

INTERACTIONS BETWEEN POLY(ACRYLIC ACID) AND NONIONIC SURFACTANTS

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Polymers and surfactants are frequently used together in formulations. While there have been several studies on the interaction of nonionic or ionic polymers with ionic surfactants, there is little work to be found on interactions between ionic polymers and nonionic surfactants (Saito and Taniguchi, 1973). Significant changes in the physical properties of solutions of polymers such as poly(acrylic acid) (PAA) occur on mixing with surfactants of the poly(oxyethylene) alkyl ether or aryl ether class. We have studied such interactions using surface tension, viscosity, cloud point, conductivity, foaming and film thinning experiments, with visual observations to construct phase diagrams. Mixtures of poly(acrylic acid) and nonionic surfactants form turbid solutions at concentrations dependent on the ethylene oxide chain length of the surfactant and on the temperature of the system (Fig. 1); viscosity data usually indicate an initial increase in flow time always followed by a substantial decrease in viscosity (Fig. 2) as nonionic surfactant molecules adsorb onto the polymer chain, reducing the effective charge of the polyanion. The subsequent increase in flow time is largely due to the viscosity imparted by the surfactant. Such changes in viscosity have a direct bearing on the drainage properties of foams prepared from the surfactant mixtures, as has been demonstrated directly using foams and isolated thin films.

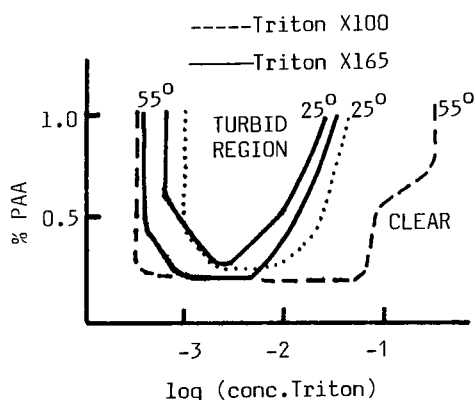


Fig. 1. Phase diagram for two non-ionic surfactant-PAA systems at 25° and 55°.

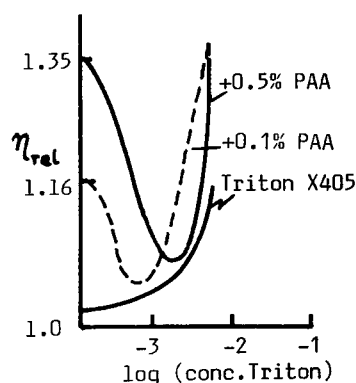


Fig. 2. Relative viscosity of Triton X405 in the presence and absence of 0.1% and 0.5% PAA.

Surface tension data show that there is an increase in surface activity below the CMC of the surfactant on interaction with PAA, but the limiting surface tension above the CMC is increased. The conductivity of PAA solutions decreases on addition of nonionic surfactant, supporting the idea of decreased ionisation of the polyanionic species and physical binding of surfactant to the polymer. The mode of interaction is thus likely to involve both hydrophobic bonding between the surfactant non-polar groups and polymer backbone and hydrogen bonding between the ether oxygens of the surfactant and the acidic groups of the polymer.

Saito, S., and Taniguchi, T. (1972) *J. Colloid Interface Sci.* 44: 114-120.