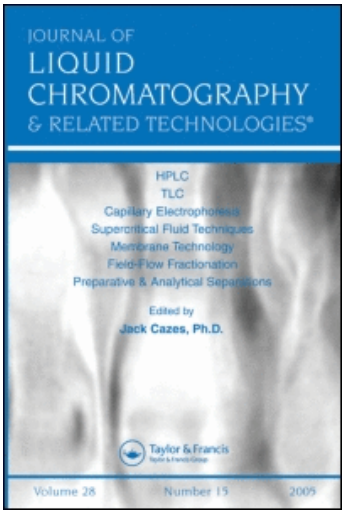

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Relative Retention in TLC r_{ij} Using Column Liquid Chromatography Terms

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Relative Retention in TLC r_{ij} Using Column Liquid Chromatography Terms

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Abstract: Using new approaches for conversion of TLC retention data in terms of column liquid chromatography (CLC), a new term of relative retention r_{ij} for TLC is proposed:

$$r_{ij} = \frac{l_{ri}}{l_{rj}} \cdot \frac{l_j}{l_i}$$

The new relative retention term r_{ij} can be used in TLC as a chromatographic constant. It was shown that $r_{ij} \neq R_{fi}/R_{fj}$. Different meanings of retention terms in CLC and TLC mode are compared.

Keywords: TLC, Relative retention, Relative retention in TLC, Comparison TLC and CLC

INTRODUCTION

The nature of chromatographic processes in column liquid chromatography (CLC) and thin-layer chromatography (TLC) is practically the same (see, for example, Refs.[1–3]). Therefore, it is desirable to use the same terms for retention characteristics in CLC and TLC.

The principal task of this work was to suggest a new equation for determination relative retention r_{ij} using linear values from the TLC chromatogram. Relative retention r_{ij} in column chromatography has a clear meaning and a high tolerance to various handicaps (see, for example, Ref.[4]).

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Without any doubt, this property of relative retention must be manifested in TLC as well.

In a published paper[5] the authors discussed the determination of retention factor k_i in TLC and proposed new equations for its calculation. New ideas were also suggested about the peculiarities of TLC and CLC. In Table 1 and Figure 1, we can see the main ideas of our approaches concerning relative retention values in TLC. The main task of this paper is to suggest the equation for determination relative retention in TLC.

EQUATIONS FOR DETERMINATION OF RELATIVE RETENTION r_{ij}

In CLC,[6] "relative retention is the ratio of the net retention volume (time) or retention factor of a component (i) relative to that of a standard (j), obtained under identical conditions."

$$r_{ij} = \frac{V_{Ni}}{V_{Nj}} = \frac{k_i}{k_j} \tag{1}$$

Using k_i and k_j (see ref. [5]), it is possible to write:

$$k_i = \frac{l_{ri}}{l_i} \tag{2}$$

and

$$k_j = \frac{l_{rj}}{l_j} \tag{3}$$

Table 1. Different meanings of retention terms in CLC and TLC mode

Characteristics	Column chromatography (CLC) (in elution mode)	Classical TLC (in developing mode)
Retention time	The retention time is different for the different separated compounds (elutes)	The retention time is the same for all chromatographed compounds
Total retention volume	The total retention volume is different for all compounds (elutes)	The total retention volume is the same for all chromatographed compounds
Hold-up time (dead time)	The hold-up time is the same for all compounds (elutes)	The hold-up time is the same for all chromatographed compounds
Hold-up volume (dead volume)	The column hold-up volume is the same for all compounds (elutes)	The hold-up volume is different for all chromatographed compounds

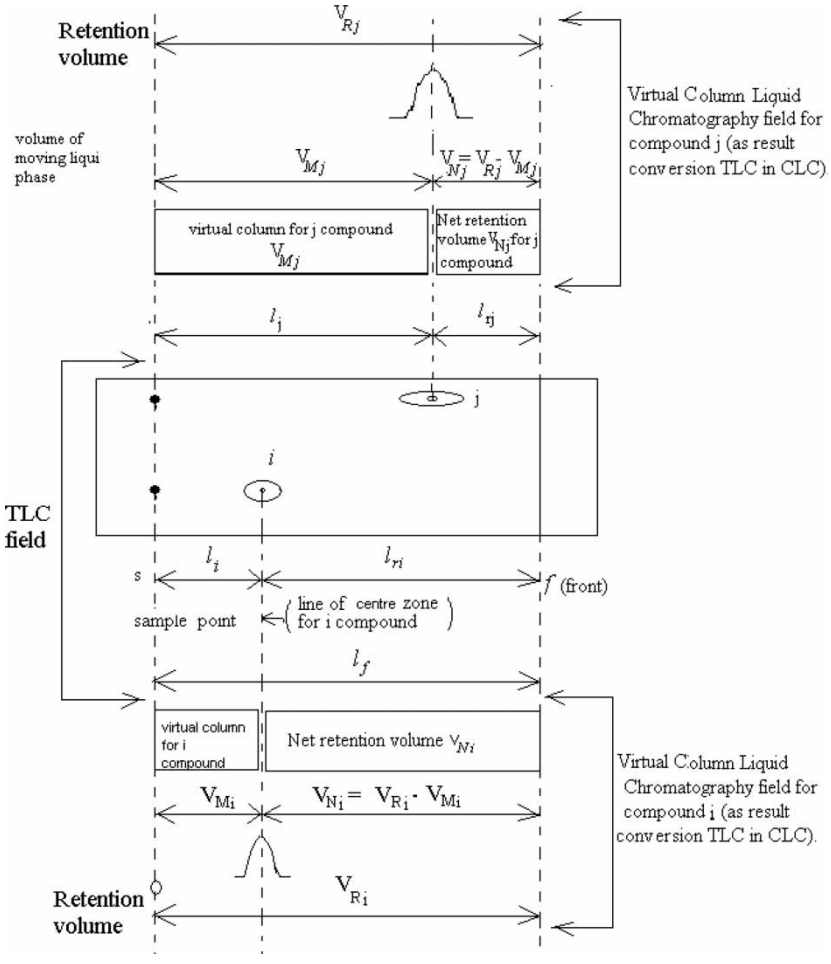

Figure 1. The physico-chemical concept of conversion terms TLC to CLC, using virtual columns, corresponding eluted compounds (on this Figure only two compounds *i* and *j*). V_{Ri} and V_{Rj} are the total retention volumes for compounds *i* and *j*, V_{Ni} and V_{Nj} are the net retention volumes and V_{mi} and V_{mj} are the hold-up volumes (or the dead volumes).

Consequently, using equations (1–3), it is possible to determine relative retention r_{ij} in the values of the TLC chromatogram (see Fig. 1):

$$r_{ij} = \frac{l_{ri}}{l_{rj}} \cdot \frac{l_j}{l_i} \tag{4}$$

It is appropriate to use relative retention data also in TLC because, as a rule, relative retention values are in more constant experimental data. So, r_{ij} is constant when using a sorption system and using conditions of measurement.

As is known,[2,6]

$$k_i = \frac{K_i}{\beta} \tag{5}$$

where K_i is the distribution constant for the ith compound; $\beta = V_m/V_{sph}$, where V_m is the volume of the moving phase in the sorption layer, V_{sph} is the volume of the stationary phase in the sorption layer in a TLC plate. Therefore,

$$r_{ij} = \frac{k_i}{k_j} = \frac{K_i}{K_j} = \frac{l_{ri}}{l_{rj}} \cdot \frac{l_j}{l_i} = const \tag{6}$$

Equation (6) can be used for application in TLC as a method for measurement of physico-chemical values.

In this paper it was proposed to use the new values l_{ri} and l_{rj} (see Fig. 1) for design of retention equations in TLC.

COMMENTARY ON "NOMENCLATURE FOR CHROMATOGRAPHY"

According to CLC in "Nomenclature for Chromatography,"[6] there was no corresponding term for relative retention in TLC. For instance, in the nomenclature of the IUPAC, we can find the following determination for relative retention: "3.8.06. Relative Retardation (R_{rel}). This term is equivalent to the relative retention used in column chromatography: it is the ratio of the R_F value of a component to the R_F value of a standard (reference) substance. Since the mobile phase front is common for the two components, the R_{rel} value can be expressed directly as the ratio of the distances traveled by the spot of compound of interest (b_i) and the reference substance (b_{st}), respectively.[6]

$$R_{rel} = R_{Fi}/R_{F(st)} = \frac{b_i}{b_{st}} \tag{7}$$

In the designations of this paper,

$$R_{rel} = R_{relij} = \frac{l_i}{l_j} \tag{8}$$

Unfortunately, R_{rel} (Eq. (8)) is not equivalent to the relative retention R_{relij} used in column chromatography:

$$\frac{l_i}{l_j} \neq \frac{l_j}{l_i} \cdot \frac{l_{ri}}{l_{rj}} \tag{9}$$

and it follows, that

$$R_{relij} \neq r_{ij} \tag{10}$$

Consequently, R_{relij} is not equivalent to the relative retention used in column chromatography and it is necessary to use r_{ij} as relative retention (see equation (4)).

The relative retention values, as a rule, are not used in TLC, although these values have a simple physically meaning and, as with all relative values, are characterized by better reproducibility. It is worthwhile to use this type of relative retention value more widely than has been done previously.

CONCLUSION

Historically, in TLC and CLC, chromatographers use different relative retention values (or different scientific languages). It has been suggested, for TLC, that the new equation for relative retention r_{ij} should be used. These new equations are in agreement with the basic *i* common characteristics of CLC and TLC.

It is desirable to use, in TLC, the relative retention

$$r_{ij} = \frac{l_{ri}}{l_{rj}} \cdot \frac{l_j}{l_i}$$

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