DEVELOPMENT OF SUSTAINABLE NON-FLUORINATED HYDROPHOBIC TREATMENTS FOR CONSERVATION OF TEXTILES

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ABSTRACT

The aim of this research is to develop a sustainable non-fluorinated treatment to protect cotton textiles from aging, hence protecting them from liquid water and degradations forms related to water contact. The proposed treatment aims at safeguarding historical textiles, which are part of our cultural heritage, such as tapestry, carpets, costumes and laces [1]. The developed fabric treatment is proposed for water repellent outdoor garments and sportswear as well in force of the valuable results. A 2% microemulsion of poly(carbonate-uretane) and silicone was created in water and isopropanol (1:1) and applied onto cotton by spray and/or dip-coating, that are facile and scalable methods. All the treatments conferred high hydrophobicity to cotton fabric with static contact angles between 143° and 147°. In order to quantify water droplet spreading in long term contact, 1 mL water droplets were colored with red colorant and were deposited on the treated fabrics' surface at room conditions. All the treated cotton fabric displayed high performance in terms of long term wettability, because at room temperature water did not penetrate through the textile, rather it evaporated leaving a contact area corresponding to the deposited droplets deposited on the fabrics. To prove this, pictures of the uncolored backside of the textiles were taken as well. SEM-EDX analyses highlighted how the product encapsulated individual fibers, penetrating deep in the core of the threads and ensuring a uniform coating. Despite this, the treatments are not altering vapor permeability (or breathability) of the cotton fabrics, allowing the water vapor to flow through the textiles, hence avoiding humidity to accumulate and biodegradation to occur. Similarly, the mechanical properties of the treated cotton fabric remained unchanged as confirmed by Peirce cantilever test (ASTM D1388)[2] and stress-strain mechanical test. The micro-emulsion application guaranteed multi-directional flexibility and structural stability. More importantly, the as-treated cotton fabrics were also characterized for their color variation that is strongly coupled with aging. According to the CIEL*a*b system, all treated samples had an overall color variation lower than the variation detectable by human eyes ($\Delta E = 3$) not only after being treated but even after undergoing 7500000 lux·hours radiation, comparable to five years of exposure in the National Gallery (UK)[3].

Bibliography

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