

Magnetic Particle Buildup Growth on Single Wire in High Gradient Magnetic Separation

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Magnetic fluids containing nano or submicron magnetic particles and their application in food, biological and pharmaceutical systems have recently attracted increasing attention. Magnetic particles can be collected efficiently in magnetizable matrices (e.g. iron wires) in high gradient magnetic separation (HGMS) process. When calculating the capture efficiency of a separator, it is not correct to use the results for a clean and particle-free wire, since the particle buildup that forms as the magnetic particles accumulate on the wire surface distorts the flow and magnetic fields, and thus influences the capture efficiency of the wire. In this work, the dynamic buildup growth process is treated as a moving-boundary problem, in which the growing front of the buildup is tracked explicitly by marker points evenly distributed on its surface. The flow field and magnetic field are calculated using the finite element method (FEM). A particle trajectory model is used to calculate where and how frequently the particles deposit on the buildup surface, and the marker point distribution and the buildup shape are updated at each simulation step. The questions as to how particle buildup develops, how it influences the flow and magnetic fields, and how single wire capture efficiency evolves with time will be addressed based on this dynamic model. The simulation results with this dynamic model showed very good agreement with experimental results.