Effect of drag models and particle-particle interaction parameters on cake formation using Discrete Element Method-Computational Fluid Dynamics (DEM-CFD) simulations

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ABSTRACT

Filtration is the process of separating solid particles from a particle-fluid mixture with the help of a filter [1]. A closer look at the filtration process shows that there are many complex events involved, for example with the presence of particle-fluid mixture there is a high chance of one phase affecting the flow behaviour of other phase. Further, the particles are most likely to come in contact with each other. The particles in contact may roll, bounce or stick depending on the balance between kinetic and surface energies. The particles deposited on the filter may even block the filter openings resulting in higher pressure drop. This blocking of filter openings eventually leads to accumulation of particles on upstream side of filter, commonly referred to as “cake formation”. The formed cake may itself undergo rearrangement due to the particle-fluid, particle-particle, and particle-filter interactions. Detail understanding of cake formation is crucial for the design of filter and numerical studies can provide some insights.

In numerical studies, solution to fluid flow is based on principles of Computational Fluid Dynamics (CFD) where solution to Navier–Stokes equations is obtained. Discrete Element Method (DEM) proposed by Cundall and Stack has been successfully used to capture the particle-particle interaction [2]. The coupling between the DEM and a CFD solver is achieved by momentum balance between the two phases. Viscous drag force is the dominant interacting force in such situations. Depending on the flow conditions there are various drag models suggested in the literature. The accuracy of the coupled DEM-CFD simulation depends on the proper choice of the drag model, and particle-particle interaction parameters.

In this study we investigate the effect of drag models and particle-particle interaction parameters on the formation of cake, predicted porosity and pressure drop using EDEM-Fluent coupling [3-4]. Conclusions of this investigation are based on the assumption that the fluid flow is three dimensional and the filter is two dimensional with negligible depth in flow direction.

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