Adsorption of novel dicephalic ammonium surfactants and polyelectrolytes at the air/water interface

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The physicochemical behavior of polymer/surfactant mixtures is of increasing interest, because of their great practical importance in conventional and modern technologies as well as various aspects of chemistry and biology. Many reviews concerning different aspects of their association behavior have been published [1-4]. Addition of surfactants to aqueous solutions of polyelectrolytes causes the spontaneous formation of complexes in a certain range of concentrations. Complex formation is driven by both electrostatic and hydrophobic interactions and determined by the natures of both surfactant and polyelectrolyte.

The interfacial behavior of novel dicephalic type surfactants N,N-bis[3,3’-(trimethylammonio)propyl]alkylamide dibromides Cn(TAPABr)2 [5] in comparison to their linear standard - 3-[(trimethylammonio)propyl]dodecanamide bromide C12TAPABr and their interactions in mixtures with anionic polyelectrolytes such as λ-carrageenan (CAR) and sodium poly(styrene sulfonate) (PSS) was investigated. Both the kinetics and the reversibility aspects of the adsorption were considered. Polymer/surfactant interactions in aqueous solution have been investigated by surface tension measurements determined by the pendant drop shape analysis method. Mixture of all examined surfactants (differ in structures and surface activity) and polyelectrolytes exhibit a synergistic effect causing considerable decrease in the surface tension. Binding of surfactant to polyions occurs above a point, which is termed as critical aggregation concentration (cac) lower than the critical micelle concentration (cmc) of the pure surfactant in an aqueous solution. The C12(TAPABr)2/PSS mixed systems show higher surface activity than C12(TAPABr)2/CAR systems. Moreover, dicephalic surfactants, as the double charge molecules, distinguish much stronger interactions with PSS in comparison to their linear counterpart with the same alkyl chain length. In case of surfactant/PSS complexes, cac appears at the constant surfactant polyelectrolyte concentration ratio and surface activity of mixture decreases with polyion concentration. The effect of the carrageenan concentration on the values of cac and cmc was found to be very weak and after a certain threshold ratio these complexes may precipitate. Such an effect can be observed for highly charged polyions.

We are convinced that these results provide promising information that will be useful for applications in the new nanocapsules design and nanoencapsulation processes of hydrophobic bioactive substances.