World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:11, No:02, 2017

Coarse-Grained Computational Fluid Dynamics-Discrete Element Method Modelling of the Multiphase Flow in Hydrocyclones

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Abstract : Hydrocyclones are widely used to classify particles by size in industries such as mineral processing and chemical processing. The particles to be handled usually have a broad range of size distributions and sometimes density distributions, which has to be properly considered, causing challenges in the modelling of hydrocyclone. The combined approach of Computational Fluid Dynamics (CFD) and Discrete Element Method (DEM) offers convenience to model particle size/density distribution. However, its direct application to hydrocyclones is computationally prohibitive because there are billions of particles involved. In this work, a CFD-DEM model with the concept of the coarse-grained (CG) model is developed to model the solid-fluid flow in a hydrocyclone. The DEM is used to model the motion of discrete particles by applying Newton's laws of motion. Here, a particle assembly containing a certain number of particles with same properties is treated as one CG particle. The CFD is used to model the liquid flow by numerically solving the local-averaged Navier-Stokes equations facilitated with the Volume of Fluid (VOF) model to capture air-core. The results are analyzed in terms of fluid and solid flow structures, and particle-fluid, particle-particle and particle-wall interaction forces. Furthermore, the calculated separation performance is compared with the measurements. The results obtained from the present study indicate that this approach can offer an alternative way to examine the flow and performance of hydrocyclones

Keywords : computational fluid dynamics, discrete element method, hydrocyclone, multiphase flow
Conference Title : ICSPT 2017 : International Conference on Separation and Purification Technology
Conference Location : Barcelona, Spain
Conference Dates : February 26-27, 2017