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SAFETY OF TEXTILE MATERIALS TREATED WITH ANTIMICROBIAL AGENTS

Abstract. The article is devoted about development of cellulose textile materials by sol-gel method, using safe antimicrobial agents. The influence of the sol-gel composition on the physical and mechanical properties and safety indices of textile materials were studied. Comparison obtained burst load data processed materials showed that a gelatin-based composition have reduced burst load parametersthan liquid glass . According to the results of the study, titanium dioxide has the lowest antimicrobial activity than zinc chloride. Optimal technological regimes for the production of antimicrobial cellulose textile materials have been developed.

Key words: sol-gel, ecological safety, antimicrobial activity, final finishing of textile materials, sodium metasilicate, gelatin, titanium dioxide, zinc chloride.

Introduction. The problem of clothing security is most relevant for the population. In addition, the trend of increasing use of materials from chemical fibers and threads, as well as their chemical finishes, along with economic advantages, also carries serious risks to human health.

A serious problem for the hygienic assessment of modern textiles is textile-auxiliary substances, the main component of which is formaldehyde, which belongs to the second class of danger, has a general toxic, irritant, allergenic, mutagenic, carcinogenic effect, causes damage to the central nervous system, lungs, liver , kidneys, organs of vision. The concentration of free formaldehyde in tissues exposed to additional final finishes with preparations based on precondensates of thermosetting resins is especially great. The allocation of chemical volatile substances in this case should not exceed the standards specified in TR TS 017/2011 "On the Safety of Light Industry Products".

The creation of materials with new preset properties is possible on the basis of chemical, colloidal processes. The technology of obtaining materials with certain chemical and physico-mechanical properties, including obtaining the sol and transferring it to the gel. Today's sol-gel technology is a way of obtaining multicomponent gels of high homogeneity and purity with the subsequent conversion into gel into: films, fibers, powders, monolithic, porous products [1].

Analysis of the literature showed that the sol-gel method in the final finishing of textile materials, as well as the safety study of these materials is still at the study stage.

In this regard, the development of a technology for the production of antimicrobial cellulosic textile materials and the study of the safety of these materials treated with antimicrobial preparations using sol-gel technology [2, 3], which

simultaneously will not only reduce the resource costs, the availability of reagents and equipment, is topical.

Safety of light industry products is estimated by the following indicators:

– mechanical (breaking load, strength of fastening, flexibility, impact strength);

– chemical (the maximum permissible release of harmful chemicals into the air and (or) aquatic environment, the list of which is determined depending on the chemical composition of the material and (or) the purpose of the product);

– biological (hygroscopicity, air permeability, water resistance, electrostatic field strength, toxicity index or local irritant effect, color stability).

To obtain antibacterial textile materials, antimicrobials and conditions for the synthesis must be appropriately selected. Using appropriate synthesis conditions and careful selection of biocides, a large amount of biocide can be incorporated inside the silica matrix, so that the biocide becomes effective [4, 5].

MATERIALS AND METHODS

Materials. The object of the study was 100% bleached cotton linen fabric with article 1030 and a surface density of 147 g / m^2.

Preparation of samples. For the sol-gel composition the following components were chosen: liquid glass concentration 5-10 g / l, gelatin 10-20 g / l, titanium dioxide, zinc chloride concentration 5-10 g / l, water solvent. After stirring the solution for 5-7 minutes, HNO3 3-5 ml / l or sodium carbonate 10-15 g / l (in portions) was added to the magnetic stirrer at room temperature, to a pH of 10-11.

Then, impregnation of tissue samples was carried out at room temperature for 2-4 minutes. After impregnation, the tissue was squeezed to a weight gain of 90-100%. Further, the samples were dried in a oven for 8-10 minutes at 70-90 °C. The heat treatment was carried out at temperatures of 100, 125, 150 ° C for two minutes.

Research methods. The tensile strength of the fabric was measured on a tensile machine RT-250M (Russia) in accordance with GOST 3813-72. "Textile materials. Fabrics and piece goods. Methods for determining tensile properties of tensile properties".

According to GOST 9.060-75 Unified system of protection against corrosion and aging. Fabrics. "The method of laboratory tests for resistance to microbiological destruction determined the biostability of tissues in laboratory conditions".

In accordance with GOST 12088-77 "Textile materials and products made of them". The method for determining air permeability was carried out on a machine MT-160 (Russia).

Determination of low-fissility of the fabric was carried out on a machine MT-022 (Russia) in accordance with GOST 19204-73 "Textile fabrics. Method for determination of non-rupture".

RESULTS AND DISCUSSION

It is known that the finishing or coating of fibers can reduce the resistance of the tissue to rupture, so studies have been carried out to identify this fact, and the biostability of tissues in the laboratory has been determined, the results are shown in table 1.

Table 1 – Parameters of the absolute breaking load of the modified samples, kgf before and after biodegradation

№	Concentration of components		The catalyst	Heat treatment, °C	The absolute breaking load, kgf			
					ducks		the substrate	
					F	L	F	L
1	TiO_2/ZnC_2 5g/L	Na_2SiO_3 5-10 g/L	HNO_3 3-5 m/L, $NaHCO_3$ 10-15 g/L	100	17.6	43.1	17.3	26.7
					17.2	38.2	16.4	28.1
				125	16.3	25.1	18.7	30.1
					16.8	26.7	18.4	33.1
				150	14.8	42.6	19.4	42.4
					14.1	39.2	18.3	29.9
2	TiO_2/ZnC_2 5 g/L	Желатин 20 g/L		100	17.8	38.6	18.4	48.4
					18.1	39.1	17.4	49.6
				125	13.2	37.8	20.2	56.1
					12.8	36.2	18.2	49.1
				150	13.1	41.7	17.8	37.9
					12.0	40.2	16.2	58.7
3	Untreated sample				13.8	45	14.1	39.3

The obtained burst load data in comparison with liquid glass and gelatin showed that the processed materials with a gelatin-based composition have reduced burst load parameters, possibly due to an increase in the gelatin concentration to 20 g / L, a liquid glass concentration of 5-10 g / L, or a different the structure of precursors affecting textile material.

With increasing heat treatment temperature, the breaking load of the treated fabric is reduced. This is due to the fact that in the process of polymerization of the nanoscale solution and the formation of a polymer film on the fiber, the mutual mobility of macromolecules decreases.

Two antimicrobial agents were used, according to the results of the study, titanium dioxide has lower antimicrobial activity results than zinc chloride. This is evidenced by the results of the burst load after biodestruction, the strength indexes decreased by 3-5%.

Mildewedness was estimated from the total opening angle of fabric folds on the basis and weft in accordance GOST 19204-73 on the SMT instrument. The results are represented in table 2.

Table 2 – Effect the concentration of components of the composition on indices of low crumeness of cotton fabric

№	Concentration of components		Catalyst	Heat treatment, °C					
				100		125		150	
				ducks	the substrate	ducks	the substrate	ducks	the substrate
1	$TiO_2/ZnCl_2$ 5 g/L	Na_2SiO_3 5-10 g/L	HNO_3 3-5 ml/L, $NaHCO_3$ 10-15 g/L	125	95	115	90	105	95
				220		205		200	
2	$TiO_2/ZnCl_2$ 5 g/L	Желатин 20 g/L		120	115	115	105	105	95
				235		220		200	
3	Untreated sample			ducks		the substrate			
				105		95			
				200					

The analysis of the results showed that in the samples treated with the proposed compositions, compared to non-impregnated tissue, the low-crease results are increased. With an increase in the concentration from gelatin to 20 g /Ll, the result of low crushing was 235 degrees, with a slightly higher temperature of heat treatment.

For many textiles, air permeability of the fabric is an important property, and studies have been carried out in connection with this. The results are shown in table 3. Based on the results obtained, it has been shown that the treatment of cellulosic materials using a sol-gel method based on liquid glass and gelatin does not lead to disruption of air and steam exchange, does not prevent the transport of moisture vapors from the surface of the human skin to the outer surface of materials, which ensures the maintenance of normal functions of thermoregulation of the human body.

Table 3 – Indices of air permeability of processed samples

№	The concentration of the components		The catalyst	Air permeability, $dm^3/m^2 \cdot s$		
				Heat treatment, °C		
				100	125	150
1	$TiO_2/ZnCl_2$ 5 g/L	Na_2SiO_3 5-10 g/L	HNO_3 3-5 мл/л, $NaHCO_3$ 10-15 g/L	169,9	168,1	162,5
2	$TiO_2/ZnCl_2$ 5 g/L	Gelatin 20 g/L		168,5	167,3	166,8
3	Untreated sample			166		

Conclusion.

1. Modified cellulose textile materials were taken using safe antimicrobial preparations with a sol-gel method;

2. When the temperature is raised to 150 ° C, a certain decrease in the strength parameters is observed. The results of the burst load after biodegradation showed a decrease in strength parameters by 3-5%;

3. Based on the results of the study, titanium dioxide has lower antimicrobial activity values than zinc chloride;

4. Studies of air permeability showed that with increasing temperature and concentration of liquid glass and gelatin, a slight decrease in air permeability occurs from 169.9 at 100 ^{0}C to 162.5 at 150 ^{0}C;

5. According to the results of the study of low-purity, it has been established that with an increase in the gelatin concentration to 20 g / L, the indices increase from 200 degrees to 235 degrees.

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Резюме

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АНТИМИКРОБТЫҚ ПРЕПАРАТТАРМЕН ӨҢДЕЛГЕН ТЕКСТИЛЬ МАТЕРИАЛДАРЫНЫҢ ҚАУІПСІЗДІГІ

Статияда золь-гель әдісін қолдану арқылы антимикробтық целлюлозалық модифицирленген текстиль материалдарын алу тәсілі жазылған. Қауіпсіз препараттар арқылы целлюлозалық модифицирленген текстиль материалдарын алу технологиясы жасалды. Ұсынылған тәсіл мақта мата үлгілерін золь-гель композициясына сіндіріп, содан кейін кептіру және термиялық өңдеуден өткізуден тұрады.

Модифицирленген үлгілердің беріктігіне және микробиологиялық тұрақтылығына шыны сұйықтығы мен желатин концентрациясының әсері зерттелді. Аппретеу үшін оптимальды келесідей параметрлер ұсынылды: сұйық шыны концентрациясы 5-10 г/л, азот қышқылы концентрациясы 3-5 мл/л, цинк хлориді концентрациясы 5 г/л және термоөңдеу температурасы 125 °С. Жасалынған текстиль мате-

риалдарын өңдеу технологиясы текстиль материалдарының гигиеналық және эксплуатационды қасиеттерін сақтай отырып антимикробтық белсенділікті қамтасыз етеді.

Түйін сөздер: золь-гель, экологиялық қауіпсіздік, антимикробты өңдеу, текстильматериалдарын соңғы өңдеу, натрий метасиликаты, желатин, цинк хлориді.

Резюме

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БЕЗОПАСНОСТЬ ТЕКСТИЛЬНЫХ МАТЕРИАЛОВ, ОБРАБОТАННЫХ АНТИМИКРОБНЫМИ ПРЕПАРАТАМИ

Описан способ получения антимикробных целлюлозных текстильных материалов с применением золь-гель метода. Разработана технология модифицирования с применением безопасных препаратов. Предложенный способ состоит в последовательной пропитке образцов хлопчатобумажной ткани в золь-гель композиции с последующей сушкой и термической обработкой.

Исследовано влияние концентрации жидкого стекла и желатина на устойчивость к микробиологическому разрушению и прочностные свойства модифицированных образцов. Выявлено, что оптимальными параметрами для аппретирования являются: концентрация жидкого стекла 5-10 г/л, концентрация азотной кислоты 3-5 мл/л, концентрация хлорида цинка 5 г/л и температура термообработки 125 °С. Разработанная технология отделки текстильных материалов обеспечивает антимикробную активность текстильного материала с сохранением гигиенических и эксплуатационных свойств..

Ключевые слова: золь-гель, экологическая безопасность, антимикробная активность, заключительная отделка текстильных материалов, метасиликат натрия, желатин, диоксид титана, хлорид цинка