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Thermo-hydrodynamic Lubrication of Misaligned Porous Journal Bearings

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Abstract

In this work, a numerical simulation for the thermo-hydrodynamic self-lubrication of misaligned porous circular journal bearing has been investigated. Mathematical model consists of a modified Reynolds equation to determine the pressure field of thin viscous oil film taking into account the oil leakage into the porous matrix, Darcy's law to determine the fluid flow in the porous media and the energy and the heat conduction equations to determine the temperature field in oil film thickness and the bearing shaft . The equation used to evaluate the oil film thickness was modified to include the effect of the bearing misalignment. The governing equations with appropriate boundary conditions were simultaneously solved using finite difference approach. Direct iterative procedure with successive under relaxation has been adopted through the present work. The effects of the dimensionless permeability and misalignment parameters on the performance characteristics of porous journal bearing have been presented and discussed. The results obtained from this analysis indicate that bearing performance is greatly affected by such parameters. The mathematical model as well as the computer program prepared to solve the governing equations of the present work have been verified by comparing the results of the load carrying capacity and attitude angle obtained through this work with that obtained by Boubendir et al..

Introduction

Self-lubricated bearings include a porous material filled with lubricating oil so that the bearing requires no further lubrication during the whole life of the machine. The self-lubricated bearings or oil retaining bearings exhibit this feature. Self-lubricated porous bearings have the advantage of high production rate because short sintering time is required, N.B. Nadvana [1]. Porous journal bearings are widely used in industrial applications where other plain metal bearings are impractical due to the lack of space or inaccessible to lubrication, like domestic appliances, medical apparatus, computers, automobiles. Lin and Hwang [2] applied the Brinkman extended Darcy's model to analyze the hydrodynamic lubrication of short porous journal bearings. Kaneko et al. [3] investigated theoretically the static characteristics at start of the operation in porous journal bearing with sealed ends lubricated only by the oil initially provided with its pores.