Prediction of Transient Foam Behavior from Equilibrium Surface Tension Data for Amphiphile´s Aqueous Systems

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We had measured the surface tension (maximum bubble pressure method) and the transient foaminess (Bikerman dynamic method) of homogeneous solutions of alcohols, alcoxyalcohols, diols, alkanenitriles and glymes in water at 298.15 K. We found that most of these solutes exhibit both a dramatic change in the surface tension vs. composition at X_{op} and a transient foam behavior with a maximum foaminess at a particular composition X_{max}, being smaller than X_{op}.

In order to predict our dynamic foaminess results we designed several isotherms to accurately represent the surface tension behavior throughout the composition interval. Here, we show our prediction of Gibbs elasticity values from the fitting of surface isotherms to our surface tension vs. composition results at constant temperature. We start assuming that for our systems the dynamic foaminess can be related to equilibrium surface tension values. So, the stability of the relatively thick lamella that sustain most of the foam column is governed by the Gibbs elastic module E. Combining the former definition with the Gibbs adsorption equation and rearranging the final equation in terms of first and second composition derivatives of surface pressures.

We applied this equation to diverse surface isotherms (Ideal, Langmuir, Temkin and a simplified Extended Langmuir). All but the last one of these isotherms fitted to our surface tension results gave a fair surface behavior but fail to predict a proper elasticity behavior vs. composition as experimentally reported. Instead they predict a monotonous increasing E values. The Simplified Extended Langmuir isotherm has a single parameter accounting for the difference in adsorption of the two components. This isotherm produces adequate E values including a divergent one at a characteristic composition, which mimics accurately the dynamic foaminess behavior for most of our systems.