

4.1: Introduction to Solvents

In a very general sense, solvents are a class of chemical compounds that allow chemistry to occur. The concept of a solvent has significant ramifications because they serve as the matrix, medium, or carrier for solutes. They are necessary in a number of processes, reactions, and systems. We tend to think of a substance like “water” as a universal solvent because it is so useful in so many disciplines. Water cleans up everything, allows biochemical reactions to occur, is used in paints, coatings, and films, allows cooking to occur (or else everything would catch fire), and provides lubrication and ease of movement for a great many devices.

Interestingly, in the business world, the word “solvent” has another meaning: A state of financial soundness characterized by the ability of an entity to meet its monetary obligations when they fall due. This latter definition does indeed apply in a certain sense to the solvent concept we are espousing in this chapter. A solvent (\$olvent) carries materials for a reaction or specific function in the same sense that solvent from a financial sense carries funding/money to meet its obligations. Thus, using an analogy:

Solvent : Solute :: \$olvent : Money

Chemically, a solvent will dissolve or “solvate” a solute. What does that mean? It means that solvent molecules will surround the solute in such a way that a solution is formed; in other words, a homogeneous system is generated in which the solute is part of/indistinguishable from the solvent network. A solute/solution concept can be visualized in the Figure below:

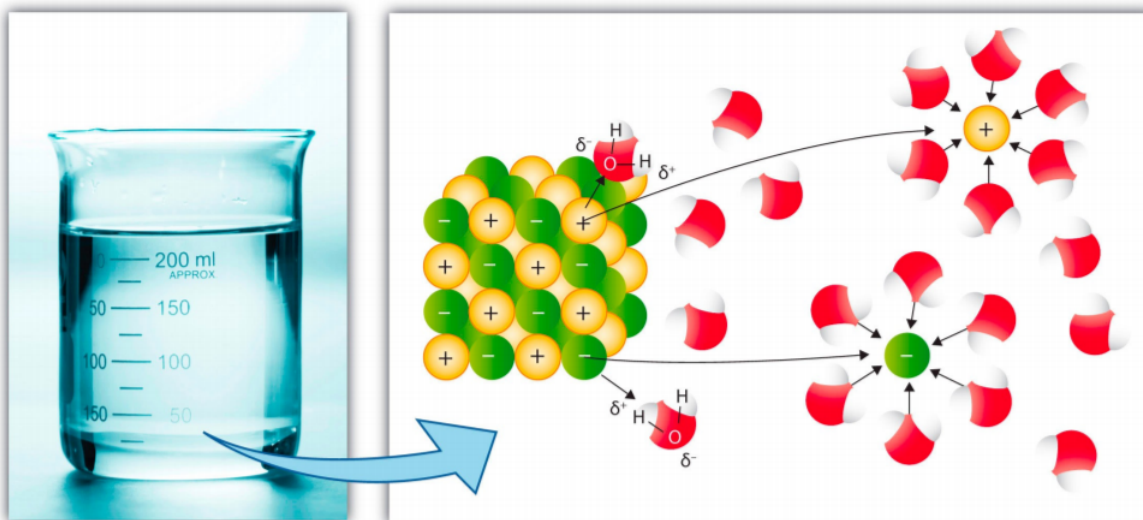


Figure 4.1.1: Shown is a simplified representation of how a solvent such as water can “encapsulate” or cause a solute to go into solution (or be washed away). https://commons.wikimedia.org/wiki/File:Sodium_chloride_dissolution.jpg

Solubility

The ability of one compound to dissolve in some other (likely different) compound is termed “solubility”. Miscibility is another term that characterizes the facility of compound A to dissolve in compound B. When the two compounds can completely dissolve or combine to form a homogeneous solution, the two liquids are said to be miscible. Two that can never blend well enough to form a solution are called immiscible.

All solutions have a positive entropy of mixing whereas the interactions between different compounds may or may not be energetically favored. If interactions are unfavorable, then the free energy decreases with increasing solute concentration. The energy loss may at some point in time outweighs the entropy gain, and no more solute can be dissolved – this is a condition solution in which the solution is said to be saturated. This condition can change with different environmental factors, such as temperature, pressure, and purity of the system. A supersaturated solution can be prepared by raising the solubility (e.g., increasing temperature) to dissolve more solute, and then lowering it by cooling. However, most gases and several compounds exhibit solubilities that tend to drop with raised temperatures. The solubility of liquids in liquids, however, is less temperature sensitive than solids or gases.

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