

Development of Superhydrophobic Cotton Fabrics and Their Functional Properties

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Abstract : The present study is focused on the development of multifunctional cotton fabric while having good physiological comfort properties. The functional properties developed include superhydrophobicity (Lotus effect) and UV protection. For this, TiO₂ nanoparticles along with fluorocarbon and organic-inorganic binder have been used to optimize the multifunctional properties. Deposition of TiO₂ nanoparticles with water repellent finish on cotton fabric has been carried out using the pad dry cure method at fix parameters. The morphology and elemental composition of as-deposited particles have been studied by using SEM and EDS. The chemical composition of nanoparticles was determined using energy dispersive spectroscopy. The treated samples exhibited excellent water repellency and UV protection factor. The study of the comfort properties of fabric showed that it had excellent physiological comfort properties. Optimized concentration of water repellent chemical (50g/l) was used in formulations with TiO₂ nanoparticles and organic-inorganic binder. Four formulations were prepared according to the design of the experiment. The formulations were applied to the cotton fabric by roller padding at room temperature (15-20°C). Surface morphology was investigated via SEM images. EDS analysis was also carried out to analyze the composition and atomic percentage of elements. The water contact angle (WCA) of cotton fabric increases with increase in TiO₂ nanoparticles concentration and reaches its maximum value (157°) when the concentration of TiO₂ is 20g/l. The water sliding angle (WSA) decreases and gains minimum value at the same concentration of TiO₂ at which WCA is highest. It was seen samples treated with formulations of TiO₂ nanoparticles exhibits excellent UPF, UV-A and UV-B blocking. However, there was no significant deterioration of air permeability. The water vapor permeability was also slightly decreased (4%) but is acceptable. It can be concluded that there is no significant change in both air and water vapor permeability after nanoparticles coating on the surface of the cotton fabric. The coated cotton fabric has little effect on the stiffness. The stiffness of coated samples was not increased significantly; thus comfort of cotton fabric is not decreased. This functionalized cotton fabric also exhibits good physiological comfort properties. "The authors are also thankful to student grant competition 21312 provided at Technical University of Liberec".

Keywords : comfort, functional, nanoparticles, UV protective

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