CONTROLLING COMPETITIVE AND SYNERGISTIC INTERACTIONS IN FORMULATIONS

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Amphiphilic block copolymers of the poly (ethylene oxide)–poly (propylene oxide) (PEO–PPO) group (commercially available as Pluronic or Poloxamers) are widely used in numerous applications, especially the pharmaceutical, consumer, technological and formulation areas. Whilst mixtures of small molecule surfactants and Pluronics have previously been examined, as has the effect of alcohols on Pluronic behavior, there are far fewer studies of the quaternary systems; Pluronic/small molecule surfactants/alcohol/water.

Against this background, we have employed a range of techniques including surface tension, pulsed gradient spin-echo nuclear magnetic resonance (PGSE-NMR) and small- angle neutron scattering (SANS) to quantify the interaction between these small molecule surfactants (sodium dodecyl sulphate, dodecyltrimethylammonium bromide and polyoxyethylene (23) lauryl ether) and short, medium and long chain alcohols (ethanol, hexanol and decanol respectively) on the critical micelle concentration (CMC) and subsequently the micellar structure. SANS data for aqueous Pluronic solutions with added alcohols fitted to a charged spherical core/shell model for the micelle. The addition of the surfactants led to significantly smaller, oblate elliptical mixed micelles in the absence of alcohols. Addition of ethanol to the system led to a decrease in the micelle size, whereas larger micelles were observed upon addition of longer chain alcohols. NMR studies provided a complementary estimate of the micelle composition using average diffusion coefficients. These observations extend our understanding of the synergistic interactions between the Pluronic and small molecule surfactants when the partitioning of the added alcohol perturbs the interaction between the two types of surfactants.