CHEMICAL SOLUTIONS

SOLUTIONS

Usually the substance present in the greatest amount is considered the solvent. Solvents can be gases, liquids or solids. The solution that forms has the same physical state as the solvent. The substance dissolved in the solvent is the solution. Solutes may also be gases, liquids or solids.

If the solvent is a gas, only gases are dissolved under all given sets of conditions. An example for a gaseous solution is air (oxygen and other gases dissolved in nitrogen). Since interactions between molecules play almost no role, dilute gases form rather trivial solutions. In part of the literature they are not even classified as solutions but addressed as mixtures.

If the solvent is a liquid or solid then gases, liquids and solids can be dissolved.

SOLUBILITY

The ability of one compound to dissolve in another compound is called solubility. When a liquid is able to completely dissolve in another liquid the two liquids are miscible. Two substances that can never mix to form a solution are called immiscible.

All solutions have a positive entropy of mixing. The interactions between different molecules or ions may be energetically factored or not. If interactions are unfavourable then the free energy decreases with increasing solute concentration. At some point the energy loss outweighs the entropy gain and not more solute particles can be dissolved. The solution is said to be saturated.

However the point at which a solution can become saturated can change significantly with different environmental factors such as temperature, pressure and contamination. For some solute-solvent combinations a supersaturated solution can be prepared by raising the solubility to dissolve more solute and then lowering it.

Usually the greater the temperature of the solvent the more of a given solid solute it can dissolve. However most gases and some compounds exhibit solubility's that decrease with increased temperature. Such behaviour is a result of an exothermic enthalpy of solution. Some surfactants exhibit this behaviour. The solubility of liquids in liquids is generally less temperature-sensitive than that of solids or gases.

PROPERTIES

The physical properties of compounds such as melting point and boiling point change when other compounds are added. Together they are called colligative properties. There are several ways to quantify the amount of one compound dissolved in the other compounds collectively called concentration. Examples include molarity, mole fraction and parts per million (PPM).

The properties of ideal solutions can be calculated by the linear combination of the properties of its components. If both solute and solvent exist in equal quantities (such as in a 50% ethanol, 50% water solution) the concepts of "solute" and "solvent" become less relevant but the substance that is more often used as a solvent is normally designated as the solvent (in this example, water).

LIQUID SOLUTIONS

In principal all types of liquids can behave as solvents – liquid noble gases, molten metals, molten salts, molten covalent network and molecular liquids. In the practice of chemistry and biochemistry most solvents are molecular liquids. They can be classified into polar and non-polar according to whether their molecules possess a permanent electric dipole moment.

Another distinction is whether their molecules are able to form hydrogen bonds (protic and aportic solvents). Water is the most commonly used solvent in both polar and sustains hydrogen bonds. Water is a good solvent because the molecules are polar and capable of forming hydrogen bonds. Salts dissolve in polar solvent forming positive and negative ions that are attracted to the negative and positive ends of the solvent molecule, respectively. If the solvent is water, hydration occurs when the charged solute ions become surrounded by water molecules. A standard example is aqueous saltwater. Such solutions are called electrolytes. For non-ionic solutes the general rule is: like dissolves like. Polar solutes dissolve in polar solvents forming polar bonds or hydrogen bonds. Non-polar solutes dissolve better in non-polar solvents.

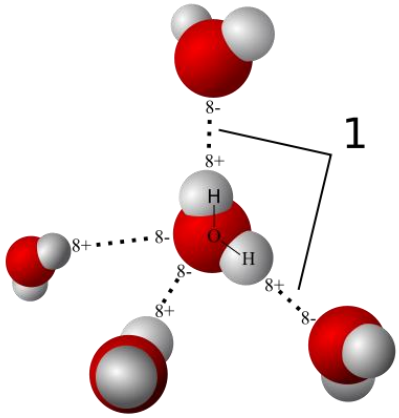
CONCENTRATION

Concentration is the amount of solute contained in a certain amount of solution. Because varying amounts of solute can be dissolved in a solution, concentration is a variable property and need to have a numerical way of indicating how concentrated a solution is. Calculating and expressing the concentration of solutions can be done with percentages using measurements of weight (mass) or volume or both. It can also be done using measurements that more closely relate to ways that chemicals react with one another (moles).

Types of concentration include volume percent, weight percent, weight/volume percent, molarity (the workhorse of chemical concentrations) and normally which can only be calculated when dealing with reactions because normality is a function of equivalents. A solution can be prepared from scratch and each of the components that go into the solution measured. A solution can also be prepared by diluting an existing solution. If an existing solution is coloured its concentration can be determined by measuring the intensity of colour using colorimetric.

MOLARITY

Another way of expressing concentration is molarity which is the number of moles of solute dissolved in one litre of solution. The units are moles of solute per litre of solution. These units are abbreviated as M or M. "Moles" measures the amount or quantity of material: "Molarity" measures the concentration of that material.



The Avogadro Number is 6.024E23

This is a specific number that represents the number of atoms or molecules in a mole of that atom or molecule. The weight of that unit is equivalent to the atomic or molecular weight of the atom or molecule in grams. One mole of carbon-12 has a mass of 12 grams because carbon-12 has an atomic weight of 12 (6 neutrons and 6 protons). One mole of hydrogen would weigh one gram and contains the same number of atoms as one mole of carbon.