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SURFACTANT ADSORPTION PARAMETERS DETERMINED FROM SURFACE TENSION DATA AS MEASURED BY DROP AND BUBBLE PROFILE ANALYSIS TENSIOMETRY

Abstract: Drop and bubble profile analysis tensiometry is the most frequently used methodology for studies of surfactant adsorption at liquid interfaces. However, there is depletion of surfactant molecules caused by adsorption when drop profile analysis tensiometry is applied for surface tension measurements at low surfactant bulk concentration. This depletion can lead to wrong characteristic adsorption parameters when not quantitatively corrected in the data analysis. We show for the two surfactants CTAB and Tween 20, that particularly the values for the adsorption activity coefficient and the molar area of adsorbed molecules are largely overestimated when using drop profile analysis data. It is shown that bubble profile analysis data provide correct values of the adsorption characteristics. The data analysis presented here is based on the Frumkin adsorption model.

Keywords: Adsorption of surfactant, bubble and drop profile analysis tensiometry, depletion effects due to adsorption, Frumkin adsorption model.

1. Introduction

Surface active molecules – surfactants – are omnipresent in our daily life and applied in many modern technologies. The optimum use of surfactants requires good knowledge of their surface properties. The surface tension isotherms measured for aqueous solutions of surfactants as a function of bulk concentration give access to the most important fundamental information about the properties of the surfactant adsorption layers, such as surface activity, molar area at the surface and critical micelle concentration [1].

Among the various surface tension methods, the bubble and drop profile analysis tensiometry is the most frequently used one to day. The pioneer for this methodology was A.W. Neumannwho published a number of fundamental papers about this method which he called ADSA (Axisymmetric Drop Shape Analysis) [1,2,3,4].Recently, the state of the art of this methodology was described with details referring to the Profile Analysis Tensiometer PAT1 (SINTERFACE Technologies, Berlin, Germany) [1].

It was discussed in [**Ошибка! Закладка не определена.**] that in studies with protein solutionsa depletion happens due to the adsorption of part of the protein molecules at the drop surface. In contrast, when using an air bubble immersed in the protein solution, the depletion due to protein adsorption at the bubble surface is negligible. From the difference between the obtained data the adsorbed amount of protein can be estimated [1].

The mentioned depletion effects in protein adsorption experiments appear as the used bulk concentrations are very low. However, also studies of solutions of strongly surface-active moleculescan be affected by this phenomenon. Thus, it is important to know from what surface activity and surfactant bulk concentration on the mentioned depletion effects become important and have to be quantitatively considered.

In a recent work, we presented experimental data for the surface tension isotherms of three different surfactants: sodium dodecyl sulphate (SDS), hexadecyl trimethyl ammonium bromide (CTAB) and the non-ionic surfactant Polyoxyethylene(20)sorbitanmonolaurate (Tween20) [1]. In this work a protocol was