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DIFFUSION OF MAGNETIC PARTICLES IN A FERROFLUID SEAL IN THE PRESENCE OF MAGNETIC AND CENTRIFUGAL FORCES

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We derive a mathematical model for the steady state of a magnetic fluid seal. It is known that ferrofluids behave as stable colloid. However the concentration of particles may become nonuniform in presence of high gradient magnetic fields. This nonuniformity of particle concentration can be partially relaxed by the appearing velocity field. We study the interaction between the magnetic and centrifugal forces appearing in high-speed rotary seals based on ferrofluids.

Simplified mathematical models were considered in a series of publications. In [6] the particle redistribution of a non-moving ferrofluid was studied. The flow field in case of uniform particle concentration was observed in [5].

Our approach leads to a nonlinear system of two strongly coupled equations. The incompressible Navier-Stokes equation describes the hydrodynamic properties of the ferrofluid. The particle redistribution is given by the concentration-diffusion equation. The question of solvability and implementation issues for the Navier-Stokes equations were investigated in [4]. The solvability of convection-diffusion equation was discussed in [2], numerical methods can be found in [1; 3].

REFERENCES

[1] C. Chainais-Hillairet and J. Droniou. Finite-volume schemes for noncoercive elliptic problems with Neumann boundary conditions. *IMA J. Numer. Anal.*, **,** 31., 61–85, 2011

[2] J. Droniou and J.-L. Vázquez. Nonconercive convection-diffusion elliptic problems with Neumann boundary conditions. *Calc. Var.*, **34** 413–434, 2009.

[3] K. Kavaliou and L. Tobiska. A finite element method for a noncoercive elliptic problem with Neumann boundary conditions. *Computational Methods in Applied Mathematics*, **12** 168–183, 2012.

[4] T. Mitkova. *Lösbarkeit und Finite-Elemente-Approximation eines mathematischen Modells für die Strömung in Magnetfluiddichtungen*. Otto-von-Guericke Universität, Magdeburg, 2004.

[5] V. Polevikov and L. Tobiska. Modeling of a Dynamic Magneto-Fluid Seal in the Presence of a Pressure Drop. *Fluid Dynamics*, **36** 890–898, 2001.

[6] V. Polevikov and L. Tobiska. Influence of diffusion of magnetic particles on stability of a static magnetic fluid seal under the action of external pressure drop. *Commun Nonlinear Sci Numer Simulat*, **16** 4021–4027, 2011.