

Thermophysical Behavior of Cationic Surfactant Solutions: Complex Formation Study

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Micellar solutions are widely used in various industrial domains covering a large variety of applications from detergents or paints, to pharmaceuticals, cosmetics, agrochemicals or food-processes. In these complex formulations, surfactants are the fundamental compounds to which several additives are added to reach the request properties. The physical properties of micellar solutions are very sensitive to the nature of the solutes and a large variety of structures are able to form : microemulsions, emulsions or gels.

Dealing with environmental applications, the formation of specific structures between surfactant and solute can be used to reduce toxicological risks in favoring the trapping of some dangerous contaminants. The control of the behavior of these solutions over a large domain of temperature and composition allows the optimization of the removal of some toxic substances in remediation applications.

For that purpose, phenol, a well-known dangerous substance used in many fields such as in polymerization reactions, has been studied in the presence of a cationic surfactant (CTAB). A relatively strong complex is formed between solute and surfactant leading to viscoelastic and gel-like solutions depending on concentrations and temperature. At lower temperatures a crystalline surfactant molecular complex is obtained while at higher temperatures gel-like solutions become fluid. A study of thermodynamic and thermophysical properties is a key tool for understanding and further for the optimization of these systems.

A differential scanning calorimeter (micro-DSC, SETARAM, France) has been used to demonstrate the cristallisation of the molecular surfactant complex. Transport properties (conductometry and rheology) allowed us to study more specifically the gel to solution transition. Finally, with a more sensitive DSC (nano-DSC, CSC, Utah) the thermal effects related to the sol-gel transition were clearly characterized.

The next step is the thermal behavior study of some chlorophenol derivatives in CTAB solutions. The aim is to show the relation between the location of substituted groups on the aromatic ring and the existence of the complex leading to peculiar structures.