Critical evaluation and comparison of fluid distribution systems for industrial scale expanded bed adsorption chromatography columns

The hydrodynamic properties of an expanded bed contactor with 30 cm or 150 cm internal diameter, which employs a rotating or oscillating fluid distributor, were compared to prototype columns of 60 cm or 150 cm diameter employing local stirring (fixed wall nozzles plus central bottom mounted stirrer) for fluid distribution. Fluid introduction through a rotating fluid distributor was found to give superior hydrodynamic characteristics in the 30 cm and 150 cm diameter column compared to using the local stirrer in both the 60 cm and 150 cm diameter columns. The shortcomings of the local stirring distributor at large scale were apparent: dead zones were present which could not be removed by increasing rotation rates or flow rates, and such changes led to a deterioration in hydrodynamic properties. In contrast, during fluid introduction through a rotating distributor no dead zones were observed, and residence time distribution tests showed that plate numbers remained constant or increased slightly as flow rate was raised from 200 cm h\(^{-1}\) to 470 cm h\(^{-1}\). Under the conditions studied, oscillation of the rotating fluid distributor led to increased mixing and poorer performance than rotary movement. The results imply that further improvement in distributor design is needed and careful attention should be given to the trade off between turbulence and adequate fluid distribution.