9.2.3.2 The Column

Column

The tube and the stationary phase contained within, through which the mobile phase passes.

Packed Column

A tube containing a solid packing.

Open-Tubular Column

A column, usually having a small diameter in which either the inner tube wall, or a liquid or active solid held stationary on the tube wall acts as the stationary phase and there is an open, unrestricted path for the mobile phase.

Wall-Coated Open-Tubular (WCOT) **Column**

In these columns the liquid stationary phase is coated on the essentially unmodified smooth inner wall of the tube.

Porous-Layer Open-Tubular (PLOT) **Column**

In these columns there is a porous layer on the inner wall. Porosity can be achieved by either chemical means (e.g., etching) or by the deposition of porous particles on the wall from a suspension. The porous layer may serve as a support for a liquid stationary phase or as the stationary phase itself.

Support-Coated Open-Tubular (SCOT) **Column**

A version of a PLOT column in which the porous layer consists of support particles and was deposited from a suspension.

Capillary Column

A general term for columns having a small diameter. A capillary column may contain a packing or have the stationary phase supported on its inside wall. The former case corresponds to *Packed Capillary Column* while the latter case corresponds to an *Open-Tubular Column*. Due to the ambiguity of this term its use without an adjective is discouraged.

Column Volume (V_c)

The geometric volume of the part of the tube that contains the packing:

$$V_c = A_c\, L$$

where A_c is the internal cross-sectional area of the tube and L is the length of the packed part of the column.

In the case of wall-coated open-tubular columns the column volume corresponds to the geometric volume of the whole tube having a liquid or a solid stationary phase on its wall.

Bed Volume

Synonymous with *Column Volume* for a packed column.

Column Diameter (d_c)

The inner diameter of the tubing.

Column Radius (r_c)

The inside radius of the tubing.

Column Length *(L)*

The length of that part of the tube which contains the stationary phase.

Cross-Sectional Area of the Column (A_c)

The cross-sectional area of the empty tube:

$$A_c = \pi\, r_c^2 = \pi\, (d_c/2)^2$$

Interparticle Volume of the Column (V_o)

The volume occupied by the mobile phase between the particles in the packed section of a column. It is also called the *Interstitial Volume* or the *Void Volume* of the column.
In liquid chromatography, the interparticle volume is equal to the mobile-phase holdup volume (V_M) in the ideal case, neglecting any extra-column volume.

In gas chromatography, the symbol V_G may be used for the interparticle volume of the column. In the ideal case, neglecting any extra-column volume, V_G is equal to the corrected gas hold-up volume (V_M^o) (see *Mobile Phase Compressibility Correction Factor* and *Corrected Gas Hold-up Volume*:

$$V_G = V_M^o = V_M\, j$$

Interparticle Porosity (ε)

The interparticle volume of a packed column per unit column volume:

$$\varepsilon = V_o / V_c$$

It is also called the *Interstitial Fraction* of the column.

Extra-column Volume

The volume between the effective injection point and the effective detection point, excluding the part of the column containing the stationary phase. It is composed of the volumes of the injector, connecting lines and detector.

Dead-Volume

This term is also used to express the extra-column volume. Strictly speaking, the term "dead-volume" refers to volumes within the chromatographic system which are not swept by the mobile phase. On the other hand, mobile phase is flowing through most of the extra-column volumes. Due to this ambiguity the use of the term "dead-volume" is discouraged.

Liquid-Phase Film Thickness (d_f)

A term used in connection with open-tubular columns to express the average thickness of the liquid stationary phase film coated on the inside wall of the tubing.

Stationary-Phase Volume (V_S)

The volume of the liquid stationary phase or the active solid in the column. The volume of any solid support is not included. In the case of partition chromatography with a liquid stationary phase, it is identical to the *Liquid-Phase Volume* (V_L).

Mass (Weight) of the Stationary Phase (W_S)

The mass (weight) of the liquid stationary phase or the active solid in the column. The mass (weight) of any solid support is not included. In the case of partition chromatography with a liquid stationary phase it is identical to the *Liquid Phase Mass (Weight)* (W_L).

Phase Ratio (β)

The ratio of the volume of the mobile phase to that of the stationary phase in a column:

$$\beta = V_o / V_S$$

In the case of open-tubular columns the geometric internal volume of the tube (V_c) is to be substituted for V_o.

Specific Permeability (B_0)

A term expressing the resistance of an empty tube or packed column to the flow of a fluid (the mobile phase). In the case of a packed column

$$B_0 = \frac{d_p^2 \varepsilon^3}{180(1-\varepsilon)^2} \approx \frac{d_p^2}{1000}$$

In the case of an open-tubular column

$$B_0 = \frac{r_c^2}{8}$$

Flow Resistance Parameter (Φ)

This term is used to compare packing density and permeability of columns packed with different particles; it is dimensionless.

$$\Phi = d_p{}^2/B_o$$

where d_p is the average particle diameter. In open-tubular columns $\Phi = 32$.