Convection Flow of Biomagnetic Fluid in Pipes

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In this study, a fully developed, steady, laminar flow of a biomagnetic fluid (blood) is investigated on the square/circular cross-section of a long pipe (cavity) under the effect of a magnetic field generated by an electric wire. There is a temperature difference between the walls which causes heat transfer within the fluid by the displacement of the magnetizable fluid particles in the cavity. The coupled Navier-Stokes and energy equations are discretized by the dual reciprocity boundary element method (DRBEM). In the DRBEM the governing partial differential equations are transformed to the boundary integral equations by using the fundamental solution of Laplace equation. The nonlinear terms in the equations are treated as inhomogeneity and approximated by using radial basis functions. The use of DRBEM has considerably small computational expense compared to domain type methods due to its boundary only nature. The numerical results reveal that, when the magnetic source is below the cold wall, the main effect of the magnetization and buoyancy forces is to cool down the cavity. Increasing magnetic field intensity is more effective than increasing the buoyancy force in cooling. The influence of the magnetization force is higher in the circular cavity and the circular cavity cools down quicker than the square cavity as magnetic field intensity increases.

Keywords. Biomagnetic fluid, forced convection, point magnetic source, DRBEM.