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Inclined Slider Bearing with Magnetic Rheological fluid under the Effects of Second Order Rotation

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Abstract

A slider bearing consisting of connected surfaces with magneto hydro dynamic fluid as lubricant is analyzed in the present study. A MR-model has been used as a non-Newtonian fluid in a slider bearing. A mathematical model of magneto hydro dynamic fluid flow in a slider bearing is conferred. An extended generalized Reynolds equation of motion for second order Rotatory theory of hydrodynamic lubrication is used for this study. Under the assumptions of the order of magnitudes of the variables, it can be seen only the viscous and non-Newtonian terms have effects, whereas the inertia terms are negligible. The pressure distribution in the bearing is calculated by neglecting higher order terms. The pressure is employed to analyze the bearing load carrying capacity. The results are conferred through table and graphs.

A generalized two dimensional Reynolds-type equation is derived using the equations of motion. The equation is solved to get the dimensionless pressure. The pressure is used to evaluate the bearing characteristics such as load carrying capacity. The results are presented graphically. The film pressure varies with density and viscosity hence it increases with the intensity of magnetic field. Thus the load carrying capacity of the bearing is enhanced by the application of the magnetic field. In presence of magnetic field there is increase in ratio α, β that leads to increased pressure as well as load carrying capacity in the bearing.

The differential equation is solved to induce the dimensionless pressure. The film pressure varies with Hartmann number, density and viscosity thus it will increase with the intensity of magnetic force. Therefore the load carrying capacity of the bearing is increased by the appliance of the magnetic force. In presence of magnetic force there's increase in aspects ratio α, β that results in increasing the pressure in addition as load carrying capacity within the bearing.

Keywords: Continuity, Density, Film thickness, Reynolds equation, Rotation number, Taylor's number, Viscosity.

References

[1]. Ozalp, A. A. and Umur, H. (2006); Optimum surface profile deign and performance evaluation of inclined slider bearings. Current Science, 90(11): 1480-1491. Available: http://www.jstor.org/stable/24091822.

[2]. Das, N. C. (1998); A study of optimum load bearing capacity for slider bearing lubricated with couplestress fluids magnetic field. Trib. Int., 31(7): 393-400. DOI: 10.1016/S0301-679X(98)00050-4

[3]. Bayrakceken, H. and Yürüsoy, M. (2006); Comparison of pressure distribution in inclined and parabolic Slider Bearing. Mathematical and Computational applications, 11(1): 65-73. Available: https://www.mdpi.com/2297-8747/11/1/65/pdf

[4]. Shah, C. J., Bhat, M. V. (2003); Lubrication of a porous exponential slider bearing by ferrofluid with slip velocity. Turkish Journal of Engineering Environmental Science, 27:183 – 187. Available: http://www.arpnjournals.com/jeas/research_papers/rp_2010/jeas_0810_370.pdf

[5]. Siddangouda, A., Trimbak, V. B. and Neminath, B. N. (2014); Non-Newtonian Effects of Second-Order Fluids on the Hydrodynamic Lubrication of Inclined Slider Bearings. Int Sch Res Notices, 787304. doi: 10.1155/2014/787304

[6]. Yürüsoy, M. A. (2003); Study of pressure distribution of a slider bearing lubricated with Powel-Eyring fluid. Turkish J. Eng. Env. Sci., 27: 299-304. Available: dergipark.gov.tr/download/article-file/126624

[7]. Bujurke, N. M. and Kudenati, R. B. (2007); Multigrid solution of modified Reynolds' equation incorporating poroelasticity and Couple Stress. Journal of Porous Media, 10(2): 125-136. DOI: 10.1615/JPorMedia.v10.i2.20

[8]. Shah, C. J. and Bhat, M. V. (2003); Effect of slip velocity in a porous secant shaped slider bearing with a ferrofluid lubricant. Fizika A–12: 1-8. Available: https://www.emeraldinsight.com/doi/abs/10.1108/00368790310470930

[9]. Lin, J. R., Yu, M. L. (2004); Steady state performance of parabolic slider bearings with a couple stress fluid. Journal of Marine Science and Technology, 12(4): 239-246. Available: http://jmst.ntou.edu.tw/marine/12-4/239-246.pdf

[10]. Stokes, V. K. (1966); Couple stresses in fluids. Phys Fluids, 9: 1709-1715. Available: https://doi.org/10.1063/1.1761925

[11]. Lin, J. R. (1997); Effects of couple Stress on the Lubrication of Finite Journal Bearing. Wear, 206: 171-178. Available: https://doi.org/10.1016/S0043-1648(96)07357-7

[12]. Mitidierri, B. P. (2005); Advanced modeling of elastohydrodynamic Lubrication. Doctoral Thesis, Tribology Section and thermo fluids section, Department of Mechanical Engineering, Imperial College, London: 17-39. Available: http://powerlab.fsb.hr/ped/kturbo/OpenFOAM/docs/PetraBrajdicPhD2005.pdf

[13]. Sarangi, M., Majumdar, B. C., Sekhar, A. S. (2005); Elastohydrodynamically lubricated ball bearings with couple stress fluids, Part 1: Steady state analysis. Tribology Transactions, 48(3): 404-414. Available: https://doi.org/10.1080/05698190500225201

[14]. Elsharkawy, A. A. (2004); Effects of misalignment on the performance of finite journal bearings lubricated with couple stress fluids. International Journal of Computer Applications in Technology (IJCAT), 21(3). doi>10.1504/IJCAT.2004.005939

[15]. Lin, J. R. (2003); Derivation of dynamic couple-stress Reynold's equation of sliding-squeezing surfaces and numerical solution of plane inclined slider bearings. Tribology International, 36(9): 679-685. Available: https://doi.org/10.1016/S0301-679X(03)00011-2

[16]. Nada, G. S. and Osman, T. A. (2007); Static performance of finite hydrodynamic journal bearings lubricated by magnetic fluids with couple Stresses. Tribology Letters, 27(3): 261-268. Available: https://doi.org/10.1007/s11249-007-9222-0

[17]. Flores, P., Claro, J. C. P., Ambrósio, J. (2006); Journal bearings subjected to dynamic loads: The Analytical Mobility Method. Mecanica Experimental, 13:115-127. Available: http://www-ext.lnec.pt/APAET/pdf/Rev_13_A11.pdf

[18]. Lin, J. R. (2002); Magnetohydrodynamic lubrication of finite slider bearings. Int. J. Applied Mech. and Engg. 7(4): 1229-1246.

[19]. Fathima, T. S., Jamal, S. and Hanumagowda, B. N. (2018); Effects of an external circuit on a MHD slider bearing with couplestress fluid between conducting plates. National Conference on Mathematical Techniques and its Applications (NCMTA 18). Journal of Physics: Conf. Series 1000, 012076. doi :10.1088/1742-6596/1000/1/012076

[20]. Ruan, X, Wang, Y., Xuan, S. and Gong, X. (2017); Magnetic field dependent electric conductivity of the magnetorheological fluids: the influence of oscillatory shear, Smart Materials and Structures, 26(3). Xiaohui Ruan et al 2017 Smart Mater. Struct. 26 035067. DOI: https://doi.org/10.1088/1361-665X/aa5fe5

[21]. Banerjee, M. B., Dube, G. S. and Banerjee, K. (1982); The Effects of Rotation in Lubrication Problems: A New Fundamental Solutions. WEAR, 79: 311-323. Available: https://doi.org/10.1016/0043-1648(82)90321-0

[22]. Miyan, M. (2018); Pressure Analysis in Infinitely Short Bearings with Nanolubricants. American International Journal of Research in Science, Technology, Engineering & Mathematics, 23(1): 62-66. Available: http://iasir.net/AIJRSTEMpapers/AIJRSTEM18-311.pdf