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Fabric Softener Deposition on Cellulose Nanocrystals and Cotton Fibers

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Abstract : Fabric softeners are aqueous formulations that contain ~10 wt. % double tailed cationic surfactants. Here, a formulation in which 50% surfactant was replaced with low quantities of natural guar polymers was developed. Thanks to the reduced surfactant quantity this product has less environmental impact while the guars presence was found to maintain the product's performance. The objective of this work is to elucidate the effect of the guar polymers on the softener deposition and the adsorption mechanism on the cotton surface. The surfactants in these formulations are assembled into large distributed (0.1 – 1 µm) vesicles that are stable in the presence of guars and upon dilution. The effect of guars on the vesicles adsorption on cotton was first estimated by using cellulose nanocrystals (CNC) as a stand-in for cotton. The dispersion of CNC in water permits to follow the interaction between the vesicles, guars, and CNC in the bulk. It was found that guars enhance the deposition on CNC and that the vesicles are deposited intactly on the fibers driven by electrostatics. The mechanism of the vesicles/guars adsorption on cellulose fibers was identified by quartz crystal microbalance with dissipation monitoring. It was found that the guars increase the surfactant deposited quantity, in agreement with the results in the bulk. Also, the structure of the adsorbed surfactant on the fibers' surfaces (vesicle or bilayer) was influenced by the guars presence. Deposition studies on cotton fabrics were also conducted. Attenuated total reflection and scanning electron microscopy were used to study the effect of the polymers on this deposition. Finally, fluorescent microscopy was used to follow the adsorption of surfactant vesicles, labeled with a fluorescent dye, on cotton fabrics in water. It was found that, in the presence or not of polymers, the surfactant vesicles are adsorbed on fiber maintaining their vesicular structure in water (supported vesicular bilayer structure). The guars influence this process. However, upon drying the vesicles are transformed into bilayers and eventually wrap the fibers (supported lipid bilayer structure). This mechanism is proposed for the adsorption of vesicular conditioner on cotton fiber and can be affected by the presence of polymers.

Keywords : cellulose nanocrystals, cotton fibers, fabric softeners, guar polymers, surfactant vesicles
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