A RELATIONSHIP BETWEEN FOAMING AND HLB VALUE

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

The foaming properties of solutions of purified samples of the C_{10} to C_{18} even-numbered sodium n-alkyl sulphates in water, have been studied using two methods. The first method has been described by Ross and Miles (1941) and generates a foam by allowing a surfactant solution to fall a fixed distance on to a reservoir of the same liquid. In the second method a predetermined volume of nitrogen was bubbled through a column of solution, under standard conditions. The volume of foam produced in both methods increased with concentration to a constant value at the critical micelle concentration (CMC). The resultant inflection in the plot of foam volume against concentration, provided a method of determining CMC. Subsequent foam volume determinations, involving comparisons between compounds, were made at a constant arbitrary value of 1.25 CMC. Neither foam volume nor rate of collapse showed any simple relationship with either hydrophile-lipophile balance (HLB) or carbon number. The two experimental methods showed the same pattern of variation in foam volume with carbon number, passing through a maximum value as the homologous series was ascended, and the point in the series where the maximum occurred was dependent on temperature. A parameter, maximum foam temperature (MFT) the temperature at which the foam produced by a given surfactant is maximal, was derived from this observation, and was found to be directly proportional to HLB. Foamability is a subjective term which has not hitherto been defined, or measured, due to its dependence on the method of measurement. MFT appears to be independent of the experimental procedure employed, since the two methods gave the same result, and could therefore provide a means of characterising foams. The equivalent triethanolamine salts behaved in a similar manner. HLB decreases by a constant increment for each methylene group added to a carbon chain (Davies and Rideal, 1963). A rectilinear plot of MFT against carbon number, obtained with the equivalent triethanolamine salts, was therefore considered as supporting evidence of the relationship between MFT and HLB.

Crook and others (1964) have determined the foam heights produced by a series of p-t-octylphenoxyethoxy ethanols over a range of temperatures. MFT values calculated from these results gave a rectilinear plot against HLB, indicating that the relationship extends to non-ionic surfactants.

MFT is a physical property which is comparatively easy to measure, and provides a new approach to the determination of HLB values.

Crook, E.H., Fordyce, D.B. & Trebbi, G.F. (1964). J.Am.Oil Chemists Soc., 41, 231-237.

Davies, J.T. & Rideal, E.K. (1963). In: Interfacial Phenomena, 2 Ed., London, Academic Press, pp 371-378.

Ross, J. & Miles, G.D. (1941). Oil and Soap, 18, 99-102.