EFFECT OF INTERACTIONS BETWEEN A HYDROPHOBICALLY MODIFIED POLYMER AND PHOSPHOLIPIDS IN THE RHEOLOGICAL AND FRICTIONAL PROPERTIES OF COMPLEX GELS

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Key Words: hydrophobically modified polymer, tribology, rheology, isothermal titration calorimetry, interactions.

O/w emulsions with polymers and phospholipids are widely used for personal care products due to their thickening and emulsifying properties. However, the underlying mechanism through which the emulsion components affect rheological and tribological characteristics is not well understood. We investigate simplified systems containing a hydrophobically modified polymer and phospholipids and find that bulk rheology and interaction between components of the studied systems play a role in frictional behavior. We characterize the tribological behavior using a soft model contact consisting of polydimethylsiloxane (PDMS) on a ball-on-disk tribometer. In addition, we investigate the bulk rheology using dynamic and steady shear experiments. Rheological behavior of systems containing the hydrophobically modified polymer is consistent with concentrated microgel systems. For systems containing phospholipids and polymer, the elastic modulus shows to a two-fold increase when compared to systems without phospholipids, leading us to hypothesize that hydrophobic interactions are occurring between these two components. To further investigate these interactions, we performed Isothermal Titration Calorimetry (ITC) experiments. The results are compared to experiments with a similar polymer that does not contain the hydrophobic moiety. No interactions are observed in the latter lending credence to our notion that interactions occur only between the hydrophobically modified polymer and the phospholipids when they are present in the same system. Tribological experiments show that in the elastohydrodynamic lubrication regime, which occurs at higher speeds where the contacts are fully separated by a lubricating film, the friction coefficients increase with increasing sample viscosity. Systems containing the polymer and phospholipids show a lower friction coefficient than Newtonian fluids at the boundary regime, where the contacting asperities dictate the frictional behavior. In order to understand this behavior, friction measurements over time at a fixed low speed and adsorption studies with quartz crystal microbalance (QCM) were performed. The tribological measurements show that the friction coefficient decreases as the concentration of hydrophobically modified polymer increases. The same behavior is observed with phospholipids. In addition, QCM results show that phospholipids are being adsorbed onto the PDMS surface and their hydrated heads are causing a decrease in the friction coefficients at low entrainment speeds due to a hydration-lubrication mechanism. These results indicate that the type of polymer used and their interactions with other components present in the system strongly affect their frictional and rheological behavior, and thus, the final performance of a personal care product containing these components.