

Surface Functionalization of Textiles with Fluorine-Free Bio-Based Coatings: Crosslinking Effects on Hydrophobicity and Network Formation

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Textile fabrics endowed with functional properties have garnered increasing attention due to their broad range of applications and the growing demand for enhanced performance, durability, and comfort. Among these functionalities, water repellency is particularly important for both everyday apparel and technical textiles. Although water repellency has traditionally been achieved using fluorinated compounds, substances such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) have raised serious environmental and health concerns due to their persistence and bioaccumulative nature, leading to stringent regulatory measures. Consequently, research has increasingly focused on the development of high-performance, fluorine-free alternatives, such as silicone-based or short-chain non-fluorinated substances [1], as well as emerging solutions based on biodegradable polymeric coatings, further supported by recent advancements in nanotechnology and polymer science [2].

In this study, the performance of two fluorine-free, bio-based acrylic polymers in imparting durable water repellency to cotton and polyester fabrics was evaluated. The textiles were treated with the bio-based formulations at different concentrations via a pad–dry–cure process, and subsequently characterized before and after washing cycles using FTIR spectroscopy and scanning electron microscopy (SEM) to investigate the chemical composition, the surface morphology and the network formation of the coatings, as well as the coating adhesion. Water repellency was assessed through static contact angle measurements and ISO 4920 spray ratings, allowing for the evaluation of the effects of crosslinking on both hydrophobic performance and coating durability.

The results confirm the effectiveness of the tested bio-based, fluorine-free resins in delivering sustainable and durable water-repellent finishes, with properties that make them suitable for multifunctional textile treatments.

References

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