Hydration of sugar based surfactants under osmotic stress: a SAXS study

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Sugar based surfactants, mainly alkyl (poly)-glucosides (APGs), have been extensively studied the two last decades because of their increasing importance in the detergent industry. They are biodegradable and produced from natural and renewable resources. Moreover they are the main surfactants used to extract membrane proteins because they prevent the protein denaturation and they can be easily separated from the protein by dialysis owing to their high hydrophilicity. Basic features of micelle formation by surfactants in water and some specific aspects concerning the packing parameter as a function of salt concentration are discussed in the present contribution.

The determination of the basic structural parameters of micelles is necessary for understanding the physical mechanisms that drive the formation of their molecular assemblies in solution. Micelles consist of a limited number of surfactants, typically between 50 and 150. The head group of the surfactant, which is for APGs composed of sugar moieties, forms an outer hydrophilic layer toward the water phase. In water the size/shape of a surfactant micelle results then from a compromise between the hydration of the head groups, which tends to promote spherical aggregates, and the minimization of the hydrophobic contact between the alkyl chain and water, which drives the system towards a bilayer structure i.e. where the area per surfactant in the aggregate is minimum. Using SAXS and UV-vis spectroscopy, we showed that the hydration of the polar part of n-octyl-glucoside micelles displays 3 regimes as a function of the ionic strength (IS): at low IS, no effect is detectable, while at intermediate IS (1-1.8) a salting-in effect is observed that strengthen hydration of the glucose polar head in the micelle and at higher IS a strong salting-out effect is detectable i.e. strong dehydration of the polar head followed by an increase in the micelle size.