

9.4 LIQUID-LIQUID DISTRIBUTION (SOLVENT EXTRACTION)

9.4.1 General Definitions

Antagonism

The converse to *synergism*.

Note: The terms *anti-synergism*, *antisynergic* and *anti-synergistic* should not be used.

Coextraction

Formation of mixed-species aggregates in a low-polarity organic phase.

Conditioning

A synonym for *pre-equilibration*.

Distribution

The apportionment of a solute between two phases.

Note: The term *partition* or *extraction* may also be used in this sense where appropriate.

Distribution Isotherm

The relationship (algebraic or graphical) between the concentration of a solute in the *extract* and the corresponding concentration of the same solute in the other phase at equilibrium at a specified temperature.

Note: Alternative terms in common use are *equilibrium line* and in the appropriate contexts: *extraction isotherm*, *scrubbing isotherm* and *stripping isotherm*. *Partition isotherm* is not normal usage.

Equilibration

The operation by which a system of two or more phases is brought to a condition where further changes with time do not occur.

Note: This term is *not* synonymous with *pre-equilibration* and should not be used in that sense.

Equilibrium Line

A plot of the *distribution isotherm*.

Extract (verb)

To transfer a solute from a liquid phase to another immiscible or partially miscible liquid phase in contact with it.

Notes:

- (i) The term is also applied to the dissolution of material from a solid phase with a liquid in which it is not wholly soluble (i.e. *leaching*). See *solvent extraction*.
- (ii) For usage as a noun see section 9.4.2, Components of the Solvent Phase.

Extraction (in liquid-liquid distribution)

See *liquid-liquid extraction*.

Notes:

- (i) See section 9.4.4, Process Terminology for a more specific usage of *extraction*.
- (ii) *Distribution* and *partition* are often used as synonyms for the general phenomenon of *extraction* where appropriate.

Liquid ion exchange

A term used to describe a liquid-liquid extraction process that involves a transfer of ionic species from the extractant to the aqueous phase in exchange for ions from the aqueous phase.

Notes:

- (i) The term does not imply anything concerning the nature of the bonding in the extracted complex.
- (ii) The term "*Solvent Ion Exchange*" (SIX) is not recommended.

Liquid-liquid distribution (extraction) (partition)

The process of transferring a dissolved substance from one liquid phase to another (immiscible or partially miscible) liquid phase in contact with it.

Note: Although *extraction*, *partition* and *distribution* are not synonymous, *extraction* may replace *distribution* where appropriate.

Macro-element

See *Main solute*.

Notes:

- (i) This term is vague and is not recommended.
- (ii) Macroelement has a different meaning in analytical chemistry and the term *major component*, the meaning of which is obvious, is preferable.

Main (extractable) solute

That (or those) species transferred which is of greatest economic or chemical interest.

Note: It is not necessarily the species present at greatest concentration.

Micro-element

This term should *not* be used in the sense of a minor component or a *contaminant* in the feed to a liquid-liquid distribution system.

Note: Microelement has a different meaning in analytical chemistry and the terms *minor component*, *impurity* or *contaminant* the meaning of which are obvious, are preferable.

Partition

This term is often used as a synonym for *distribution* and *extraction*. However, an essential difference exists by definition between *distribution constant* or *partition ratio* and *partition constant*.

Note: This term should be, but is not invariably, applied to the distribution of a single definite chemical species between the two phases.

Pre-equilibration

- (i) Preliminary treatment of a solvent in order to convert the extractants into a suitable chemical form.
- (ii) Preliminary treatment of either phase with a suitable solution of the other phase (in the absence of *main extractable solute(s)*) so that when the subsequent *equilibration* is carried out changes in the (volume) *phase ratio* or in the concentrations of other components are minimized.

Notes:

- (i) The use of *equilibration* in this sense is confusing and should be avoided.
- (ii) The term *conditioning* may be used as a synonym for *pre-equilibration*.

Re-extraction

Since the prefix "re-" can signify "back" as well as "again" this term is ambiguous and *should be avoided*, except where the process of extraction (e.g. from aqueous solution to an organic phase) in a single direction is repeated (following stripping). It should not be used as a synonym for *stripping* or *back-extraction*.

Salting out

The addition of particular electrolytes to an aqueous phase in order to increase the *distribution ratio* of a particular solute.

Notes:

- (i) The addition of electrolytes to improve phase separation behavior should not be referred to as salting out.
- (ii) The term is also used for the addition of electrolytes to reduce the mutual partial miscibility of two liquids.
- (iii) It has no connection with *synergism*.

Solvent Extraction

The process of transferring a substance from any matrix to an appropriate liquid phase. If the substance is initially present as a solute in an immiscible liquid phase the process is synonymous with *liquid-liquid extraction*.

Notes:

- (i) If the extractable material is present in a solid (such as a crushed mineral or an ore) the term *leaching* may be more appropriate. The extractable material may also be a liquid entrapped within or adsorbed on a solid phase.
- (ii) Common usage has established this term as a synonym for *liquid-liquid distribution*. This is acceptable provided that no danger of confusion with extraction from solid phases exists in a given context.

Solvent Ion Exchange (SIX)

This term is not recommended (see *Liquid ion exchange*).

Sublation

A flotation process in which the material of interest, adsorbed on the surface of gas bubbles in a liquid, is collected on an upper layer of immiscible liquid.

Note: There is no liquid-phase mixing in the bulk of the system; as a result recoveries can approach 100%.

Substoichiometric Extraction

Here the amount of reagent used is lower than that dictated by stoichiometry. If the constants of formation and extraction of the complexes are high, the amount of extracted metal is dictated by the amount of extractant introduced.

Synergism

A term describing the co-operative effect of two (or more) *extractants* where the *distribution ratio* for the combination is greater than the largest individual *distribution ratio* (measured under comparable conditions)

Notes:

- (i) The corresponding adjective is *synergic* and the term *synergistic* should not be used.
- (ii) No standard method for quantification of the phenomenon has been agreed and any approach should be clearly defined in a given situation.