Durable Bio-Based Multifunctional Coatings for Cotton and NyCo Fabrics

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Abstract

Bio-based compounds have attracted increasing attention as functional components of textile coatings because they can provide multiple protective properties while reducing reliance on conventional synthetic additives. Phytic acid (PA) provides a phosphorus-rich source for promoting char formation, while tannic acid (TA) supports the development of a carbonaceous layer and improves UV absorption. However, the practical application of such coatings depends on their ability to retain these functions after repeated laundering. In this study, cotton and nylon/cotton (NyCo) fabrics were functionalised with a multilayer coating composed of PA and TA coordinated with Zn2+ and Y3+ ions, with emphasis on the durability of their flame-retardant and UV-protective performance.
The morphology and elemental composition of the coated fabrics were examined by scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy (SEM-EDS). Flame-retardant performance was evaluated using limiting oxygen index (LOI) measurements and vertical flame tests, while UV protection was assessed through the ultraviolet protection factor (UPF) and UVA and UVB transmittance. Coating durability was investigated by repeating the morphological and functional analyses after laundering.

The treatment increased the LOI from 17.4 % to 28.6 % for cotton and from 17.8 % to 26.8 % for NyCo. The UPF increased from 1.32 to 17.83 for cotton and from 11.78 to 23.25 for NyCo, together with lower UVA and UVB transmittance. SEM-EDS analysis confirmed that P, Zn and Y remained present on the surfaces of the treated fibres after washing. The treated fabrics also retained improved flame-retardant and UV-protective performance compared with the untreated materials. The findings demonstrate the potential of PA/TA-Zn/Y systems as durable bio-based multifunctional treatments for protective textile applications.
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Keywords: coatings, phytic acid, tannic acid, flame retardancy, UV protection, washing durability, cotton, NyCo fabrics

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