Solvents and Solutions for a More Sustainable Future

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Today, there is an increasing quest for more sustainable solvents for many applications, be it in formulations of cosmetics, food, cleaning agents or pharmaceutics, etc., or in industrial processes, like plant extraction or large-scale production of chemicals, for which still (eco-)toxic solvents such as DMF and NMP are used.

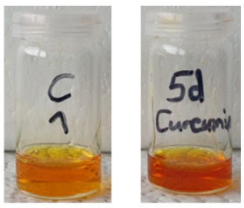
In the present contribution, I will discuss some alternative liquids that are currently still neglected or not yet widely used, but that have a significant potential for future applications. For example, gamma-valerolactone (GVL) shows very promising properties such as a very high solubility power, e.g., for several polymers, together with a very low ecotoxicity, excellent biodegradability, and a complete miscibility with water [1]. Besides other promising solvents, I will also shortly discuss the potential of fashionable Ionic Liquids and Deep Eutectic Solvents (DES).

Clearly, water would be the most sustainable solvent. To use it, often oils or other hydrophobic molecules must be made soluble with the help of appropriate adjuvants. These can be classical surfactants or hydrotropes. We recently found different ways to use natural (and "drinkable") substances as additives. In some cases, they can even stabilise the obtained solutions, e.g., against oxidation, further to enhanced solubility, and have other beneficial effects. [2,3] Even the solubilisation of proteins in water is often a challenge, and I will also discuss this issue. [4]

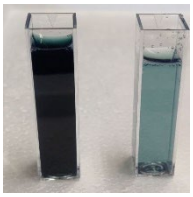
Often the question is, if in water, defined interfaces, as they occur in the case of surfactant solutions, are necessary, e.g. to stabilise catalysts or if a week structuring in so-called surfactant-free microemulsions is sufficient or if even a simple unstructured medium is enough. I will show examples for all three cases [5,6,7].

Finally, I will shortly talk about a new nematic discotic phase made in aqueous solutions with simple surfactants that are admitted in cosmetics, and their possible applications [8].

Curcumin in water

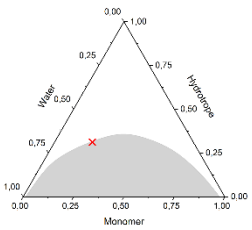


Indigo in water



GVL dissolves PVC

Microemulsion Polymerisation without Surfactants



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