QO‘QON DAVLAT PEDAGOGIKA INSTITUTI ILMIY XABARLARI
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TABIIY FANLAR

NATURAL SCIENCES

KALIFORNIYA DARAXTI PO'STLOG‘IDAN OLINGAN SELLYULOZANING SIFAT KO‘RSATKICHLARINI O‘RGANISH

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Annotatsiya: Ushbu maqolada Kaliforniya daraxti po'stlog’idan yuqori sifatli sellyuloza olish hamda ular asosida tarkibida sellyuloza saqlagan materiallar olish, fizik-kimyoviy xossalarini, daraxt po'stlog’idan olingan sellyuloza miqdori va uning pishirish jarayoni natriy ishqorining konsentratsiyasiga bog'liqligi asosida yangi yo'nalishlari keltirilgan.

Kalit so'zlar: sellyuloza, texnologiya, polimerlanish, fizik-kimyoviy xossalari, H_2O_2.

ИЗУЧЕНИЕ ПОКАЗАТЕЛЕЙ КАЧЕСТВА ЦЕЛЛЮЛОЗЫ, ПОЛУЧЕННОЙ ИЗ КОРЫ КАЛИФОРНИЙСКОГО ДЕРЕВА.

Аннотация: В данной статье рассматриваются новые направления получения высококачественного целлюлозы из коры калифорнийского дерева, а также получение материалов, содержащих целлюлозу, на основе этого, их физико-химические свойства, зависимость количества целлюлозы, полученной из коры дерева, и ее процесса варки от концентрации натриевого щелочи.

Ключевые слова: целлюлоза, технология, полимеризация (СП), физико-химические свойства, H_2O_2.

STUDY OF THE QUALITY INDICATORS OF CELLULOSE OBTAINED FROM THE BARK OF THE CALIFORNIA TREE

Abstract: This article presents new directions for obtaining high-quality cellulose from the bark of the California tree, as well as materials containing cellulose based on it. The physical-chemical properties, the amount of cellulose obtained from the tree bark, and the dependence of its cooking process on the concentration of sodium hydroxide are discussed.

Keywords: cellulose, technology, polymerization (SP), physical-chemical properties, H_2O_2.

Introduction

On February 8, 1994, the Cabinet of Ministers of the Republic of Uzbekistan issued a decree titled "Measures for the Development of Industrial Forestry and the Creation of Fast-Growing Wood-Producing Tree Plantations," which set the goal of establishing 10,000 hectares of tree plantations annually in the country. Following this, significant attention was given to the forestry industry. In recent years, the global importance of saving and recycling natural resources has been growing [1-2]. In particular, the paper and cellulose industry has faced the need to seek new and efficient raw material sources to meet the changing demands. Uzbekistan's natural conditions, mainly consisting of semi-desert, foothill, and mountainous regions, have limited forest areas. Therefore, meeting the demand for cellulose and paper products in our country remains one of the pressing issues [3]. California poplars are distinguished by their fast growth rate and high productivity. Their bark attracts attention as an environmentally friendly and easily recyclable raw material. The cellulose extracted from these plants is an essential component for producing high-quality materials [4]. Furthermore, determining the physical-chemical properties of the cellulose extracted from California poplar bark, and its potential use in paper and other material production, will help improve the efficiency of utilizing this resource [5]. Cellulose extracted from California poplar bark, through its chemical composition and processing methods, can be used to produce high-quality products in the paper industry. Therefore, scientific research in this field opens opportunities to develop environmentally sustainable and economically efficient methods.

Literature Review

In the literature, there are studies on the physical-chemical properties of cellulose extracted from poplar bark, including its chemical composition, structural and textural changes, as well as its suitability for processing. These properties mainly affect the use of cellulose in paper and other products. For example, in order for the cellulose to be stronger, it needs to be properly processed, with attention to the concentration of sodium hydroxide and treatment with oxidizing agents. In recent years, several scientific papers have emerged that research new innovative approaches and technologies for obtaining cellulose from California poplar bark. These studies propose new methods to optimize the cellulose extraction process, reduce technological errors, and improve quality. It is known that the result of cellulose extraction from poplar bark depends on the plant's characteristics, as well as the thickness and composition of the bark. The study of the physical and chemical properties of cellulose extracted from California poplar bark aims to develop possible methods for its effective use in the paper industry. The ongoing scientific work in this field presents new approaches to improving the quality of cellulose extracted from poplar bark and expanding its industrial applications. Thus, the literature review focuses on exploring the technological, ecological, and economic aspects necessary for improving the quality of cellulose extracted from California poplar bark and its effective use in various industries.

Research Methodology

To extract cellulose from California trees, the bark is first ground to a size of 2-3 mm. It is then cleaned of mechanical impurities, followed by washing in 80°C hot water under laboratory conditions to remove dust, after which it is dried. In order to determine the optimal concentration of the alkaline solution for extracting cellulose from poplar, it is boiled in 2%, 3%, 4%, 5%, and 6% solutions, and the optimal polymerization degree is determined. To identify the optimal concentration of the hydrogen peroxide solution for extracting cellulose, the bark is boiled in 3%, 4%, 5%, 6%, and 7% hydrogen peroxide solutions. In a 4% hydrogen peroxide solution, the cellulose is bleached, washed with hot water, and then dried at 100-105°C. The amount of cellulose obtained and its whiteness degree are measured. After the samples have been treated with the alkaline solution, they are washed, then boiled in a 5% hydrogen peroxide solution for 50-60 minutes. The samples are then left to oxidize for 11 hours at room temperature until the reaction completes. After washing to a neutral pH, they are dried at 100-110°C until their mass remains unchanged.

Analysis and Results

After the bark of the California tree was initially ground and cleaned of impurities, it was washed in hot water under laboratory conditions and then dried. To determine the optimal concentration of NaOH solution for extracting cellulose from the tree bark, it was boiled in the alkaline solution, and the optimal polymerization degree of the cellulose was determined (Table 1). The cellulose obtained under laboratory conditions is shown in Figure 1: A) California tree bark and B) cellulose obtained from the California tree bark.

Figure 1. A) Tree bark B) Cellulose obtained from tree bark

Table 1.

The amount of cellulose obtained from California tree bark and its dependence on the concentration of sodium hydroxide during the cooking process

№	NaOH concentration %	Cellulose content %	Degree of polymerization
1	2	31,5	1025
2	3	35,1	1066
3	4	37,7	1110

4	5	38,2	1150
5	6	41,4	1153

The cellulose was boiled with a hydrogen peroxide (H_2O_2) solution to determine the optimal concentration. It was then bleached in a 4% hydrogen peroxide solution, washed in hot water, and dried. The amount of cellulose obtained and their whiteness degree were determined (Table 2). As a result of hydrolysis, the degree of polymerization of polysaccharides decreases. The breaking of glycosidic bonds of polysaccharides is represented by the following schematic expression.

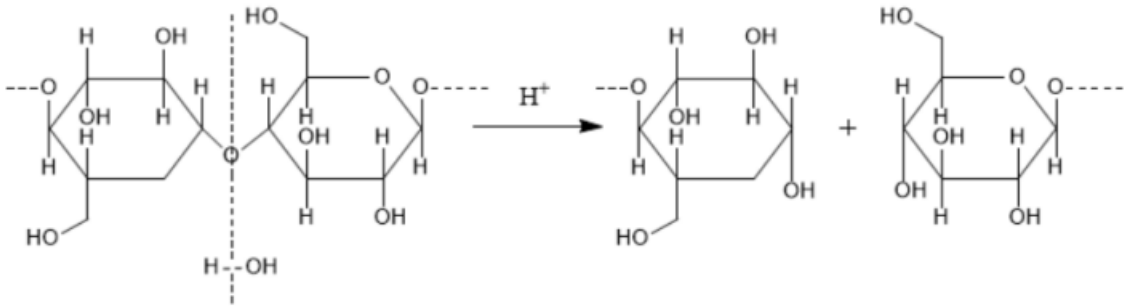

Table 2

The amount of cellulose obtained from the California poplar bark and its whiteness degree as a function of hydrogen peroxide concentration

№	H_2O_2 concentration %	Cellulose content %	Whiteness degree %
1	3	37,5	71,1
2	4	36,1	80,3
3	5	35,1	87,4
4	6	34,2	83,5
5	7	33,3	89,4

As shown in the table, with the increase in alkali concentration, the amount of cellulose decreases, while the whiteness degree increases. Specifically, the cellulose obtained using a 3% alkali solution had a yield of 37.5 % and a whiteness degree of 71.1 %. In contrast, the cellulose obtained using a 7% alkali solution had a yield of 33.3 % and a whiteness degree of 89.4 %. This phenomenon occurs because, at lower alkali concentrations, lignin and other hemicelluloses in the cellulose do not completely dissolve into the solution, resulting in a lower whiteness degree. The presence of lignin and other substances in the cellulose causes a brownish coloration, which reduces the whiteness of the final product. Conversely, as the amount of cellulose decreases and the whiteness degree increases, the amount of non-cellulose substances in the sample reduces.

Conclusion

In conclusion, based on our experimental results, we determined that the optimal alkali concentration for cellulose extraction is 5%. Under these conditions, the amount of cellulose

obtained was 33.3 %, and its whiteness degree was 89.4%. The cellulose produced under these conditions had a whiteness degree of 80-90%, a polymerization degree of 1110, and an ash content of 4.2%. Scientific research and investigations in this area are ongoing.

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