Particle Methods for Modelling Stirred Media Mills

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ABSTRACT

Wet comminution is an important process in the mineral processing industry. Modelling of wet comminution in stirred media mills requires the simultaneous modelling of grinding media, moving internal stirrer, and slurry. In the present study, a novel approach for modelling the physical interactions between slurry, grinding media and mill structure in a stirred media mill is presented. The slurry is modelled with the particle finite element method (PFEM) [1, 2]. The grinding media is modelled using the discrete element method (DEM) [3] and the mill structure is modelled using the finite element method (FEM). The interactions between slurry, grinding media and mill structure is modelled by two-way couplings between the PFEM, the DEM and the FEM models. The coupled model of the present study is used to predict the motion of slurry and grinding media and the driving torque on the stirrer during wet comminution in a pilot scale-size horizontal stirred media mill. Furthermore, the model is used to compare a Newtonian and a non-Newtonian model of the slurry, where the non-Newtonian model is used to capture experimentally observed shear-thinning of the slurry. The coupled PFEM-DEM-FEM model preserves the robustness and efficiency of each of the methods and it gives the possibility to use large time increments for the fluid, greatly reducing the computational expense. The coupled model of the present work provide information on the complex dynamics of slurry and grinding media during wet comminution in stirred media mills.

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