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Flow Modification and Heat Transfer Enhancement Using Ferromagnetic Particle Laden Fluid with Switched Magnetic Fields[1] MARK MURRAY[2], U.S. Naval Academy — A convective heat transfer enhancement technique and the experimental methods used to quantify the improvement in heat transfer and subsequent differential pressure rise are introduced. The enhancement technique employs time varying magnetic fields produced in a pipe to cause the ferromagnetic particles of a particle laden fluid to be attracted to and released from the pipe wall. The ferromagnetic particles act not only to advect heat into the bulk fluid, but they also significantly modify the flow field disrupting the boundary layer, allowing cooler fluid to reach the high temperature pipe wall, increase thermal energy transfer directly to the fluid and contribute to the overall improvement in heat transfer rate. The enhancement technique demonstrated a 250% increases in heat transfer coefficient with only a corresponding 48% increase in flow differential pressure for the experimental parameters tested. It is also found that magnetic field switching frequency significantly influences both enhancement and pressure drop magnitudes.

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