Different Aspects of Polymer-Surfactant Interactions: A Critical Assessment of Their Interfacial and Bulk behaviors with Reference to Conformational Changes

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The present work consists of a detailed investigation on the interaction of surfactants with water-soluble polymers both in aqueous and in aquo-organic media through the advent of both classical and modern experimental techniques. A detailed study of the polymer induced micelle formation of the surfactants, the thermodynamics of their binding, configurational changes of the polymer upon interaction with the surfactants has been undertaken. In this work, biologically compatible polymers such as PVP, inulin, and cationic cellulose, JR400 and hydrophobically modified cationic cellulose, LM200 have been used.

The interaction between SDS and PVP in aqueous and aquo-isopropanol media has been investigated in detail. It is observed that isopropanol (IP) is a good representative for dual characteristics, as ‘co-surfactant’ and ‘co-solvent’ which manifest special influence on the SDS-PVP interaction. It forms mixed micelle with SDS, and reduces the micellar surface charge density that manifests decreased counter ion condensation (lowering in $\beta$). Polymer induced small micelle formation of SDS occurs at a lower surfactant concentration, called critical aggregation concentration (CAC), which is independent of [IP] in solution. On the other hand, the free micelle formation, (CMC)$_f$ is a method dependent quantity because of the differences in the probing features of the methods employed.

The interaction of inulin, a polydisperse reserve polysaccharide, with cationic surfactant, Octadecyltrimethylammonium Bromide (C$_{18}$TAB) has been investigated along with the types of product formed in respect of their shapes, sizes. The surfactants interact with the globular inulin, with their monomers and their assemblies to form complexes and coacervates that disintegrate into smaller species in excess presence of the surfactants following a number of sequential steps. This has been observed by TEM study.

We have also investigated the interaction of Sodium N-Dodecanoyl Sarcosinate (SDDS) with cationic hydroxyethylcellulose, JR400 and hydrophobically modified cationic hydroxyethylcellulose, LM400 in aqueous medium. Their modes of interaction with SDDS are although primarily of electrostatic in nature, hydrophobicity plays a fair role for LM200. Thus, the dodecyl chain attaches to the cationic centers on the substituent helps easier formation of small micelles with lower CAC for LM200 than JR400. For JR400, the normal small micellar entities form and attach to the polymer segments whereas mixed micelles form by the combinations of the hydrophobic cationic substituents and the DDS$^-$ ions of SDDS associating with segmental regions of LM200.

References.