THE γ-IRRADIATION OF TRITON X-100 AND THE PROPERTIES OF MIXED MICELLES OF NON-IONIC SURFACTANTS

A. Al-Saden, A.T. Florence and T.L. Whateley, Departments of Pharmaceutical Technology and Pharmaceutical Chemistry, University of Strathclyde, Glasgow, G1 1XW

Few studies have been conducted on mixtures of non-ionic surfactants, yet the size and shape and solubilising capacity of simple micelles can be altered by the addition of amphipathic compounds. We have studied by light scattering, surface tension and viscosity techniques aqueous solutions of mixtures of t-octyl phenyl polyoxyethylene ethers (Tritons, Rohm and Haas) and mixtures of oleyl alcohol polyoxyethylene ethers (Brij, Honeywill Atlas).

One of the reasons for such studies was to confirm what appeared to be degradation of the polyoxyethylene chain during gamma (γ)-irradiation of aqueous solutions of Triton X-100. Following the work of Stafford (1970) who showed that polyoxyethylene chains were cross-linked by γ-irradiation, it was hoped that intramicellar cross-linking of the polyoxyethylene chains would occur. However, the properties of the γ-irradiated aqueous solutions are very similar to those of the mixed micellar systems of Tritons of varying polyoxyethylene chain length.

Water dispersible surfactants of low hydrophile-lipophile number (low HLB) can be solubilised in micelles of freely-soluble surfactants. In the process the spherical micelles are transformed into asymmetric aggregates (Fig. 1).

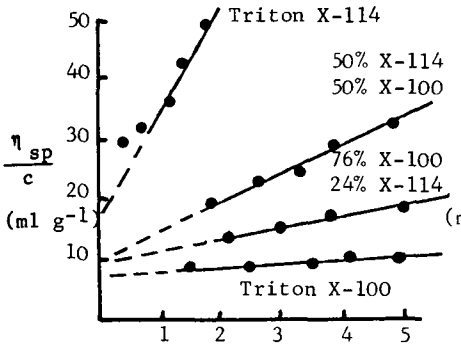


Fig. 1

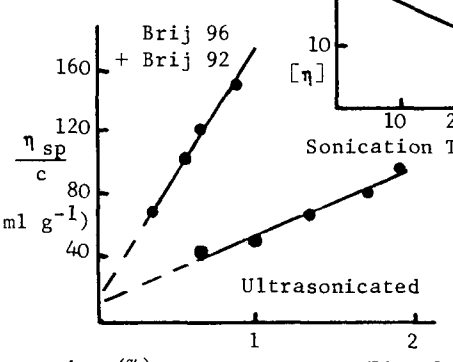
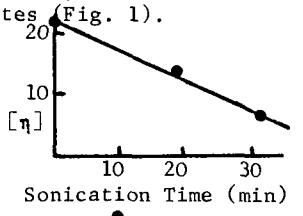


Fig. 2

Concentration (%)



Light scattering data for the mixture of 76% Triton X-100 and 24% Triton X-114 gives a micellar weight of 157,000 with a dissymmetry value, Z_{45}, of 1.35 (Triton X-100 gives values of 91,000 and 1.02 respectively). The cloud point for the above mixture was 56°C (for Triton X-100, 67°C). For a solution of γ-irradiated Triton X-100, the cloud point was 54°C, the micellar weight 152,000 with a Z_{45} value of 1.32, suggesting that some scission of the polyoxyethylene chains had occurred leading to mixed micelle formation.

An unusual finding was that ultrasonic treatment of a Brij 92-96 mixture led to a permanent decrease in the viscosity of the solution and a reduction in the intrinsic viscosity (Fig. 2). We believe this is the first reported observation of this kind, although it is well known that ultrasonication of phospholipid-cholesterol dispersions reduces the molecular weight of the aggregates (Attwood & Saunders, 1965).

Stafford, J.W. (1970). Makromol. Chem., 134, 57-119.
Attwood, D. & Saunders, L. (1965). Biochim. Biophys. Acta, 98, 344-350.