THE EFFECT OF SURFACTANT PURITY ON FOAM VOLUME

A.A. Badwan, K.C. James and W.J. Pugh, Welsh School of Pharmacy, UWIST, Cathays Park, Cardiff, CF1 3NU.

Inter-laboratory disagreement between foam evaluation results has been attributed to differences between the purities of the surfactants since most of the workers used commercial materials. A rule has emerged from the resulting observations, that impure surfactants produce more foam than their pure equivalents. This generalisation is tested below.

Purified samples of triethanolamine dodecyl and tetradecyl sulphates were prepared from specially purified fatty alcohols, and their identities and purities established by elemental analysis, i.r. and n.m.r. spectrometry and differential scanning calorimetry. The final purification stage involved successive crystallisations from acetone. For this investigation, samples were withdrawn at various stages of crystallisation, dried, and their purities determined by differential scanning calorimetry. The impurities were not identified; the procedure was employed because it represents the actual process followed in industry, when preparing detergents. It also overcomes the problems of uniformity of mixing, which arise with blended mixtures. Foam volumes were measured at 25^{o}, using the Ross Miles (1941) method. Preliminary work with pure materials indicated that foam volumes increase with surfactant concentration to a limiting value, and then remain constant. The inflection corresponded to the critical micelle concentration, as determined by conductance and surface tension measurements. Solutions equivalent to 2 to 2.5 times critical micells concentration were used for subsequent volume determinations, because this concentration range was economical on materials, and considered sufficiently far removed from the inflection point. Rates of foam collapse were also examined, by recording foam volumes after a series of time intervals.

With both surfactants, foam volume increased rectilinearly with percentage purity, but the stabilities of the foams produced by the impure samples were greater than those of the pure materials.

The change in foam volume could be a result of the increase in surfactant concentration with purification. The observed increase in foam volume was in fact, quantitatively equivalent to the change in purity. However, the argument does not apply if the impurities are also surfactants. This is unlikely with the sample of triethanolamine dodecyl sulphate, since no other homologue could be detected in the fatty alcohol from which it was prepared. The tetradecyl homologue contained traces of decanol and hexadecanol. Florence and Mysels (1974) observed that impurities play a significant role in the bursting of foam bubbles, and suggested that the impurities are adsorbed strongly and increase the surface viscosity of the monolayer. This would contribute to the extra stability of the film of less pure surfactant. An alternative or additional factor is that the molecules in a pure alkyl sulphate film are kept apart by the electrical repulsion of their head groups. Uncharged molecules could occupy these spaces, forming a complex film, more impervious to the outward diffusion of air than the film of pure surfactant.

Ross.J. & Miles. G.D. (1941) Oil and Soap 18, 99- 102
Florence. A.T. & Mysels. K.J. (1974) J. Phys. Chem. 78, 234-235