Relationships between unique surface tension behavior and aggregation properties for the mixture of potassium dodecanoate and diglycerol derivatives

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Surface tension is the excess energy at the surface of the liquid due to the difference in energy of the molecules between the surface and the bulk. In general, the surface tension decreases with increasing surfactant concentration due to the surface layer of surfactant and remains constant at concentrations above the critical micelle concentration (CMC). From the value of surface tension, the surface excess concentration Γ of surfactant molecules at the air / water interface can be obtained using Gibbs' adsorption isotherm.

However, it is difficult to apply this formula in practice because various additives are added to commercial products such as cleaning agents. As an example, surface tension measurements were performed on a mixed system of potassium dodecanoate (C_{11}COOK), an anionic surfactant, and diglycerol derivatives polyoxyethylene diglyceryl ether (2GlyEO$_9$) and polyoxypropylene diglyceryl ether (2GlyPO$_9$). The C_{11}COOK alone system showed a general surface tension curve, but the C_{11}COOK / diglycerol derivative mixture showed unique surface tension behavior in both systems. In this unique surface tension curve, the Gibbs adsorption isotherm cannot be applied, so Γ cannot be determined. Therefore, neutron reflectometry (NR) measurements were performed to investigate Γ, but since this technique only provides information on the interface, small-angle neutron scattering (SANS) was performed to compare with the bulk structure.

In this study, bulk aggregate properties of the C_{11}COOK / diglycerol derivative mixture system will be characterized by SANS and discussed in combination with adsorption characterization at the air/water interface by surface tension and NR measurements to be performed separately.

For SANS measurements, $C_{11}H_{23}$COOK / diglycerol derivative mixed deuterium oxide solution was sealed in a 1 mm thick solution cell provided with the instrument and a sample changer was used.

Fig. 1 shows the SANS profile of the $C_{11}H_{23}$COOK / 2GlyPO$_9$ (1 wt%) mixture with fitting curve. The CMC was determined by a sharp increase in I_0 near 10 mmol dm^{-3}. This was correlated with surface tension and NR.

By combining SANS, NR, and surface tension, we were able to comprehensively characterize the aggregate properties of mixtures of $C_{11}H_{23}$COOK and diglycerol derivatives and the adsorption properties at the air / water interface. Details will be reported in a paper currently under preparation.

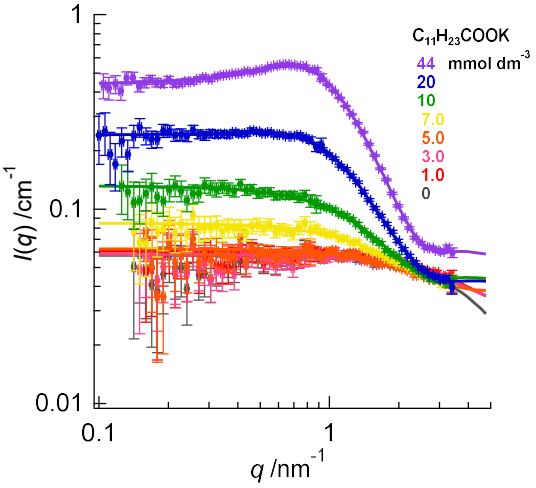

Fig. 1. SANS profiles for $C_{11}H_{23}$COOK / 2GlyPO$_9$ (1 wt%).