Binary Chromatography

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Note: The material covered in the class can be studied in:

Mazzotti M. "Local equilibrium theory for the binary chromatography of species subject to a generalized Langmuir isotherm", *Ind. Eng. Chem. Res.* **45** (2006) 5332-5350

In order to facilitate the use of the material on this paper, it is worth noting the differences with respect to the notation used in the class.

With reference to eq. (1), i.e. the material balance equation (conservation law), the space coordinate x is dimensionless and defined as $x = z/L$, with reference to the variables used in the class; accordingly the dimensionless time τ is defined as $\tau = tV/L$, again in terms of the variables used in the lecture. As a consequence, the dimensionless slope of the characteristics in the physical plane of coordinates (x, τ) is given as $\sigma_j = 1 + \theta_j$, i.e. without dividing by V as in the lecture.

Another way of seeing the analogy between the equations in the paper and those used in the lecture is to look at the equations in the paper as those in the lecture where the column length is L=1 (in arbitrary units, e.g. cm) and the interstitial velocity is V=1 (in consistent units, e.g. cm/min).

Another important difference is that the paper deals with a generalized Langmuir isotherm, as defined in eqs. (11) and (12). The Langmuir isotherm considered in the lecture and that you have to study is a special case of eq. (12) where $p_1 = p_2 = 1$. Please, consider only this simple case in the paper and ignore the other possible values of these two parameters. Moreover the Henry's constant is defined as $H_i = K_i N_i$.

Having said that, let me list the equations that we have derived in the lecture according to the numbering in the paper; you can ignore all the others:

- eqs. (1) to (10);
- eqs. (11) to (19) ;
- eqs. (22) to (26);
- eqs. (29) to (31);
- eq. (34);
- eqs. (37) to (41);
- we have not derived eq. (42), but this is very practical to calculate the ω values for a given composition state (c_1, c_2) without going through the values of the ζ parameters;

- eq. (44) and eq. (55);
- eqs. (82) to (84) (see also Table 1 for a summary of the results related to an elution-type of Riemann problem);
- eqs. (88) to (90) (see also Table 2 for a summary of the results related to an adsorption-type of Riemann problem);
- eqs. (94) to (96) (see also Table 3 for a summary of the results related to an chromatographic-cycle-type of Riemann problem; see also Figure 4 (b), (c) and (d) for an illustration of the solution of this Riemann problem in the hodograph plane, in the physical plane and as elution profile at the column outlet).