Relation between Foaming Properties and the Structure of Surfactant Solution

(Determination of Critical Micelle Concentration of Sodium Dodecyl Sulfate by Foaming Power Measurement)

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Because of the difficulty to make accurate reproducible measurement and accordingly to interpret experimental data quantitatively, the foaming power measurement has been applied largely to find only relative foaming power of a detergent solution.

The author, however, found a very useful technique in the forming power measurement concerning the study of the structure of detergent solution. The method applied here is that of Ross-Miles[1] since this gives the most reproducible results among other methods.

Experimental

The apparatus used has somewhat different size from the standard Ross-Miles apparatus which is shown in Fig. 1. The diameter of a
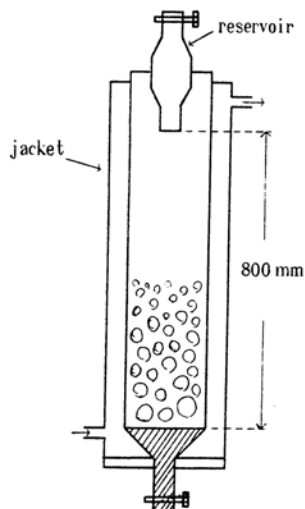

Fig. 1.   Ross-Miles apparatus.

receiver containing the sample is 55 mm. instead of usual 50 mm. and the height from the orifice of a pipette reservoir to the level of the bottom solution is 800 mm. instead of 900mm. The other parts are the same. The temperature is kept at $40 \pm 0.1°C$. The height of the foam part is measured from the water level to the top of the foam part by the mm. scale marked on the re-

1) J. Ross, G. D. Miles, *Oil and Soap*, **18**, 99 (1941).

ceiver. The analysis of sodium dodecyl sulfate shows that 98.72% is an active substance in which unreacted alcohol amounts 0.74% and very small quantity of alkali is also present.

The data are averaged over three measurements and reproducibility was found to be very good.

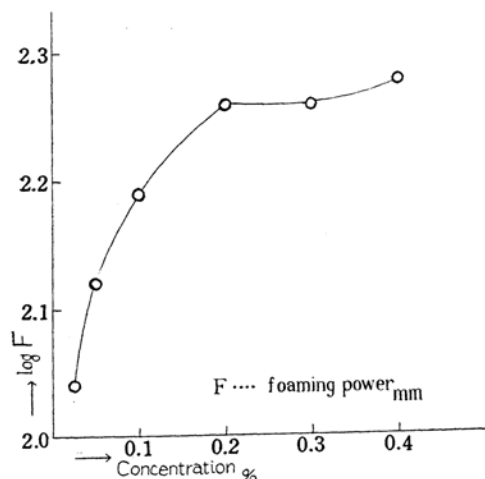This is plotted on a graph as shown in Fig. 2.

Fig. 2. Foaming power of sodium dodecyl sulfate.

From the curve it is very clear that there is a marked singular point (i. e. critical micelle concentration) at around the concentration of 7×10^{-3} M. This is in good agreement with surface tension $(7.2 \times 10^{-3} M)$[2], conductivity $(7.2 \times 10^{-3} M)$[3] and viscosity $(9 \times 10^{-3} M)$[4] data.

2) J. Powney and C. C. Addison, *Trans. Faraday Soc.*, **33**, 1243 (1937).

3) H. F. Ward, *Rroc. Roy. Soc. London*, **176 A**, 412 (1940).

4) K. Hess, W. Philippoff and H. Kiessig, *Kolloid Z.*, **88**, 40 (1939).

Conclusion

The application of Ross-Miles method measuring foaming properties of detergent solution is found to be useful for the study of the structure of surfactant solution, and critical micelle concentration of aqueous sodium dodecyl sulfate is determined, which shows a good agreement with the values from other methods.

The same method is being applied to many other surfactants including soaps and the detail of the work will be published elsewhere.