SOLVABILITY INVESTIGATION ON A NONLINEAR MAGNETO-HEAT COUPLING AXISYMMETRIC PROBLEM

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Abstract. This paper aims to investigate a nonlinear magneto-heat coupling axisymmetric problem from induction heating models. The liquid metallic material satisfies a nonlinear constitutional relationship between the magnetic field and the magnetic induction and have the temperature-dependent electric conductivity. This material is allowed to move without changing its domain. Making full use of cylinder symmetry, we reduce the original three-dimensional problem to a two-dimensional one on a meridional section provided the current density has only azimuthal component in cylindrical coordinates. The variational formulation of a magnetic vector potential and a temperature variable in appropriate weighted Sobolev spaces is given. Employing Rothe's method and the theory of monotone operator, we prove the existence of a weak solution to this nonlinear coupling system. Finally we show some numerical simulation results to an approximate induction furnace model to support our conclusion.

Keywords: Magneto-heat coupling, Axisymmetric problem, Maxwell's equations, Heat convection-diffusion equation, Nonlinear, Solvability

Mathematics Subject Classifications (2010): 35Q61, 35Q79, 65M12

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