The thesis describes the implementation of a numerical model that simulates the interaction between rigid particles and a fluid. The numerical model is based on the arbitrary Lagrangian-Eulerian (ALE) method, which uses the movement of the mesh to realize the movement of particles. The ALE method is initially presented on a simple problem of calculating the drag force acting on a single sphere moving through a viscous fluid. A general version of the model capable of simulating tens of particles is then described and tested on various benchmarks to prove the reliability of used method. Finally, a problem inspired by the flow of red blood cells in the blood is studied to show the effect of shear thinning emerging in a mixture of Newtonian fluid and rigid particles.