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Note

Plate height in porous-layer open-tubular columns

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The mass transfer terms in a porous-layer open-tubuar column were derived in a previous paper[1]. The full equation, using these terms, correcting some typographical errors, adding the gas compressibility corrections, replacing the f of the previous paper by $(1 - R)/(1 - \Phi R)$, and converting the nomenclature to terms more usual in gas chromatography, is

$$H = \frac{2D_{g1}jf}{\bar{v}p_o} + \left\{\frac{(6\Phi^2R^2 - 16\Phi R + 11)(r - d)^2}{24} + \frac{2(1 - \Phi R)^2 d^2}{3(1 - \Phi)\gamma_p}\right\}\frac{\bar{v}p_o f}{jD_{g1}} + \frac{q_1 R(1 - R)^2 d_1^2 \bar{v}}{D_1(1 - \Phi R)}$$

where

d = depth of porous layer
d_1 = depth of liquid stationary phase at its deepest point
D_{g1} = diffusivity of sample in carrier gas at unit pressure
D_l = diffusivity of sample in liquid stationary phase
f = Giddings compressibility factor, $9(P^4 - 1)(P^2 - 1)/8(P^3 - 1)^2$
j = James-Martin compressibility factor, $3(P^2 - 1)/2(P^3 - 1)$
H = plate height
P = inlet pressure/outlet pressure
p_o = outlet pressure in same units as D_{g1}
q_1 = geometrical factor for liquid stationary phase
R = relative zone velocity, elution time of unretained sample/elution time of sample
r = total radius of column (including porous layer)
$\bar{v}$ = mean velocity, column length/elution time of unretained sample
γ_p = obstruction factor for diffusion within the porous layer
Φ = fraction of the mobile phase which is outside the porous layer

REFERENCE

1 S. J. Hawkes, *J. Chromatogr.*, 68 (1972) 1.