RESPONSIVENESS TO HYDROCARBONS OF MIXED ANIONIC/CATIONIC WORMLIKE SURFACTANT MICELLES

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Surfactant molecules can self-assemble into long cylindrical or wormlike micelles (WLMs) which behave like reversibly breakable polymers. WLMs can entangle and form a network which imparts viscoelastic properties to solutions. WLMs are highly responsive to the addition of hydrocarbons, which destroy the structure of WLMs. Mixed anionic/cationic WLMs are currently attracting much attention, but the influence of hydrocarbons on their structure is not well understood. The aim of this work is to study the structural and rheological transformations produced by n-decane for mixed wormlike micelles of cationic (n-octyltrimethylammonium bromide, C8TAB) and anionic (potassium oleate) surfactants.

Viscoelastic solutions of long WLMs are formed at various ratios of C8TAB to oleate. Addition of small amounts of oil results in the transformation of highly viscoelastic fluids to water-like liquids. As shown by SANS, this is due to the solubilization of hydrocarbon in the micellar hydrophobic cores leading to the change of surfactant packing and breaking of WLMs. Higher amounts of hydrocarbon are needed to disrupt the network of micelles at higher C8TAB content than for those at lower C8TAB content, even though the initial viscosity is lower at high C8TAB cocentration. This is explained by preferential solubilization of hydrocarbon inside the branching points. SANS shows that hydrocarbon-induced transition of long WLMs with elliptical cross-section to ellipsoidal microemulsion droplets occurs. The internal structure of the droplets is revealed by contrast variation SANS. Ellipsoidal shape of the droplets is attributed to partial segregation of longer- and shorter-tailed surfactants inside the surfactant monolayer, providing an optimum curvature for both of them.

Responsiveness to hydrocarbons of mixed anionic/cationic WLMs studied in this work is a key property for the application of such viscoelastic surfactant solutions as hydraulic fracturing fluids in oil recovery.

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[2] Shibaev A.V., Kuklin A.I., Philippova O.E. (2019) Different responsiveness to hydrocarbons of linear and branched anionic/cationic-mixed wormlike surfactant micelles. 297, 351-362.