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MODIFICATION OF DISULFIDE BONDS OF KERATIN DURING ELECTRIC DISCHARGE TREATMENT OF WOOL

The use of electric discharge non-linear bulk cavitation (EDNBC) is an effective, economical and environmentally friendly method of modification of wool with the aim of improving the quality of manufactured woolen material [1].

During electric discharge treatment the wool undergoes simultaneous physical and chemical effect. The major factors that have the most significant impact on the process of modification of wool fibers are a direct effect of the electro-hydraulic shock and water cleavage products generated in the working environment under the influence of cavitation. Reactions of keratin which occur during electric discharge treatment in an aqueous environment, are of particular interest because of the large number of cystine bonds which are particularly sensitive to various chemicals.

It was established experimentally that the electric discharge treatment reduces the oxidation-reduction potential of water, due to the formation of hydrogen atom and hydrated electron which are active reducing agents. Thus, the chemical processes occurring during the electro-hydraulic action on the water during the treatment of the wool fiber, will be primarily a reducing nature.

However, during the electric discharge treatment is not possible to completely separate the physical and chemical effects on the treated material. Based on a comprehensive analysis of the processes occurring during the electric discharge treatment, the probable mechanism of modification of wool fiber are proposed.

We assume that under the influence of atomic hydrogen produced in the water at electric discharge treatment of wool fibers interpeptide disulfide bonds are cleaved, cystine goes into cysteine. Furthermore, polypeptide chains with the recovered cystine bonds can move freely relative to each other under the influence of the electro-hydraulic shock. Under the action of oxidizing agents present in the working environment, the sulfhydryl groups of cysteine can be easily re-oxidized to form new cystine bonds. In addition, during cavitation treatment reactive SH-groups can enter into chemical interaction to form other, more stable cross-linkages $–CH_2–S–CH_2–$.

In order to study changes in the chemical structure of wool after electric discharge treatment conducted research using the method of infrared spectroscopy. A comparison of the IR spectra of the modified and untreated wool found that the main changes are related to intermolecular structural changes of hydrogen bonded NH-groups. In the pre-modified samples increases the number of associated NH-groups, which confirms the reallocation of cross-linkages in wool keratin under the influence of EDNBC.

Thus, in the process of electric discharge treatment under the complex influence of EDNBC occur modification of disulfide bonds of wool keratin, leading to a change in its native properties. Formation of new cross-linkages in keratin lead to increased strength, increased resistance to hydrolysis action of oxidizing and reducing agents, as well as reduced tendency to felting of fiber.

Literature

1. Asaulyuk T. The influence of electrical discharge pretreatment on the surface fiber properties during bleaching of wool // T. Asaulyuk, O. Semeshko, S. Myasnykov // Study of problems in modern science: new technologies in engineering, advanced management, efficiency of social institutions. Monograph: edited by Y. Shalapko, Z. Wyszkowska, J. Musial, O. Paraska. – 2015. – 753 p. (P. 159-169).