Simulated Moving Bed (SMB) chromatographic processes are continuous processes developed for the separation of binary mixtures which are extensively used in petrochemical, food, pharmaceutical, cosmetics and others industries.

**CHROMATOGRAPHIC PROCESS**

A batch chromatographic process consists of a column filled with adsorbent, in which a binary mixture is injected. By adding solvent, the feed mixture components start travelling through the column with different speeds making the extraction of each one of them at the output of the column.

**SMB PROCESS**

The SMB process consists of a set of columns connected in series. The liquid flow is each zone is controlled by pumps situated at the input/output ports. Counter-current movement is obtained by rotating the columns in the direction of the solid phase, at the end of each cycle.

**Controller design**

**THE FOOT-POINT MODEL**

\[
\dot{\phi}_j(k+1) = \frac{\theta_j - Q_j(k) I \tau_j(k) T_{sw}(k)}{Q_j(k+1) T_{sw}(k+1)}, \quad j = I, \ldots, IV
\]

\[
\theta_j = \theta_{sw} = \frac{A_L(H_C J + F)}{(F + I)} \quad \text{or} \quad \theta_j = Q_{sw}
\]

**PROPORTIONAL CONTROLLER AND PARAMETER ESTIMATION**

Manipulated variables:
- external flow-rates
- time duration of the cycle

Controlled variables:
- retention times in each zone

Control law: \( w_i(k) = \tilde{\phi}_i(k)(1 - a_i \theta_i(k)), \quad i = I, \ldots, IV \)

Cycle duration: \( T_{sw}(k) = \frac{w_i(k) - w_j(k)}{Q_{sw}} \)

Parameter errors: \( \tilde{\phi}_j(k) = Q_j(k) T_{sw}(k) \left( \tau_j(k) - \tilde{\phi}_j(k) \right) \)

Estimator law: \( \tilde{\phi}_j(k+1) = \tilde{\phi}_j(k) + (1 - a_j) \tilde{\phi}_j(k) \)

**Simulation results**

Extensive test for the Cyclopentanone – Cycloheptanone separation

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