9.2.3.10 Terms Expressing the Efficiency of Separation

Peak Resolution (R_s)

The separation of two peaks in terms of their average peak width at base ($t_{R2} > t_{R1}$):

$$R_s = \frac{(t_{R2} - t_{R1})}{(w_{b1} + w_{b2})/2} = \frac{2(t_{R2} - t_{R1})}{w_{b1} + w_{b2}}$$

In the case of two adjacent peaks it may be assumed that $w_{b1} \approx w_{b2}$, and thus, the width of the second peak may be substituted for the average value:

$$R_s \approx (t_{R2} - t_{R1})/w_{b2}$$

Separation Number (SN)

This expresses the number of peaks which can be resolved in a given part of the chromatogram between the peaks of two consecutive *n*-alkanes with *z* and (*z* + 1) carbon atoms in their molecules:

$$SN = \frac{t_{R(z+1)} - t_{Rz}}{w_{hz} + w_{h(z+1)}} - 1$$

In the German literature the symbol TZ (*Trennzahl*) is commonly used to express the separation number.

As the separation number depends on the *n*-alkanes used for the calculation, they always must be specified with any given SN value.

Plate Number (N)

A number indicative of column performance, calculated from the following equations which depend on the selection of the peak width expression (see *Peak Width*):

$$N = (V_R/\sigma)^2 = (t_R/\sigma)^2$$

$$N = 16(V_R/w_b)^2 = 16(t_R/w_b)^2$$

$$N = 5.545(V_R/w_h)^2 = 5.545(t_R/w_h)^2$$

The value of 5.545 stands for 8ln 2 (see *Peak Widths*). These expressions assume a Gaussian (symmetrical) peak. In these expressions the units for the quantities inside the brackets must be consistent so that their ratio is dimensionless: i.e., if the numerator is a volume, then peak width must also be expressed in terms of volume.

Note: In former nomenclatures the expressions "Number of Theoretical Plates" or "Theoretical Plate Number" were used for the same term. For simplification, the present name is suggested.

Effective Plate Number (N_{eff})

A number indicative of column performance calculated by using the adjusted retention volume (time) instead of the total retention volume (time). It is also called the *Number of Effective Plates:*

$N_{eff} = (V_R'/\sigma)^2 = (t_R'/\sigma)^2$

$N_{eff} = 16(V_R'/w_b)^2 = 16(t_R'/w_b)2$

$N_{eff} = 5.545(V_R'/w_h)^2 = 5.545(t_R'/w_h)^2$

The plate number and effective plate number are related to each other:

$$N = N_{eff}\left[\frac{k+1}{k}\right]^2$$

where k is the *Retention Factor*.

Notes: In the former literature the expression "number of effective theoretical plates" had been used to express this term. This is incorrect since the plate number is either theoretical or effective, but cannot be both.

In former nomenclatures the respective symbols n and N have been used for the plate number and the effective plate number. However, there was often a confusion in the proper selection of lower case and capital letters; therefore, the present usage, characterizing the effective plate number by a subscript, is suggested.

Plate Height (H)

The column length (L) divided by the plate number:

$$H = L/N$$

It is also called the *Height Equivalent to One Theoretical Plate* (HETP).

Effective Plate Height (H_{eff})

The column length divided by the effective plate number:

$$H_{eff} = L/N_{eff}$$

It is also called the *Height Equivalent to One Effective Plate*.

Notes: In the former literature the expression "height equivalent to one effective theoretical plate" had been used to express this term. This is incorrect, since the plate height is either theoretical or effective (see *Effective Plate Number*), but cannot be both.
In former nomenclatures the respective symbols h and H have been used for the plate height and the effective plate height, respectively. However, there was often a confusion in the proper selection of lower case and capital letters and also due to the fact that h (lower case letter) is also used to express the *Reduced Plate Height*. The present usage is suggested in order to avoid any confusion.

Reduced Plate Height (h)

A term used in liquid chromatography. It is the ratio of the plate height to the average particle diameter:

$$h = H/d_p$$

For open-tubular columns:

$$h = H/d_c$$