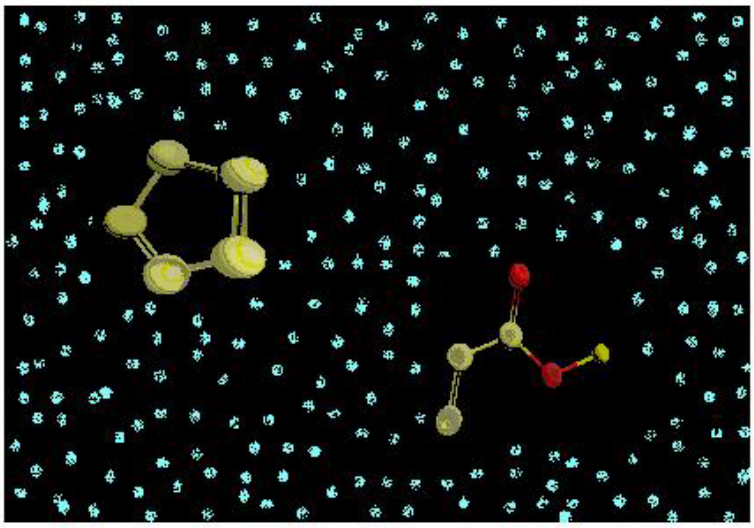
# Faster organic reactions in water

Most reactions in the laboratory and in the chemical industry are performed in volatile organic solvents. Organic solvents are a major source of waste during synthesis. The high vapour pressure of conventional organic solvents makes them hazardous, as the solvents evaporate easily into the air damaging earth's atmosphere. Hence, the chemical processes are being re-evaluated with regard to the use of volatile organic compounds (VOC). Green solvents are being developed as more environment friendly alternative to VOC. Water, supercritical carbon dioxide, ionic liquids, etc. are greener alternatives to the organic solvents.

An ionic liquid is a compound, which is entirely made up of ions and is liquid at room temperature. Ionic liquids are good solvents for a variety of compounds and have no measurable vapour pressure. This makes them desirable substitutes for VOCs. Ionic liquids are emerging as possible green solvents and much attention has been paid to the synthesis and characterisation of room temperature ionic liquids. In the past few years, based on numerous studies, it has been assumed that ionic liquids can be potential substitutes for VOC in the synthetic organic chemistry both in laboratory and industrial processes. Ionic liquids have, therefore, been treated superior to many other solvents used frequently in chemical research. On the other hand, water, the Nature's solvent of choice for ages, has found very limited use as reaction medium in synthetic organic chemistry.

Dr. Anil Kumar and his research group at National Chemical Laboratory (NCL), Pune have been investigating solvent effects for a wide range of organic reactions. The main focus of their research is to study the complex interactions of substrate with solvent molecules, which involves different factors – hydrogen bonding, polarity, solvophobicity, viscosity, internal pressure, etc. The scientists carried out simple Diels-Alder reaction (carbon – carbon bond forming reaction leading to six-member ring) involving cyclopentadiene with methyl acrylate, ethyl acrylate and butyl acrylate both in water and ionic liquids under identical conditions. They found out that the reaction of cyclopentadiene with methyl acrylate is 10-times faster in water as compared to ionic liquid. Similarly, the reactions of cyclopentadiene with ethyl acrylate and butyl acrylate are at least 3 to 4 times faster in water as compared to ionic liquid.



Diffusion of diene and dienophile through viscous ionic liquid

The NCL scientists experimentally demonstrated for the first time that ionic liquids are not superior to "universal solvent: water". The scientists ascribe this observation to the high viscosity of ionic liquids as compared to water. In this investigation, Diels-Alder reactions have been observed to be faster in water than in ionic liquids. The outcome of this research raises an issue whether ionic liquids are really effective solvents in promoting organic reactions.

This work has attracted the attention of the scientific community and was featured in Nature Research Highlights.

Diels-Alder reactions are faster in water than in room temperature ionic liquids: An experimental evidence, Shraeddha Tiwari and Anil Kumar, *Angew. Chem. Int. Ed.* **2006**, 45, 4824

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