Implication of Dead Volume Geometric Factor on the Flushing Scheme in 7-Zone Para-xylene Simulated Moving-Bed

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Dead volumes in the para-xylene (PX) simulated moving-bed (SMB) are accounted up to 3% of the unit volume and can be classified into bed-head, bed-tail, and bed-line. The 7-zone PX SMB applies two flushing sequences to prevent impurities accumulation inside bed-line dead volume. In one-dimensional process simulation, the real geometry of dead volume is often modeled into a simplified geometry. However, little attention has been paid to the influence of dead volume geometry simplification on SMB modeling. This study investigated the effect of the geometric factor of dead volume on PX SMB involving two flushing streams in the presence of axial dispersion. The one-dimensional unsteady-state SMB model was solved by a fast and accurate solution tool for chromatography and SMB (FAST-Chrom/SMB). This work demonstrated that a real or complex geometry of dead volume can be modeled into a simple geometry by using a geometric factor to have the same SMB simulation results. Optimal flushing flow rates were found by the parametric study on recovery and purity, applying a simplified geometry with the axial dispersion converted by a geometric factor.