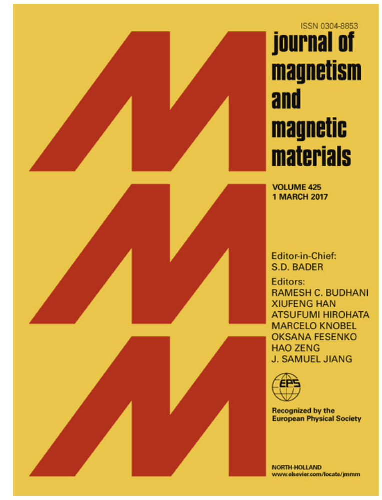
Accepted Manuscript



Research articles

Numerical simulation of magnetic convection ferrofluid flow in a permanent magnet−inserted cavity

Majid Ashouri, Mohammad Behshad Shafii

PII: S0304-8853(16)33122-5
DOI: http://dx.doi.org/10.1016/j.jmmm.2017.06.089
Reference: MAGMA 62885

To appear in: *Journal of Magnetism and Magnetic Materials*

Received Date: 26 November 2016
Revised Date: 17 April 2017
Accepted Date: 16 June 2017

Please cite this article as: M. Ashouri, M. Behshad Shafii, Numerical simulation of magnetic convection ferrofluid flow in a permanent magnet−inserted cavity, *Journal of Magnetism and Magnetic Materials* (2017), doi: http://dx.doi.org/10.1016/j.jmmm.2017.06.089

Numerical simulation of magnetic convection ferrofluid flow in a permanent magnet–inserted cavity

Majid Ashouri, Mohammad Behshad Shafii*

School of Mechanical Engineering, Sharif University of Technology, Tehran, Iran.

*Corresponding author.
P.O. Box 11365-9567, Tehran, Iran.
Tel.: +98 21 66165675; Fax: +98 21 66000021.
E-mail address: behshad@sharif.edu (M.B. Shafii).

Abstract

The magnetic convection heat transfer in an obstructed two-dimensional square cavity is investigated numerically. The walls of the cavity are heated with different constant temperatures at two sides, and isolated at two other sides. The cavity is filled with a high Prandtl number ferrofluid. The convective force is induced by a magnetic field gradient of a thermally insulated square permanent magnet located at the center of the cavity. The results are presented in the forms of streamlines, isotherms, and Nusselt number for various values of magnetic Rayleigh numbers and permanent magnet size. Two major circulations are generated in the cavity, clockwise flow in the upper half and counterclockwise in the lower half. In addition, strong circulations are observed around the edges of the permanent magnet surface. The strength of the circulations increase monotonically with the magnetic Rayleigh number. The circulations also increase with the permanent magnet size, but eventually, are suppressed for larger sizes. It is found that there is an optimum size for the permanent magnet due to the contrary effects of the increase in magnetic force and the increase in flow resistance by increasing the size. By increasing the magnetic Rayleigh number or isothermal walls temperature ratio, the heat transfer rate increases.

Keywords: Ferrofluid; magnetic convection; Nusselt number; square cavity; thermomagnetic.