The quality parameters of the cellulose formed at other time intervals, except for 10 minutes, did not change much. The difference in other different alkali concentrations is almost non-existent. Because in alkaline boiling, it was not observed that the temperature above the parameters that cause destructive conditions is exceeded. In it, the yield of cellulose is 91.6%, α-cellulose is 98.2%, and the degree of polymerization is 830, and the flexibility is 145 g.

REFERENCES

1. M.M. Murodov., G.R. Rakhmonberdiyev, M.Q. Urozov, P.J. Tojiev. «Technology of making cellulose and its ethers by using raw materials» // *International Conference* “Renewable Wood and Plant Resources: Chemistry, Technology, Pharmacology, and Medicine”. *Saint-Petersburg, Russia*. June 21-24., 2011. 142-143.
2. M.M. Murodov., M.Q. Urozov, P.J. Tojiev. «Reconstruct the department of making carboxymethyl- cellulose (cmc) in the enterprise «KARBONAM» » // *International Conference* «Renewable Wood and Plant Resources: Chemistry, Technology, Pharmacology, Medicine». *Saint-Petersburg, Russia*. June 21-24., 2011. 178-179.
3. M.M. Murodov. «The technology of making carboxymethyl cellulose (cmc) by method monoapparatus» // *International Conference* «Renewable Wood and Plant Resources: Chemistry, Technology, Pharmacology, and Medicine». *Saint-Petersburg, Russia*. June 21-24., 2011. 141-142.

4. Патент на изобритение № IAP 04989. Способ получение карбоксиметилцеллюлозы// Рахманбердиев Г, Негматов С.С., Мурадов М.М., Хусанов А.О., Негматова К.С., Лисьенко А.М. // Расмий ахборотнома.-2014.-№11.
5. Патент на изобритение № IAP 05270. Способ получения целлюлозы// Ходиев Б.Ю., Туробжонов С.М., Рахмонбердиев Ғ,Р., Муродов М.М. // Расмий ахборотнома.-2016.-№9.