ABSTRACT

Natural cellulose fibers are high-molecular polymers that are strongly susceptible to microbial degradation. Fungal and bacterial attack on the fibers cause depolymerization of cellulose macromolecules, which is reflected in decreased molecular weight and strength, increased solubility and a changed crystallinity. Although biodegradable textile fibers are classified as environmentally-friendly materials, the biodegradation process that occurs when the textile product is still in use could cause serious functional, aesthetic and hygienic problems because of textile deterioration, staining, discoloration and odor. To protect the cellulose against biodegradation, chemical modification is of great importance. In this chapter, therefore, fibers were chemically modified by the use of an antimicrobial finish on the basis of AgCl (AG) in combination with a reactive organic-inorganic binder (RB), water and oil repellent finishes on the basis of fluoroalkylfunctional siloxane (FAS), perfluorooctyltriethoxysilane (PFOTES) in combination with di-ureapropyltriethoxysilane [bis(aminopropyl)terminated-polydimethylsiloxane (1000) (PDMSU) and aminopropyl-perfluoroisooctyl polyhedral oligomeric silsesquioxane ($AP_2PF_2IO_4$ POSS), as well as with an easy-care and durable press finish on the basis of imidasolidinone (DMeDHEU). Moreover, it was expected that these finishes would provide the active or passive antimicrobial properties of the modified fibers. Biodegradation of the finished cellulose fibers was carried out by the soil burial test according to SIST EN ISO 11721-2:2003. The chemical and functional properties of the fibers were determined by means of DP, SEM, AFM, FT-IR, XPS, ICP-MS, appropriate microbiological tests and static contact angle measurements of different liquids on the fiber surface. It can be seen from the study that AgCl embedded in RB imparts active antibacterial and antifungal properties to the coated fibers resulting in excellent microbial reduction and, consequently, strong inhibition of biodegradation. The presence of FAS, PFOTES-PDMSU and $AP_2PF_2IO_4$ POSS coatings, which cause an increase in fiber hydrophobicity, as well as a high drop in surface free energy, results in

decreased adhesion of microorganisms and impaired conditions of their growth. In the modification process of cellulose fibers by DMeDHEU, the formation of covalent bonds between the finish and the cellulose macromolecules strengthens the less ordered amorphous regions, resulting in a decrease of fiber swelling. This inhibits the penetration of microorganisms into the fibers, where biodegradation takes place. By applying a combination of FAS and DMeDHEU finishes, a synergistic action of the components is obtained in the coating. In this case, the protective properties of the coating against biodegradation are much higher than those obtained by single component finishing.

Key words: cellulose, biodegradation, chemical modification, finishing, antimicrobial, water and oil repellent, durable press, soil burial test, microbial growth inhibition.