

BIOCIDAL COPPER IMPREGNATED COTTON

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Contaminated textiles in hospitals contribute to endogenous, indirect-contact, and aerosol trans-mission of nosocomial related pathogens. Copper impregnated cotton have wide-spectrum anti-microbial, antifungal, and antiviral properties. The cost of materials made of copper is considerably lower than those of silver. For the moment, cotton fabrics with the additives of copper are not commonly used in practice. Chinese producers offer knitted antimicrobial medical and sports fabric from a mixture of cellulose and polyester fibres. Israeli physicians within 6 months investigated the influence of antimicrobial copper tissue on 60 patients with traumatic brain injury and have seen good results in most cases with about 25% reduction of hospital length of stay and also 32% reduction of antibiotic administration [1]. The paper offers the method for producing of cotton and linen antibacterial fabric. The technology for producing such fibres consists of the following operations: cotton or linen fabric is impregnated with a complex-formative solution dissolving cellulose surface on which a complex compound is subsequently formed; then the fabric is treated with an alkali solution and a reducing agent (it reduces the complex compounds in copper nanoparticles); further the resultant product is washed with water and dried. The content of copper nanoparticles in the fabric can be as high as approximately 3-4 %. Currently, the technology for producing the fibres in laboratory has been developed. High magnification microscopy images of the fabric surface are presented in Fig. 1-3.



Figure 1. 5x magnification



Figure 2. 100x magnification

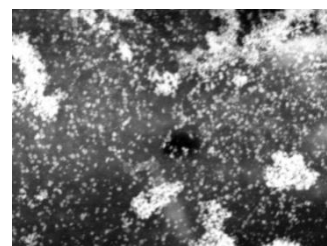


Figure 3. 10000x magnification

The antibacterial activity of cotton or linen fabric was studied according to standard methods on *Coliform bacteria* and *Staphylococcus aureus*. The biocidal cotton can be used for producing a large range of products, including clothing, bedding, napery, drapery, bandages and dressings for household applications and in medical institutions. Since copper nanoparticles and cellulose form chemical bonds to each other, the fabric withstands 20 washing cycles at hospital washing standards and retains its antibacterial properties. It is also possible to use the line technology for dyeing of the fabrics with small modification. The biocidal copper impregnated cotton has been developed at Southwest State University (Russia) in laboratory conditions. It was established the composition of the complex-formative solution, the required ratio of the amount of solution to the amount of fabric at impregnating of copper nanoparticles, impregnating temperature, concentration of alkali, temperature of washing and drying. Further, we made X-ray diffraction diagrams of the fabric and also got photographs of the fabric surface (Fig. 1-3) by scanning electron microscope. It was important to determine the optimal size of copper nanoparticles (40-50 nm) and study the mechanism of nanoparticles interaction with cellulose by means of IR-spectroscopy and Raman spectroscopy. Oxidation of copper with formation of a thin copper oxide layer does not alter significantly the fibres antibacterial properties. The copper impregnated cotton has dark-red colour.

[1] A. Lazary, I. Weinberg, J.-J. Vatine, A. Jefidoff, R. Bardenstein, G. Borkow, N. Ohana. *International Journal of Infectious Diseases*, Volume 24, 2014, Pages 23–29.