Asociación Argentina de Mecánica Computacional

Mecánica Computacional Vol XXVII, págs. 589-589 (resumen)
Alberto Cardona, Mario Storti, Carlos Zuppa. (Eds.)
San Luis, Argentina, 10-13 Noviembre 2008

NUMERICAL SIMULATION OF SOLID PARTICLE DEPOSITION IN DUCTS

Mario A. Storti, Norberto N. Nigro, Rodrigo R. Paz and Lisandro D. Dalcín

Centro Internacional de Métodos Computacionales en Ingeniería (CIMEC), INTEC(CONICET-UNL), Güemes 3450, (S3000GLN), Santa Fe, Argentina, mstorti@intec.unl.edu.ar, http://www.cimec.org.ar/mstorti

Keywords: Visualization, particle trace, computational fluid dynamics

Abstract. Solid-gas multiphase flows are present in many industrial processes as, for instance, the ventilation system of sinterization plants. One of the most important results from the practical point of view for the transport of particles in ventilation ducts is the prediction of deposition rates. Large particles in ventilation ducts tend to fall quickly and to accumulate in a saltation layer near the lower surface of the duct. When the particle flux in the saltation layer exceeds a given threshold which depends on the shear stress, the particles begin to accumulate and a deposited layer growths. If this layer growths too much its weight may cause the collapse of the supporting structure. For small particle diameter the Eulerian/Eulerian approach is useful because the characteristic times in which the particle velocity reaches the equilibrium velocity is small. In this case a system of PDE's is solved for each phase. When the particle diameter is very small the Algebraic Slip Model is appropriate, whereas for a moderate diameters the momentum equation of the solid phase must be solved and the Two-Fluid Model is more appropriate. When the particles are large, and consequently the characteristic time is large, they behave almost independently of the fluid, and terms like particle inertia, virtual mass, lift, and Magnus effect are important. This effects are difficult to cast as terms in the momentum equation as PDE's through an average process and then the Lagrangian approach where each particle trajectory is solved as an ODE is more appropriate. Moreover, the resulting system of equations may be ill posed. In addition, some effects related with the interaction of particles with solid boundaries, like bouncing, lift-off and sliding can be treated almost uniquely in the Lagrangian formulation. In this article the implementation of an Eulerian/Lagrangian formulation for the transport of moderate to large solid particles is described. The implementation includes an efficient tracking of particles through unstructured moving meshes, the Schiller-Naumann drag model, and partially elastic collision with solid surfaces. Deposition rates can be computed in terms of the particle flux in the saltation layer and the shear stress at the wall. Several examples in ventilation ducts for industrial sinterization plants are presented.