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PREPARATION OF TEXTILE MATERIALS FOR DYEING AND PRINTING

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The article presents data on the development of technology for the preparation of cotton fabrics for subsequent coloring processes and final finishing. Improving the quality of products in the process of preliminary preparation of fabrics is associated with the development of highly efficient technologies using textile auxiliaries, new chemical and physical methods for intensifying ongoing processes. Technologies have been developed for the preparation of cotton fabrics aimed at obtaining the required level of physical and mechanical characteristics of materials. The optimal parameters for the preparation of technological solutions, concentrations of chemicals, the ratio of components in the solution, temperature and duration of the process were selected. The qualitative parameters of the treated tissue, capillarity, degree of whiteness, and discontinuity characteristics were studied. A periodic and continuous method of preparing cotton fabrics is proposed, ensuring the removal of non-fibrous impurities from harsh fabrics, which will improve the quality of the treated fabric by increasing capillarity and whiteness, reduce energy consumption and duration of the process. The obtained research allows us to build modern and promising, economically justified technological processes for the preparation of textile materials made from natural, chemical fibers and their mixtures.

Keywords: textile materials, concomitant impurities, textile auxiliaries, finishing preparations, technological processes of preparation, decoction, bleaching, final finishing of textile materials, consumer characteristics.

ПОДГОТОВКА ТЕКСТИЛЬНЫХ МАТЕРИАЛОВ К КРАШЕНИЮ И ПЕЧАТАНИЮ

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В статье представлены данные по разработке технологии подготовки хлопчатобумажных тканей к последующим процессам колорирования и заключительной отделке. Повышение качества выпускаемой продукции в процессе предварительной подготовки тканей связано с разработкой высокоэффективных технологий с использованием текстильно-вспомогательных веществ, новых химических и физических способов интенсификации протекающих процессов. Разработаны технологии по подготовке хлопчатобумажных тканей, направленные на получение требуемого уровня физико-механических характеристик материалов. Подобраны оптимальные параметры приготовления технологических растворов, концентрации химических веществ, соотношение компонентов в растворе, температура и длительность процесса. Исследованы качественные показатели обработанной ткани, капиллярность, степень белизны, разрывные характеристики. Предложены периодический и не-прерывный способы подготовки хлопчатобумажных тканей, обеспечивающие удаление из суровых тканей неволокнистых примесей, которые позволят повысить качественные показатели обработанной ткани за счет повышения капиллярности и степени белизны, снизить энергозатраты и длительность процесса. Полученные исследования позволят строить современные и перспективные, экономически обоснованные технологические процессы подготовки текстильных материалов, изготовленных из природных, химических волокон и их смесей.

Ключевые слова: текстильные материалы, сопутствующие примеси, текстильные вспомогательные вещества, отделочные препараты, технологические процессы подготовки, отварка, беление, заключительная отделка текстильных материалов, потребительские характеристики.

ТЕКСТИЛЬ МАТЕРИАЛДАРЫН БОЯУҒА ЖӘНЕ СУРЕТ БАСУҒА ДАЙЫНДАУ

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Мақалада мақта маталарын бояу және соңғы өңдеу процестеріне дайындау технологиясын әзірлеу бойынша деректер ұсынылған. Маталарды алдын ала дайындау процесінде өнімнің сапасын арттыру, процестердің қарқындылығын арттырудың жаңа химиялық және физикалық әдістерін, сондай-ақ тоқыма-көмекші заттарды қолдана отырып, жоғары тиімді технологияларды әзірлеумен байланысты. Қажетті физикалық-механикалық сипаттамалары бар материалдарды алу мақсатында мақта маталарын дайындау технологиялары әзірленді. Технологиялық ерітінділерді дайындаудың оңтайлы параметрлері, химиялық заттардың концентрациясы, ерітіндідегі компоненттердің арақатынасы, температура мен процестің ұзақтығы таңдалды. Өңделген матаның сапалық көрсеткіштері, капиллярлығы, ағаруының дәрежесі, жыртылу сипаттамалары зерттелді. Мақта маталарын кезеңдік және үздіксіз дайындау әдістері ұсынылды, олар табиғи маталардан қоспаларды алып тастауды қамтамасыз етеді, бұл өңделген матаның сапалық көрсеткіштерін арттыруға, капиллярлығы мен ағаруының дәрежесін жақсартуға, энергия шығындарын азайтуға және процестің ұзақтығын қысқартуға мүмкіндік береді. Алынған зерттеулер табиғи, химиялық талшықтардан және олардың қоспаларынан жасалған тоқыма материалдарын дайындаудың заманауи және перспективалы, экономикалық тұрғыдан тиімді технологиялық процестерін құруға мүмкіндік береді.

Негізгі сөздер: текстиль материалдары, қоспалар, текстиль көмекші заттары, өңдеу препараттары, технологиялық процесстерді әзірлеу, қайнату, ағарту, текстиль материалдарын соңғы өңдеу, тұтынушылық сипаттамалары.

Introduction

Preparation of fabrics for dyeing and printing is a set of processes that ensure the removal of non-fibrous impurities from harsh fabrics in order to give them the ability to quickly and evenly wet with water and stable whiteness. The substances to be removed include natural impurities that accompany natural fibers, and chemical materials applied to fiber and yarn in the processes of their manufacture and processing. For fabrics made of natural fibers, such materials include natural cellulose satellites, oilers and dressings, residues of fatty and sweat substances, cellulose impurities, sericin, waxy substances, fatty emulsions and soaps applied before twisting and weaving [1-3].

Harsh fabrics containing these impurities are poorly wetted with water, it is almost impossible to get bright, uniform, saturated and durable colors on them. In the process of preparing fabrics for dyeing and printing, it is necessary to free the surface and pores of the fibrous material for subsequent interaction with the dye and auxiliary materials, to remove internal stresses that cause uneven properties, while the physico-mechanical and chemical properties of the fiber must be preserved [4-6].

At the same time, chemical reagents and textile auxiliaries used in preparatory operations should not cause the destruction of cellulose. In this regard, it is necessary to know the structure and properties of non-cellulose impurities, which must be destroyed and removed during the preparation of cotton materials [7-9].

Currently, training is carried out on continuously operating equipment or on high-performance batch machines. To increase labor productivity, separate operations are combined in the preparation of textile materials. However, in this case, it must be remembered that the properties of textile materials do not deteriorate.

The preparation of fibrous materials for dyeing and printing is a complex process and involves a large number of operations. Technological processes and equipment for chemical purification of fibrous materials are determined by the nature of impurities and the strength of their bond with the fiber, the chemical, physico-chemical structure of the fiber and its properties.

The process of preparing cotton products for dyeing and printing should be carried out under quality control, so that when the best whiteness and maximum capillarity are achieved, the cellulose is damaged as little as possible, in this regard, the development of technology for preparing cotton textile materials for dyeing and printing is an urgent scientific task [10,11].

Materials and research methods

The cotton fabric was boiled according to a periodic method in a 400 ml bath module: NaOH - 10 g/l, $Na_2SiO_3 \cdot nH_2O$- 5 g/l, OP-10 - 2 g/l, $NaHSO_3$- 10 g/l. After preparing the solution at a temperature of up to 40-50 °C, we place the samples, then raise the temperature to 80 °C and boil for 30 minutes. We wash the tested samples, squeeze them out and proceed to the next bleaching process. At the first stage of processing, the fiber swells and adsorbs caustic soda, then chemical reactions of caustic soda with impurities occur. As a result of hydrolysis, pectin substances pass into soluble compounds and are completely removed from the fiber. Nitrogen-containing protein substances are hydrolyzed to form amino acids, which, with caustic soda, give water-solu-ble salts. The remaining waxy substances are re-moved by emulsification using surfactants. The bleaching process was carried out in a 400 ml bath module: NaOH-5 g/l, Na_2CO_3- 2,5 g/l, $Na_2SiO_3 \cdot nH_2O$ – 7,5 g/l, H_2O_2- 30-40-50 g/l. Bleaching at a temperature of 90 ºC for 30 minutes. Next, washing, pressing and drying.

The cotton fabric was boiled and bleached using a continuous method in a 400 ml bath module: NaOH-12 g/l, $Na_2SiO_3 \cdot nH_2O$ – 7,5 g/l, OP-10 - 2 g/l, $NaHSO_3$ -10 g/l, H_2O_2 - 30-40-50 g/l. The temperature is 90 °C, the time is 30 minutes. The processed samples are washed, squeezed and dried.

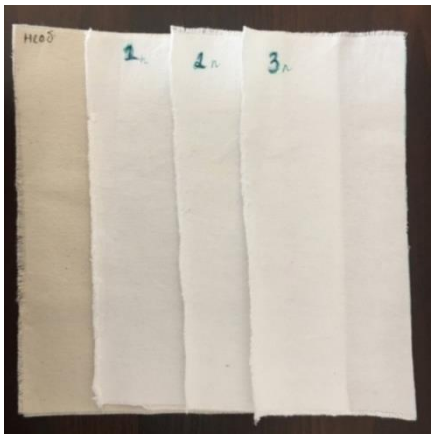
Results and discussion

The main indicators characterizing the quality of prepared textile materials are: capillarity, whiteness and degree of damage to cellulose.

Periodic and continuous methods of preparing cotton fabrics have been developed. The results of the studies are shown in Table 1 and Figure 1.

Table 1. Indicators of bleaching of samples treated in a periodic and continuous method

№	Boiling process	NaOH-10 g/l, Na_2SiO_3-5 g/l, OP-10-2 g/l, $NaHSO_3$-10 g/l		
1	Bleaching process	NaOH-5 g/l, Na_2CO_3-2,5 g/l, Na_2SiO_3-7,5 g/l.		
		H_2O_2-30 g/l	H_2O_2-40 g/l	H_2O_2-50 g/l
		Whiteness, %		
		87,8	88,5	92,8
2	Boiling and bleaching process	NaOH 12 g/l, $Na_2SiO_3$7,5 g/l, OP-10 - 2 g/l, $NaHSO_3$- 10 g/l		
		H_2O_2-30 g/l	H_2O_2-40 g/l	H_2O_2-50 g/l
		Whiteness, %		
		89,5	90,2	90,7
3	Raw material	69,04		

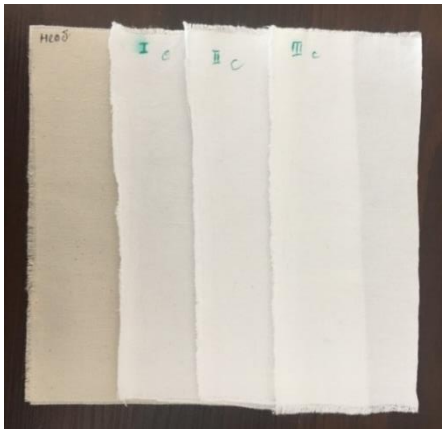


необр-raw material

1п- H_2O_2 – 30 g/l

2п- H_2O_2 - 40 g/l

3п- H_2O_2 – 50 g/l



необр-raw material

Iс- H_2O_2 – 30 g/l

IIс- H_2O_2 – 40 g/l

IIIс- H_2O_2 – 50 g/l

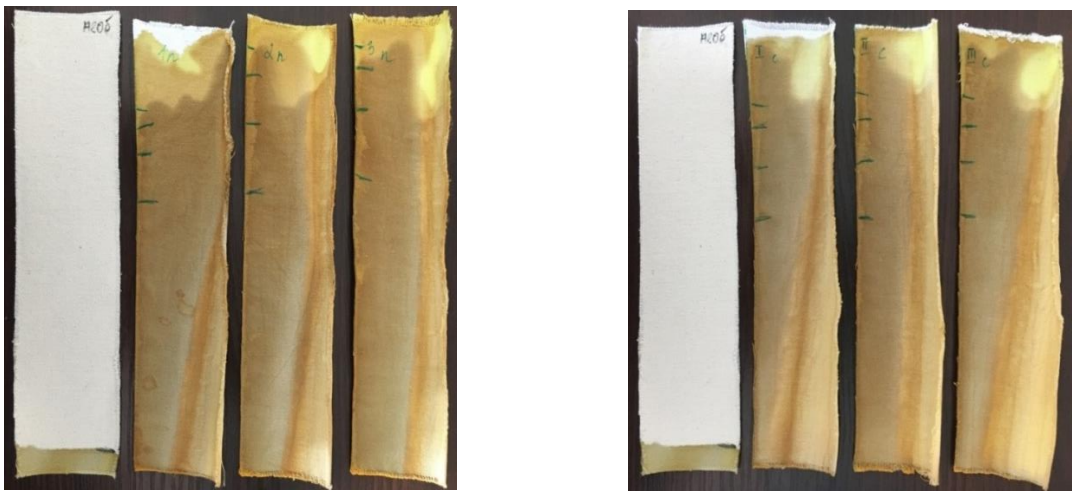
Figure 1. Comparison of the whiteness of cotton textile materials

According to the results of the study using the periodic method, the whiteness of cotton fabrics was 92,8 %, according to the continuous method 90,7 %, and the harsh sample was 68 %. In accordance with the requirements of the standards, the whiteness of linen fabrics should be at least 80 %, and for improved varieties – 83 %, the whiteness of magpie fabrics should be 87- 88 %. Based on experimental data, it was found that the preparation of cotton fabrics according to the proposed methods leads to an increase in the whiteness index in accordance with the requirements of GOST 18054-72 [12,13].

The results of determining the capillary properties of cotton fabrics are presented in Table 2 and Figure 2.

Table 2. The effect of treatment and concentration of solutions on the capillary properties of cotton fabric

№	Time, min	Raw material	Capillary properties, h, cm					
			periodic method	continuous method	periodic method	continuous method	periodic method	continuous method
			H_2O_2-30 g/l		H_2O_2-40 g/l		H_2O_2-50 g/l	
1	15	1 cm	11,5 cm	10,5 cm	12,0 cm	10,7 cm	12,6 cm	10,9 cm
2	30		13,6 cm	12,9 cm	14,9 cm	13,2 cm	15,5 cm	13,3 cm
3	45		14,7 cm	14,7 cm	17,0 cm	15,2 cm	17,2 cm	15 cm
4	60		15,5 см	15,8 см	18,1 см	16,4 см	18,2 см	16,2 см



необр-raw material

1п- H_2O_2 – 30 g/l

2п- H_2O_2 – 40 g/l

3п- H_2O_2 – 50 g/l

необр-raw material

Iс- H_2O_2 – 30 g/l

IIс- H_2O_2 – 40 g/l

IIIс- H_2O_2 – 50 g/l

Figure 2. Determination of capillarity of cotton textile materials

According to the results of studies of the capillary properties of cotton fabrics, where OP-10 was used as a textile auxiliaries, capillarity indicators reached h = 18.2 cm using the periodic method, h = 16.2 cm using the continuous method at a concentration of H_2O_2 = 50 g/l. At a concentration of H_2O_2 = 30 g/ l, the capillarity indices according to two methods were h = 15.8 cm, in contrast to the harsh sample h = 1 cm. This is due to the fact that the textile auxiliaries in the preparation process contributed most to the removal of the main part of the natural satellites of natural fiber and substances deposited on textile fibers during their processing [14].

The determination of the tensile properties of cotton fabrics was carried out according to GOST 3813-72 [15]. The results of the studies are presented in Table 3.

Table 3. Indicators of the absolute breaking load of samples according to the periodic and continuous method

№	Breaking load, F (H)								
1	H_2O_2	weft				warp			
		periodic method		continuous method		periodic method		continuous method	
		F (H)	L (mm)	F (H)	L(mm)	F (H)	L (mm)	F (H)	L (mm)
	30 g/l	391	44,51	371	54,70	266	23,79	268	23,77
	40 g/l	372	42,98	385	50,26	279	53,52	244	27,32
	50 g/l	402	46,89	369	42,56	271	59,03	266	44,63
2	raw material	344	46,79	344	46,79	286	30,84	286	30,84

It can be seen from the data that the breaking load of the continuous method decreases slightly with an increase in the concentration of H_2O_2 = 50 g/l. In the periodic method, the discontinuous characteristics do not decrease with an increase in hydrogen peroxide.

Conclusion

The preparation process was carried out according to periodic and continuous methods. According to the periodic method, the whiteness of cotton fabrics was 92,8%, according to the continuous method 90,7%, and the harsh sample was 68 %. In accordance with the requirements of the standards, the whiteness of linen fabrics should be at least 80 %. The capillarity indices were reached by the periodic method h = 18,2 cm, by the continuous method h = 16,2 cm at a concentration of H_2O_2 = 50 g/l. At a concentration of H_2O_2 = 30 g/l, the capillarity indices according to two methods were h = 15,8 cm, in contrast to the harsh sample h = 1 cm. The breaking load of the combined method decreases slightly with an increase in the concentration of hydrogen peroxide to 50 g/l. In the periodic method, the discontinuous characteristics do not decrease with an increase in hydrogen peroxide. According to the results of the study, an optimal combined method for the preparation of cellulose textile materials with a concentration of components was found: NaOH=12 g/l, Na_2SiO_3=7,5 g/l, OP-10=2 g/l, $NaHSO_3$=10 g/l, H_2O_2=40 g/l. With a continuous method, the processing process is more economical both in terms of labor productivity and in terms of removing products from 1 m^2 of production area.

Gratitude, conflict of interest (funding)

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14. GOST 3816—81 (ISO 811—81) Polotna tekstil'nye. Metody opredeleniya gigroskopicheskih i vodoottalkivayushchih svojstv [Textile fabrics. Methods of determination of hygroscopic and water-repellent properties].

15. GOST 3813—72 (ISO 5081—77, ISO 5082—82) Materialy tekstil'nye. Tkani i shtuchnye izdeliya. Metody opredeleniya razryvnyh harakteristik pri rastyazhenii [Textile materials. Fabrics and piece goods. Methods of determination of tensile breaking characteristics].