



Smart and green interfaces: Fundamentals and diagnostics

*COST Action MP1106: Smart and green interfaces -
from single bubbles and drops to industrial,
environmental and biomedical applications (SGI)*

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PI:8. Foam compositions based on surfactants and sodium carboxymethylcellulose

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Currently foams are used for fire, in the manufacture of detergents, pharmaceuticals and cosmetics, foodstuffs, used in petroleum engineering, construction materials, flotation [1]. The aim of the work is to study foam stabilizing effect of associates of surfactants with the water soluble polymer – sodium carboxymethylcellulose. The surfactants were used as the main foam formers: sodium dodecylsulfate $C_{12}H_{25}OSO_3Na$ (NaDDS), ammonium dodecylsulfate $C_{12}H_{25}OSO_3^*NH_3$ (ADDS), sodium dodecyl-2-etoxy sulfate $C_{12}H_{25}O(CH_2CH_2)_2SO_3Na$ (NaDDES), ammonium dodecyl-2-etoxy sulfate $C_{12}H_{25}O(CH_2CH_2)_2SO_3^*NH_3$ (ADDES) and cetyltrimethylammonium-chloride $C_{16}H_{33}N(CH_3)_3Cl$ (CTACI). Sodium carboxymethylcellulose (NaCMC) was used as the stabilizer of foams obtained from aqueous solutions of surfactants.

Foam formation of aqueous solutions of surfactants (NaDDS, ADDS, NaDDES, ADDES, CTACI), and of their mixtures with NaCMC was studied. These associates were shown to have higher foam forming ability compared to separate components. Optimum concentration ratios of surfactant components (NaDDS, ADDS, NaDDES, ADDES, CTACI) and NaCMC and conditions (surfactant and polyelectrolyte concentrations, ionic strength, pH) for maximum stability of foams were found. The foams stabilized by NaCMC were shown to have lower values of capillary pressure and ratio upon higher equilibrium thickness of foam films, than the foams stabilized by surfactants. The main parameters that describe foam systems in detail were calculated. The stability and quality of foams may be regulated depending on conditions (polymer concentration, pH, ionic strength).

The formation of mixed adsorption surfactant-polymer layers and its relation to the foam stabilizing effect were studied. Additives of surfactants were found to substantially affect both the adsorption kinetics and surface tension isotherms of aqueous solutions of NaCMC. This effect is most marked in case of oxyethylated surfactants and CTACI. The effect of interaction of surfactants with NaCMC on formation and properties of adsorption layers, and surface tension isotherms of their binary systems was determined. The values of surface activity at liquid-gas boundary, molecular parameters of associates of surfactants (NaDDS, ADDS, NaDDES, ADDES, CTACI) with NaCMC and their constituents were determined. The values of layer relaxation times were calculated and the limiting stage of adsorption layer formation of associates was determined, and diffusion of molecules to the liquid-air boundary was found to be the limiting stage.

The values of synergetic effect of surface tension decrease were calculated on the basis of surface tension isotherms. Decrease acceleration of σ and synergetic effect are accounted by formation of complexes and associates between surfactants and NaCMC, as a result of which hydrophilic-lipophilic balance of NaCMC polymer chains and surface activity of its segments change substantially. The results of the investigation may be used in fire fighting, in flotation of ores, in medicine, in production of detergents and makeup preparations.

References:

1. K. Holmberg, B. Jonsson, B. Kronberg, B. Lindman, *Surfactants and Polymers in Aqueous Solution*. John Wiley & Sons: Chichester, 2002.