Physicochemical characterization of dibromide dimeric surfactants with phenyl and cyclohexyl rings in the head group

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The importance of surfactants in practical applications continues to grow. They are used in antibacterials, liquid crystals, oil recovery, mineral flotation, and other aspects of material science [1]. Current investigations in surfactant science are driven by the requirements to design surfactants that possess enhanced physicochemical properties, new surfactant utilization in complex systems, and specific applications in modern technologies [2]. Hence, investigations of the structure–property relationship in surfactant systems are important in order to be able to design new surfactants and their supramolecules for specific applications. In this work the two dimeric surfactants $N,N'$-(1,3-phenylenebis(methylene))bis($N,N$-dimethyl-$N$-(1-dodecyl)ammonium dibromide ($12\text{PH}-12,2\text{Br}^-$) and $N,N'$-(cyclohexane-1,3-diylbis(methylene))bis($N,N$-dimethyl-$N$-(1-dodecyl)ammonium dibromide ($12\text{CH}-12,2\text{Br}^-$) were prepared and characterized. The critical micelle concentration, the micellar ionization degree and the average aggregation number were obtained by using different techniques. The results are discussed with the help of $^1\text{H}$ NMR two-dimensional, 2D, rotating frame nuclear Overhauser effect spectroscopy, ROESY, which seem to indicate that the phenyl and cyclohexyl rings are bent towards the micellar interior in order to avoid contact with water. The surface activity of the surfactants was studied by means of surface tension measurements. The occurrence of morphological transitions upon increasing surfactant concentration as well as the variations in the polarity and in the microviscosity of the interfacial region accompanying this sphere-to-rod transition were investigated. It was shown that the formation of spherocylindrical micelles also causes changes in the $^1\text{H}$ NMR spectra of the surfactant solutions.

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