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Commentary

Development of Three-Column Periodic Counter-Current Chromatography

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DESCRIPTION

Multi-column counter-current chromatography is a cutting-edge technique that increases process productivity, resin capacity utilization, and product uniformity. This presents a few general and practical guidelines for Three-Column Periodic Counter-Current Chromatography (3C-PCC). For the optimal productivity, a wide variety of interactive effects of feed Concentration (c0), resin characteristics, recovery and regeneration durations have been used. Additionally, Pmax variation was examined in light of the restriction factors (capacity utilization target and flow rate limitation). There was a critical concentration to determine if the operating circumstances of Pmax were constrained. Qmax, tRR, and c0 interacted to limit the operating parameters for Pmax. A series of breakthrough curves was utilized to improve the process performance and screen resins, and these curves could be used to establish the ideal operating parameters. The suggested technique was validated using Monoclonal Antibody (mAb) capture using a 3C-PCC system at various mAb and feed doses.

The results demonstrated the necessity for a thorough comprehension of model-based multi-column counter-current chromatographic processes, which might result in improved process development and the construction of model-free applications. Continuous multi-column counter current chromatography systems are difficult to regulate using conventional methods because of fluctuations in the intake feed stream concentration. Instead of utilizing an impurity baseline, a novel control method based on computed product column breakthrough using UV sensor signals. Instead of using an impurity baseline, this technique employs the impurity to product ratio. The concentration of the intake feed has no effect on this calculation. The suggested technique can compute the product column breakthrough correctly even with varying and extremely unstable inlet feed concentration throughout a loading cycle, according to *in-silico* simulation.

The usual approach failed to maintain constant column loading in each cycle when used to operate a three column periodic counter current chromatography operation with varying intake feed concentration. For an accurate computation of column breakthrough when comparing input and exit UV signals, an intrinsic limiting factor has been discovered as inevitable band widening brought on by diffusion and dispersion. The suggested sophisticated computations expand the capacity to handle unstable incoming streams and boost the resilience of periodic counter current chromatography. To further improve the functionality of the Counter-Current Chromatography (CCC) separation procedures, Sequential Sample Loading (SSL), a new variation of the traditional Multiple Sample Loading (MSL) mode, is proposed.

The sequential sample loading method is straightforward and simple to apply: brief bursts of "pure" mobile phase supply are alternated (interrupted) with continuous sample solution feeding to a CCC column. It is possible to build and deploy SSL, CCC separations that are continuous and periodic (batch).

CONCLUSION

The sample solution loading in continuous operations is done in the form of different series, which include a number of successive sample solution loads. The two operating modes under consideration—conventional multiple sample loading and sequential sample loading counter-current chromatography—are compared using modelling. Equations are provided for calculating band profiles, recovery yields, and purity. Equations are also developed that allow the separation processes' ideal operating parameters to be calculated. Mathcad software is used to simulate the sequential sample loading counter-current chromatographic separations as well as the traditional multiple sample loading.

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