Synopsis of Original Research Paper

Development and Applications of Novel Sugar-Based Surfactants

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Novel nonionic gemini surfactants such as N, N'-dialkyl-N, N'-dilactobionylamidoethyle nediamine (2CnLac, n is hydrocarbon chain length of 8, 10, and 12) and N-[2-(N'-alkyl-N'-lactobionylamino)ethyl]-N, N-dimethyl-1-alkylammonium bromide (2CnAmLac, n = 8, 10, and 12) were synthesized, and characterized by investigating surface tension, dynamic light-scattering, and fluorescence spectrum of pyrene. 2CnLac with two hydrocarbon chains and two sugar hydrophilic groups were obtained by the reaction of ethylenediamine and alkyl bromide, followed by the reaction with lactobionic acid. 2CnAmLac with two hydrocarbon chains and one ammonium and one sugar hydrophilic groups were prepared by the reaction of N, N-dimethylethylenediamine and alkyl bromide, followed by the reaction with lactobionic acid. The solution properties of nonionic gemini surfactants, 2CnLac and 2CnAmLac, were influenced significantly by the hydrocarbon chain length, number of chains, and nature of hydrophilic groups. The critical micelle concentrations (cmc) of gemini surfactants shifted to lower concentrations with increasing hydrocarbon chain length, and their values were smaller by about one to three orders of magnitude than those of the corresponding monomeric surfactants with the same chain length. The areas per molecule occupied by gemini surfactants were extremely small, showing they were highly compact at the air/water interface. In addition, adsorption and micellization behavior of gemini surfactants was estimated by parameters such as pC20 (the efficiency of surface adsorption), cmc/C20 (the ease of adsorption relative to the ease of micellization), and Gibbs free energy of adsorption and micellization. From the dynamic light-scattering measurements, the aggregates of gemini surfactants were very small, and two hydrodynamic diameters above the cmc were observed. The fluorescence intensity ratio of the first to the third band in the emission spectra of pyrene started to lower from far above the cmc for gemini surfactants. This suggests that loose micelles or premicellar aggregates are formed in solutions. Thus, sugar-based gemini surfactants exhibited unique properties superior to the conventional monomeric surfactants.