Co-adsorption of alkane vapor from the gas phase and surfactants from the aqueous phases on the water-air interface

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Spreading oil at the water/air interface is an old story, investigated frequently since more than one century ago, especially for the oil slick problem. However, there are still many unknown details that remain to be understood. In comparison with the spreading of oil on the water-air surface there is much less work on the adsorption of alkane from the vapour phase on water or aqueous solution surfaces.

In our recent work \cite{1} we presented the adsorption of short chain alkanes (pentane, hexane, heptane, and octane) from the vapour phase at the pure water/air interface. Measurements with the drop profile analysis tensiometry demonstrated an instant quick molecular adsorption with significant effects on the surface tension. The rate and extend of this process depends on the alkane chain length which can even lead to an oil lens formed at the water drop apex after a respective time.

In the present work similar phenomena are investigated at the surface of drops of aqueous surfactant solutions in a hexane vapour atmosphere. For the anionic surfactant SDS as well as the cationic surfactant DoTAB a significant surfactant-hexane co-adsorption and a remarkable decrease in surface tension are observed. This hexane additional co-adsorption effect increases with surfactant concentration and reaches a maximum value (at about 14 mN/m for SDS and 16 mN/m for DoTAB) at intermediate surfactant concentrations. Dynamic surface tension measurements and calculation of the standard deviation from the Laplacian shape fitting, demonstrate three different adsorption regions. The kinetics and equilibrium state of adsorption depend significantly on the surfactant concentration. For the initial effects (regular adsorption region) which appear quickly, a thermodynamic model is applied which is based on a mixed adsorption layer approach. Similar results were observed for pentane, heptane, and octane, however the kinetic of adsorption, instant and long time effects can be different depending on their chain length and evaporation rate.