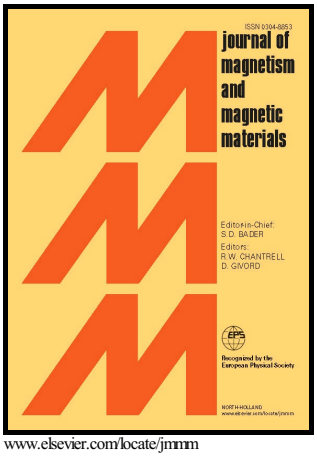

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Simulation of Dynamic Magnetic Particle Capture and Accumulation Around a Ferromagnetic Wire

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Abstract

A new approach for modeling high gradient magnetic separation (HGMS)-type systems during the time-dependent capture and accumulation of magnetic particles by a ferromagnetic wire was developed. This new approach assumes the fluid (slurry) viscosity, comprised of water and magnetic particles, is a function of the magnetic particle concentration in the fluid, with imposed maxima on both the particle concentration and fluid viscosity to avoid unrealistic limits. In 2-D, the unsteady-state Navier-Stokes equations for compressible fluid flow and the unsteady-state continuity equations applied separately to the water and magnetic particle phases in the slurry were solved simultaneously, along with the Laplace equations for the magnetic potential applied separately to the slurry and wire, to evaluate the velocities and concentrations around the wire in a narrow channel using COMSOL Multiphysics. The results from this model revealed very realistic magnetically attractive and repulsive zones forming in time around the wire. These collection zones formed their own impermeable viscous phase during accumulation that was also magnetic with its area and magnetism impacting locally both the fluid flow and magnetic fields