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SIMULTANEOUS DYEING AND ANTIMICROBIAL FINISHING OF TEXTILE MATERIALS USING THE SOL-GEL METHOD

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Abstract. Proposed technological solutions of combined processes of dyeing and finishing of cotton fabrics with direct dyes using sol-gel method. Regularities of changing colors and antimicrobial activity of direct dyes, dyed textile materials when using aqueous liquid glass and zinc acetate. The possibility of combining the dyeing with direct dyes final finish.

Key words: final finishing, dyeing, combined processes, the sol-gel method, antimicrobial properties

In the finishing of textile industry production, as in any other industry, acute ecological problems of production, conserve natural resources and energy, because the coloring technology and final finishing of fabrics involves toxic chemicals and dyes with a large consumption of water and electricity.

Development of resource-saving, low-cost, environmentally sound technologies coloring based on domestic preparations, with the possibility of combining with the final finish is actual scientific task that has a large practical value [1].

With the advent of new methods is possible the creation of a large diversity of colors and special effects on textile materials. Sol-gel method is more applicable in coloring textile materials, as well as in finishing textile material with special properties, as binders.

Using this method, you can achieve high results, reduce skill with technological and economic costs in the processes of dyeing and special finishing textile materials of different fibre composition.

A method of sol-gel analysis now, has not yet found widespread use in combined processes of coloring and finishing of textile materials. Purpose of the project is the development of the combined technology of dyeing and antimicrobial finishing of cotton textile material.

Significant value in coloring textile materials has a selection of colours, sometimes a mixture of dyes, the use of auxiliary substances, like the choice of technology. One of these solutions is the sol-gel method to obtain materials with certain chemical and physico-mechanical properties, including receipt of zola and gel.

All major processes occurring during the sol-gel transition, and products obtained by sol-gel synthesis, schematically depicted in accordance with figure 1, where marked:

I. The maturation of zola and gelation: sol (1) → gel (2);
II. Dryer in supercritical conditions or washing gel in solvents: gel (2) →
III. aerogel (3);
IV. Drying under normal conditions: gel (2) → xerogel (4);
V. Deposition of nanoparticles: sol (1) → powder (6);
VI. Drawing of zola on substrate: sol (1) → film xerogel (7);
VII Roasting: xerogel (4) or film xerogel (7) → monolithic materials (5) or films and coatings (8).

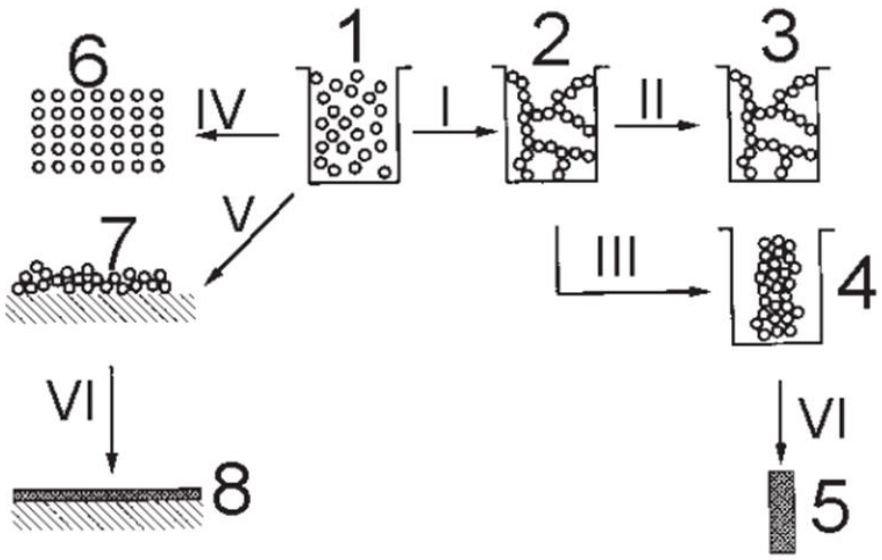

Figure 1. Schematic diagram of the production of various materials, coatings and powders by the sol-gel technology

As a rule, for the realization of the sol-gel processes used two traditional approach [2,3]:

- colloid method - hydrosols gel-processing, which occurs due to the association of particles of an aqueous suspension (for example, through hydrogen bonds between groups belonging to different particles). A variation of this method is the direct precipitation and polymerization of hydrated oxides of chemical elements from solutions of their salts, for example, from soluble silicates;

- alkoxide method - hydrolytic polycondensation of the starting compounds (alkoxides, nitrates, etc.) in water-organic media, followed by drying the products, either in atmospheric or in supercritical conditions.

The first sol - gel composition was developed on the basis of the alkoxide method; the film-forming solution consists of: a water-alcohol solution of tetraethyl orthosilicate, with the addition of zinc acetate and an active dye. The textile material acquired a uniform color, since the solution consists of 80% water, which promotes good dissolution of the dye in the sol – gel composition [4]. However, the proposed technology contains components of high cost, their use is disadvantageous for the mass consumer.

An alternate method is to use non-hydrolytic method, which is in collaboration with metal halide donors oxygen-alkoxide metals, waterless environment. Soluble liquid glass is products inorganic synthesis and produced in all industrialized countries. Interest in these technical products has increased significantly in recent years. It is determined by a wide range of their valuable properties, environmentally friendly production and use, inflammability and not toxicity, as well as in many cases the cheapness and availability of feedstock [5].

For the preparation of the second sol-gel solution, as a major component of using aqueous solution of liquid glass, with the addition of dye. Further processing in a solution containing zinc acetate figure 2.

Assessment carried out on indicators coloristic spectrophotometer "Minolta", a specialized technique. The results obtained for the intensity of the colors prove similar effects on the surface of the fabric painted nanomesh direct dyes. Increase the intensity of the coloration is achieved when using zinc acetate and high concentrations of sodium silicate.

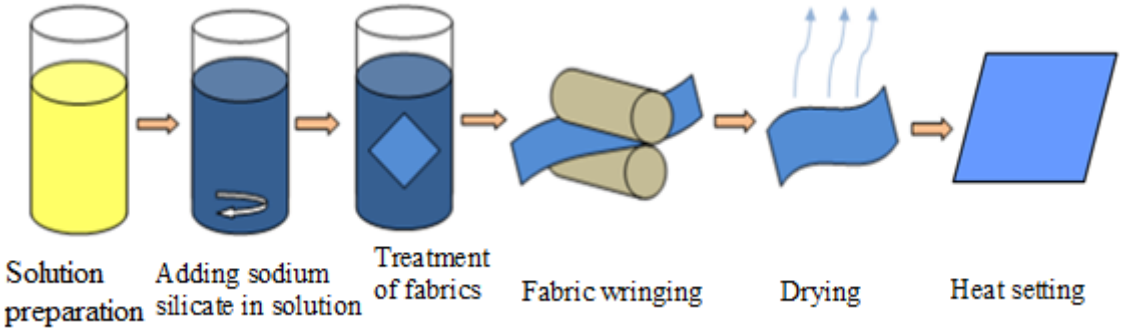

Figure 2**.** Stages of fabric processing

Study on the identification of the antimicrobial activity of textile materials held in accordance with the GOST P ISO 13629-1-2014. Investigated antimicrobial activity against microorganisms Aspergillus, Penicillium, E.Coli.

The results found that after dressing developed compositions of cellulose textile materials acquire antimicrobial properties. The magnitude of the delay zone amounted E.Coli - 5 mm, Penicillium-2 mm, Aspergillus – 3 mm.

Developed by the second method of colouring cotton fabric has large techno-environmental advantages allows dyeing at a respectable rate, combine painting and final finishes, which contributes to improvement of aesthetic and performance properties of textile material, as well as cost reduction applied chemical materials, water, electricity.

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