Quantitative description of the surface tension minimum in a two-component surfactant system

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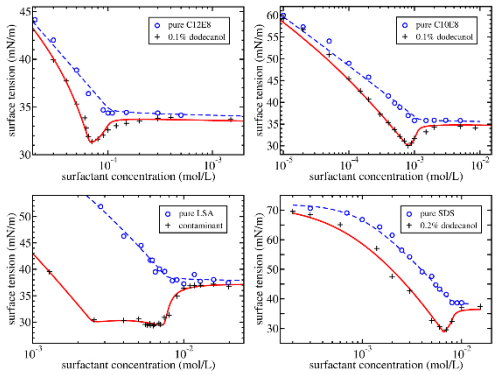
The Gibbs adsorption equation is the thermodynamic cornerstone for the description and understanding of the surface tension in a surfactant solution. It relates the decrease in surface tension to an increased surfactant adsorption. In the early 1940's, it therefore puzzled researchers to sometimes observe a *minimum* in the surface tension for certain surfactant solutions, which seemed to indicate surfactant desorption (even depletion) according to the Gibbs adsorption equation. It is now understood that the minimum is related to contamination of the surfactant (notably by dodecanol) and its occurrence has since then been studied extensively in experiments [1-3]. Still, the precise role of the (tiny amount of) contaminant present is not well understood and a quantitative description and understanding of the minimum in the experimental surface tension is lacking. It is our aim to provide such a quantitative description. Our theoretical analysis is based on a Statistical Thermodynamic treatment of the Langmuir model for a surfactant mixture combined with the mass action model adapted to describe the formation of mixed micelles [4]. A new Statistical Thermodynamic expression for the surface tension is derived and used to compare with a number of surface tension experiments for both ionic and non-ionic surfactant systems [4].

Keywords:
Surfactant, Surface Tension, Langmuir model, Mass Action model, Micelle Formation, Surfactant Mixture



Surface tension as a function of surfactant concentration for a (contaminated) solution of (a) C12E8, (b) C10E8, (c) LSA, (d) SDS. Open symbols are experimental results by Lin et al. [1], McBain and Vinograd [2] and Elworthy and Mysels [3]. The solid lines are the theoretical results [4].

References:

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