NWO EBA2.0: Multiphase Computational Fluid Dynamics of Expanded Bed Adsorption

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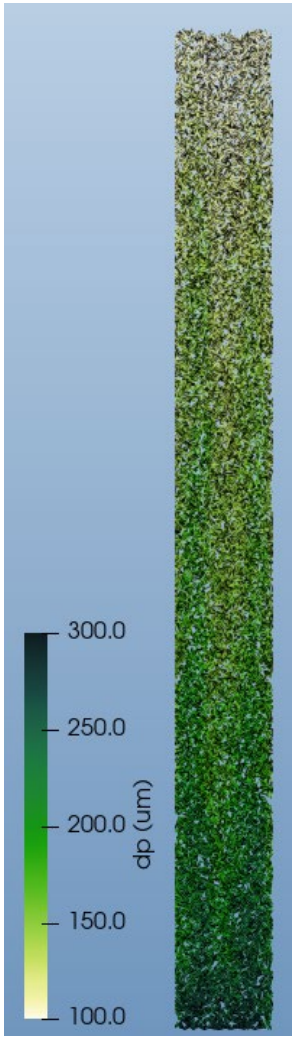
Expanded Bed Adsorption is a promising technology for process intensification in bioseparations. The currently applied separation procedure for purification of fermentation broths consists of centrifugation, (ultra-)filtration, packed bed chromatography, and further polishing steps. By performing the initial chromatography step in an expanded (fluidised) bed, the clarification and capture steps are combined in a single unit operation. The increased distance between the resin beads allows the cell material to pass through the bed unhindered. Meanwhile, the desired proteins bind selectively to the resin, which are eluted afterwards, ready for further purification.

Hydrodynamics play a major role in the efficiency of the column. In order to obtain the best separation, mixing must be prevented. Simultaneously, higher liquid velocities and dense feedstocks are desired to increase throughput. Therefore, a highly stable expanded bed must be attained and maintained. Wide particle size distributions are used to stabilise the bed through stratification. In addition to separation efficiency, the prevention of aggregates, good cleanability, and hygiene are important factors to consider.



Project goals:

- we further uncover the hydrodynamic workings of the column through CFD-DEM modelling. We study the movement of the particles and their collisions, and assess measures for stabilisation of the bed.
- The dispersion of the proteins is detrimental for the separation efficiency. We study the influence of particle movement on the liquid-phase dispersion, and measure the residence time distribution of the proteins.
- The mass transfer processes governing the binding and elution of the proteins on the resin beads dictate the throughput and capacity of the column. We implement these factors to obtain a complete model.