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Note

An optimization problem in capillary gas chromatography: a generalization

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In a former note[1], the conditions were considered under which a capacity ratio would be optimal for the separation of the last component to be eluted from a column.

When the component for which separation should be optimized is not the last component, the formulae derived earlier should be modified as follows.

Let k designate the capacity ratio of the component for which optimal separation should be realized, and let αk, with $\alpha > 1$, designate the capacity ratio of the last component desired for the record. All considerations elaborated in the earlier note[1] are valid up to eqn. 4a. In this equation, however, the time of passage of the component of interest, t_s, should be expressed as a function of the time of passage, t_e, of the last component by the formula:

$$t_s = \frac{1 + k}{1 + \alpha k} t_e$$

We obtain then:

$$Q\ (k, b, \alpha) = \frac{k}{216^{1/4}\ (1 + \alpha k)^{1/4}\ (1 + k) \left[\frac{1}{48} f_k + \frac{bk^3}{9\ (1 + k)^2}\right]^{1/4}}$$

where:

$$\frac{\Delta t_s}{\Delta t_b} = \varepsilon \left(\frac{p_i t_e}{\mu}\right)^{1/4} Q(k, b, \alpha)$$

The table given earlier for the parameters of interest should then be extended as follows for three selected values of α:

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α = 1

b =	0	0.1	0.3	1	3	10	30	100
k =	2.692	2.366	2.032	1.581	1.206	0.899	0.713	0.593
Q =	0.221	0.216	0.208	0.192	0.170	0.141	0.113	0.087
y =	2.599	2.547	2.475	2.327	2.113	1.790	1.430	1.009

α = 3

b =	0	0.1	0.3	1	3	10	30	100
k =	2.148	1.929	1.684	1.326	1.011	0.741	0.570	0.450
Q =	0.177	0.174	0.169	0.158	0.142	0.120	0.098	0.076
y =	2.713	2.680	2.632	2.525	2.361	2.095	1.774	1.361

α = 10

b =	0	0.1	0.3	1	3	10	30	100
k =	1.892	1.713	1.503	1.185	0.896	0.643	0.477	0.355
Q =	0.135	0.133	0.129	0.122	0.111	0.095	0.079	0.062
y =	2.786	2.764	2.732	2.658	2.541	2.345	2.100	1.761

REFERENCE

1 M. J. E. Golay, *J. Chromatogr.*, 348 (1985) 416–420.