The adsorption of soil-releasing polymers at model fabric interfaces and their effectiveness in the removal of complex soils

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Hydrophobic fabrics, such as polyester or poly(ethylene terephthalate) (PET), prove to be a challenging surface to remove complex soils, such as sweat and sebum from. Creating a more hydrophilic surface can inhibit the adsorption and redeposition of these soils, and this can be achieved by chemical surface modification. Soil-release polymers (SRPs) are designed to promote hydrophilicity at the fabric surface, and a novel family of biosourced pyridine dicarboxylate SRPs have been developed, which are specific to PET[1]. The SRPs are triblock copolymers of polyester and poly(ethylene glycol) (PEG), where polyester binds to the fabric surface and the PEG outer blocks extend into the PET/water interface, forming a hydrophilic layer (*Figure 1).* This improves soil removal by increasing the affinity for aqueous laundry liquor and reducing its redeposition. Furthermore, these polymers can have a positive environmental impact, improving cleaning effectiveness at lower temperatures and shorter wash cycles. The pyridine dicarboxylate monomers are a sustainable alternative to petroleum-derived terephthalate. Within the family, we find that small variations in their chemical structure significantly influences their performance. The detailed arrangement of SRP on PET must be established to understand the structure-property relationship. Recent experiments at ISIS Neutron and Muon Source, Didcot provided valuable insights to measure the SRP layer thickness before and after rinsing, the initial kinetics of the SRP-PET adsorption, and by using solutions with contrasting scattering length densities, their arrangement. Additionally, we accompanied these experiments with a rheometric analysis of soil adhesion, where we measured the shear rate $\dot{\gamma}$ at the point where complex soil droplets were removed from PET, then on SRP-treated PET *(Figure 2).* The adhesion of complex soils is dominated by ageing effects, due to changes in their physical and chemical conformation. Oily soils, i.e. human sebum, can produce a yellow discoloration on polyester/cotton during its aging when not completely removed during cleaning due to its oxidation[2]. Thus, by studying soil removal at day 1 vs day 7 of aging, and the effectiveness by SRPs, provides information on how the PET responds to stress.

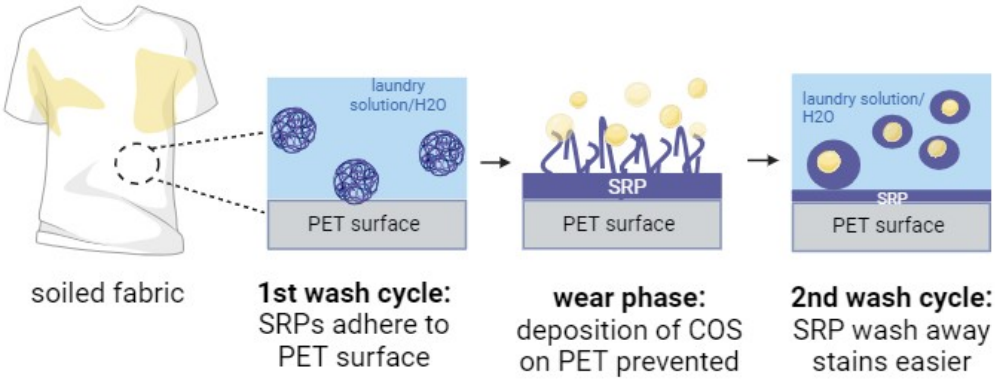

Figure 1: the adsorption of SRPs at the PET surface and their removal performance during washing.

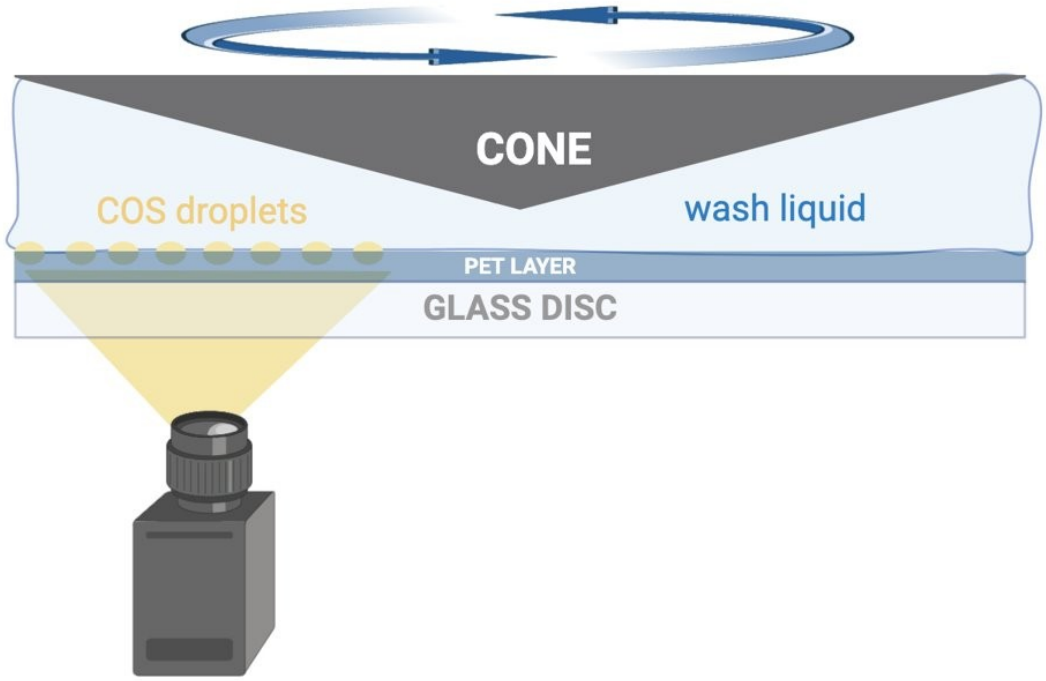

Figure 2: the rheology set up for complex soil stained PET.

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References

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2. *Chi, Y. and Obendorf, S.K. (1998) 'Aging of oily soils on textile materials: A literature review', Journal of Surfactants and Detergents, 1(3), pp. 407–418. doi:10.1007/s11743-998-0044-0.*