Ecofriendly and Colorful Superhydrophobic Fabric Fabricated by Disperse Dyeing Process

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Introduction

Superhydrophobic technologies have been developed only by focusing on industrial materials and with little consideration for clothing materials. Therefore, the methods using nanoparticles and perfluorinated compounds (PFCs) have numerous problems such as surface color change (Sasmal, A. K. et al., 2014), decrease of breathability (Wang et al., 2014) and handle, and environmental and health problems (Kim et al., 2007, Lindstrom, A. B.et al., 2011). In addition, the developed white or dark colored superhydrophobic textiles (Park et al., 2016) have limitation to be used as fashion textiles. Therefore, superhydrophobic technologies considering not only superhydrophobicity but also aesthetic aspects and human-friendliness are necessary. Furthermore, in order to display superhydrophobicity, extra coating process with hydrophobic chemicals necessarily need for colorful polyester fabrics dyed with conventional disperse dyeing process (Xue, 2013). Thus, in this study, without adding any process to conventional disperse dyeing process, we fabricated colorful fluorine-free superhydrophobic polyester fabric via controlling the conditions of conventional disperse dyeing process.

Research Method

The conventional polyester dyeing process with disperse dye was modified to create a streamlined process for the colorful fluorine-free superhydrophobic polyester fabric. Two kinds of dyestuffs were used. Wettability was evaluated with static contact angle and shedding angle and color change was characterized with a spectrophotometer. Color fastness against light, abrasion and washing was also analyzed. Water vapor transmission rate and air permeability were measured.

Results and Discussion

After alkaline hydrolysis, the pre-treatment of conventional dyeing processing, the surface of polyester kept its nanocraters. Furthermore, owing to thermal hydrophobic aging process during drying, the developed polyester fabric showed superhydrophobicity exhibiting the static contact angle of 163.7°±2.6° and shedding angle of 9.3°±1.1°. Regardless of chemical structures of dyestuffs, color strength was reinforced after alkaline hydrolysis, but the polyester fabric dyed with antraquinone dyestuff had decreased color strength after drying process, with the decrease of ΔE value by 2.7. On the other hand, the polyester fabric dyed with coumarin dye showed stronger color after drying process, increasing ΔE value by 4.06. Not only color fastness but also water vapor transmission rate and air permeability of the superhydrophobic polyester fabric were improved.

Conclusion

We successfully made the colorful fluorine-free superhydrophobic polyester fabric through disperse dyeing process. The fact that, without any additional process, the colorful superhydrophobic polyester can be fabricated by modifying the conventional dyeing process is of great importance. Additionally, technologies that take not only superhydrophobicity into account, but also aesthetic aspects and human-friendly have very important academic and industrial significance. Therefore, the developed colorful fluorine-free superhydrophobic polyester fabric has the potential for commercial production and could be extensively applied in indoor or outdoor clothing and many other fields.

References

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