

Title: Influence of ionic liquids on the clouding behaviour of pure and mixed surfactant solutions

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Project Overview

Surfactants are amphiphilic molecules with wide range of applications. The reason behind their extensive use is their remarkable ability to influence the properties of surfaces and interfaces, and thus to have an impact on industrial processes and products. Surfactants may be applied to enhance the production and processing of foods, pharmaceuticals, laundry products, and petroleum. They can also be found in medical applications, soil remediation techniques and other environmental, health and safety applications. Surfactants can be classified in various categories for instance cationic, nonionic, anionic, zwitterionic, Gemini/dimeric to name a few. Among many characteristics of surfactants, like critical micelles concentration (CMC), aggregation number (N_{agg}) and kraft point, cloud point (CP) of a nonionic surfactant is one of the most sought after properties. CP can be defined as the characteristic temperature where the surfactant mixture becomes cloudy (i.e., phase separate into two phases). The clouding phenomenon is preferred for some applications whereas in some cases it has to be avoided.

Ionic liquids (ILs) are organic salts composed solely of bulky cations attached to a relatively small anions or vice versa. Due to this charge asymmetry and sterical mismatch they exist as liquid at or near room temperature (≤ 100 °C). ILs are also known as designer solvents as ions can be tailored for a specific task. ILs in dilute solutions are known to behave as simple electrolytes, but they can also form aggregates/micelles in solutions like surfactants do. Their ability to solubilize bio materials is remarkable. It was shown that ILs have the ability to form mixed micelles also, which are of great importance in various applications. Mixed surfactants exhibit enhanced properties compared to single surfactants. Even mixing surfactants or additives to a non ionic surfactant alter the CP of the system considerably.

The aim of the present work is to explore the effect of addition of various hydrophilic and hydrophobic ionic liquids on the clouding phenomena of some common nonionic surfactants. Effect of various salts, alcohols, amines, carbohydrates and amino acids etc. has already been reported in literature. But the structural diversity of ionic liquids gives us the possibility to alter the CPs of some nonionic surfactants solutions in a given

direction more effectively. A correlation with the structural variation of added ionic liquids will also be explored.

Training Objectives

During the research training student will perform:

- (i) Handling novel class of solvents (ionic liquids).
- (ii) Turbidity measurements (visual detection for CP) of mixtures of some nonionic surfactants in presence of various ionic liquids.
- (iii) CP measurements for mixtures of nonionic + other types of surfactants in absence and presence of additives will be carried out.
- (iv) Student will also gain some experience in viscometry, dynamic light scattering (DLS) and ^1H NMR techniques to monitor the micellar growth and morphology.

References

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