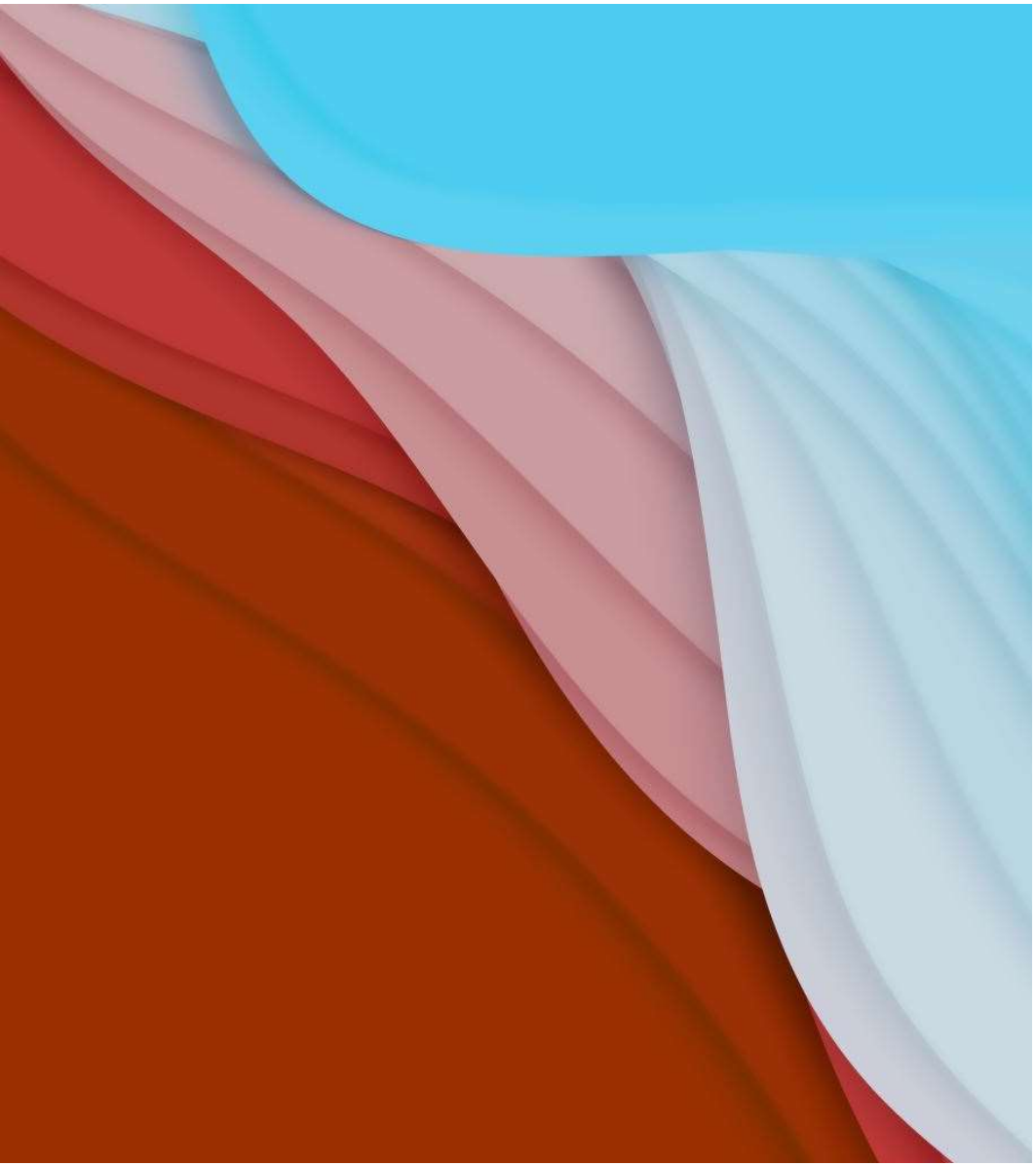

CEN416
PROCESS DESIGN II

Lewis-Matheson method

The method proposed by **Lewis and Matheson** is essentially the application of the Lewis-Sorel method to the solution of multicomponent problems.

Constant molar overflow is assumed and the material balance and equilibrium relationship equations are solved stage by stage starting at the top or bottom of the column.

Lewis-Matheson method

The usual procedure is to start the calculation at the top and bottom of the column and proceed toward the feed point.

The initial estimates of the component distributions in the products are then revised and the calculations repeated until the compositions calculated from the top and bottom starts mesh, and match the feed at the feed point.

Lewis-Matheson method: details

If a mixture of components **A**, **B**, **C**, **D**, and so on has mole fractions x_A, x_B, x_C, x_D, and so on in the liquid and y_A, y_B, y_C, y_D, and so on in the vapour, then:

$$y_A + y_B + y_C + y_D + \ldots = 1 \quad (1)$$

$$y_A/y_B + y_B/y_B + y_C/y_B + y_D/y_B + \ldots = 1/y_B \quad (2)$$

$$y_i/y_B = \alpha_{iB}\, x_i/y_B \quad (3)$$

$$_{AB}\, x_A/x_B + \ _{BB}\, x_B/x_B + \ _{CB}\, x_C/x_B + \ _{DB}\, x_D/x_B + \ldots = 1/y_B \quad (4)$$

$$\sum_{i=1}^{N} \alpha_{iB} x_i = x_B/y_B \quad (5)$$

$$\Big/ \sum_{i=1}^{N} \alpha_{iB} x_i \quad (6)$$

$$y_A = x_A \sum_{i=1}^{N} \alpha_{iA} x_i \ ; \quad y_C = x_C \sum_{i=1}^{N} \alpha_{iC} x_i \ ; \quad y_D = x_D \sum_{i=1}^{N} \alpha_{iD} x_i \ ; \quad (7)$$

Thiele-Geddes method

The variables specified in the basic method:

1. Reflux temperature.
2. Reflux flow rate.
3. Distillate rate.
4. Feed flows and condition.
5. Column pressure.
6. Number of equilibrium stages above and below the feed point.

Relaxation methods

With the exception of this method, all the methods described solve the stage equations for the steady-state design conditions.

In an operating column other conditions will exist at start-up, and the column will approach the "design" steady-state conditions after a period of time.

The stage material balance equations can be written in a finite difference form, and procedures for the solution of these equations will model the unsteady-state behaviour of the column.

Linear algebra methods

If the equilibrium relationships and flow-rates are known (or assumed) the set of material balance equations for each component is linear in the component compositions.

Whit the aim of a numerical method these equations are solved simultaneously and the results used to provide improved estimates of the temperature and flow profiles.

REFERENCES

1. Sinnot, R.K. 1999, Coulson's & Richardson's Chemical Engineering, Volume 6, Chemical Engineering Design, ButterWorth Heinemann, Oxford.

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