Experimental report

20/01/2018

Proposal: 9-10-1466 **Council:** 4/2016

Title: Take it to the limit: VERY low surface tension surfactants

Research area: Chemistry

This proposal is a new proposal

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Samples: surfactants and water

Instrument	Requested days	Allocated days	From	To
FIGARO	2	4	04/10/2016	07/10/2016
			25/02/2017	26/02/2017

Abstract:

Results from this experiment will develop the ability to design 21st century surfactants (better performance with lower environmental consequences) by gaining essential information on how molecular packing in air-water interfacial films influences surface tension. A sister proposal has been submitted this round to study aggregation of similar surfactants by SANS (“Surfactants in the mirror”). Reduction of the surface tension through mixed systems using only hydrocarbon surfactants will have consequences for industrial formulations including lubricants, surface coatings and medical formulations. However, it is first important to understand how these systems pack at the interface and how this impacts on the final aqueous surface tension reduction. Neutron reflectivity (NR) and contrast variation provides the ideal approach to study surface composition, orientation and surface excess of surfactant monolayers

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Title: Take it to the limit: VERY low surface tension surfactants
Instrument: FIGARO
Dates: 04/07/2016 – 17/10/2016

Abstract: Fluorocarbon (FC) surfactants provide the greatest reduction of surface tension due to the unique properties of fluorine. However, it has recently been identified that FC surfactants are environmentally hazardous and there is now a need to develop replacements. Hydrocarbon surfactants have recently be developed to achieve surface tensions which rival certain FC surfactants, and thus, could provide an alternative. Here, mixed systems of hydrocarbon surfactants are capable of achieving very low surface tensions, lower than either constituent surfactant. Neutron reflectivity has been used to investigate the surface composition of these highly effective mixtures.

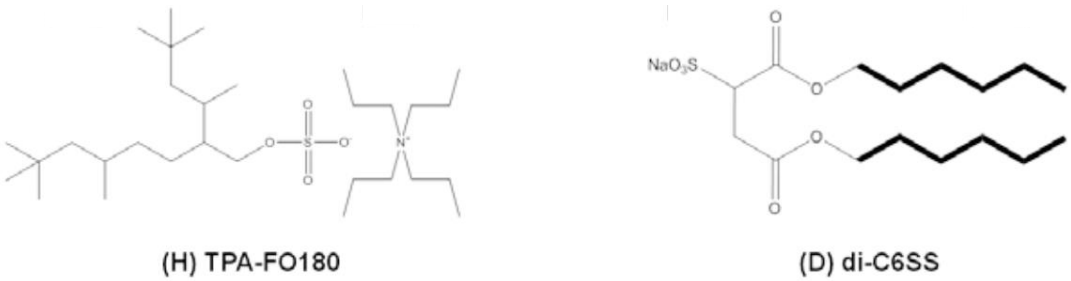

Figure 1: Two example hydrocarbon surfactants that have been mixed in various compositions and studied by reflectivity in this experiment.

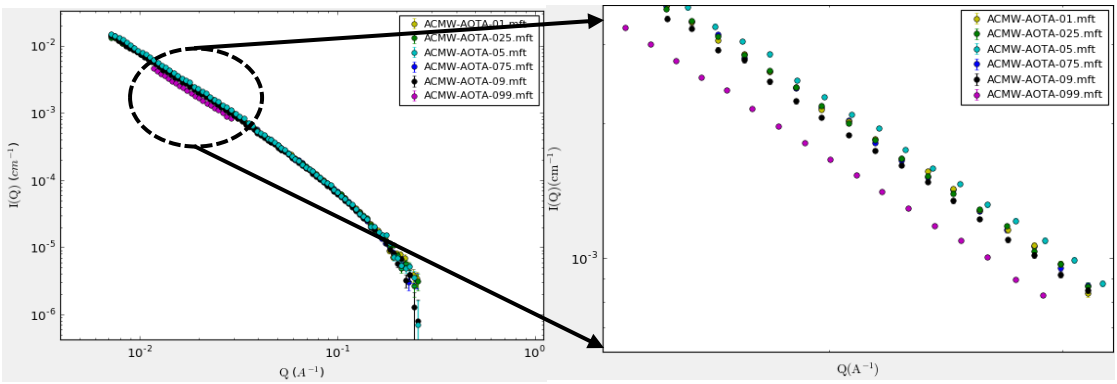

Figure 2: Raw scattering profiles for AOTA:diC8SS mixtures at different compositions highlighted in the image legend. Showing the variation in scattering profile when a tiny proportion (1%) of AOTA is incorporated into the mixture.

The data was analysed during the experiment using Igor Pro. From the scattering length densities of each surfactant, it was possible to determine the actual proportion of each surfactant adsorbed at the air-water interface. As the composition of one surfactant increased in the mixture, this was also seen in the corresponding scattering profile. By comparing scattering profiles of mixtures to those of the individual surfactants, we found that for one particular system (AOTA:diC8SS), having as little as 1% AOTA in the mixture had an effect on the scattering (Figure 2). The remaining time during the experiment was spent characterising this system and has warranted an extension on the original proposal to investigate mixtures such as 99.9 % di-C8SS : 0.1 % AOTA. In conclusion, this experiment has provided structural information on the composition of the mixtures set out in the proposal. But

also provided insight into an extremely sensitive mixture, expanding the potential of how hydrocarbon surfactants can be mixed to give very low surface tensions. This data will be involved with the upcoming proposal to form part of the manuscript.