

Solubility

The solution produced when equilibrium is established between undissolved and dissolved solute in a dissolution process is termed a *saturated solution*. The amount of substance that passes into solution in order to establish this equilibrium at constant temperature and so produce a saturated solution is known as the *solubility* of the substance. It is possible to obtain supersaturated solutions but these are unstable and precipitation of the excess solute tends to occur readily and spontaneously.

Methods of expressing solubility and concentration

Solubilities may be expressed by any of the variety of concentration terms explained below. In general, solubility is expressed in terms of the maximum mass or volume of solute that will dissolve in a given mass or volume of solvent at a particular temperature and at equilibrium.

Expressions of concentration

Quantity per quantity

Concentrations are often expressed simply as the weight or volume of solute that is contained in a given weight or volume of the solution. The majority of solutions encountered in pharmaceutical practice consist of solids dissolved in liquids. Consequently, concentration is expressed most commonly by the weight of solute contained in a given volume of solution. Although the SI unit is kg m^{-3} the terms that are used in practice are based on more convenient or appropriate weights and volumes. For example, in the case of a solution with a concentration of 1 kg m^{-3} the strength may be denoted by any one of the following concentration terms, depending on the circumstances:

1 g L^{-1} , $0.1 \text{ g per } 100 \text{ mL}$, 1 mg mL^{-1} , $5 \text{ mg in } 5 \text{ mL}$ or $1 \text{ } \mu\text{g } \mu\text{L}^{-1}$.

Percentage

Pharmaceutical scientists have a preference for quoting concentrations in percentages. The concentration of a solution of a solid in a liquid is given by:

$$\text{concentration in \% wv} = \frac{\text{weight of solute}}{\text{volume of solution}} \times 100 \quad (2.7)$$

Equivalent percentages based on weight (w) and volume (v) ratios (expressed as % v/w, % v/v and % w/w) can also be used for solutions of liquids in liquids and solutions of gases in liquids.

It should be realized that if concentration is expressed in terms of weight of solute in a given *volume* of solution then changes in volume caused by temperature fluctuations will alter the concentration.

Parts

Pharmacopoeias give information on the approximate solubility of official substances in terms of the number of 'parts' of solute dissolved in a stated number of 'parts' of solution. Use of this method to describe the concentration of a solution of a solid in a liquid suggests that a certain number of parts by weight (g) of solid are contained in a given number of parts by volume (mL) of solution. In the case of solutions of liquids in liquids, parts by volume of solute in parts by volume of solution are intended, whereas with solutions of gases in liquids, parts by weight of gas in parts by weight of solution are inferred. The use of 'parts' in scientific work, or indeed in practice, is not recommended as there is the chance for some degree of ambiguity.

Molarity

This is the number of moles of solute contained in 1 dm^3 (or more commonly expressed in pharmaceutical science as 1 litre) of solution. Thus, solutions of equal molarity contain the same number of solute molecules in a given volume of solution. The unit of molarity (M) is mol L^{-1} (equivalent to 10^3 mol m^{-3} if converted to the strict SI unit).

Molality

This is the number of moles of solute divided by the mass of the solvent, i.e. its SI unit is mol kg^{-1} . Although it is less likely to be encountered in pharmaceutical science than the other terms, it does offer a more precise description of concentration because it is unaffected by temperature.

Mole fraction

This is often used in theoretical considerations and is defined as the number of moles of solute divided