ABSTRACT

The effect of bearing elastic deformation on the thermo-hydrodynamic performance of self-lubricated misaligned porous circular journal bearing has been investigated in the present work. Suitable mathematical model is developed to study such effect. The modified Reynolds equation to take into consideration the slip velocity effect, the Darcy's equation, the energy equation and the heat conduction equation have been simultaneously solved numerically using appropriate boundary conditions. The oil film thickness equation has been modified to take into consideration the effect of bearing misalignment and the bearing elastic deformation. A suitable oil film viscosity model to consider the effect of oil film temperature has been used. The mathematical model as well as the computer program written to solve the governing equations were verified by comparing the results of the load carrying capacity and the attitude angle obtained in the present work with obtained by Boubendir, et al. (2010). The maximum percentage difference of the results obtained in the present work is 4%. The combined effects of elastic deformation and journal misalignment on the different bearing characteristics have been investigated. It has been shown that considering the elastic deformation of the bearing bush has a beneficial effect by removing the pressure spikes at both end of the misaligned bearing.

Keywords: Thermo-hydrodynamic Lubrication, Self-Lubricated Journal Bearings, Misalignment, Elastic Deformation.

INTRODUCTIO :

Porous journal bearings have been widely used in industrial applications for a long time. The main advantage of these bearings is that they need no external oil supply once the bearing with its porous material impregnated with oil is installed. As the journal picks up speed, the oil in the porous matrix is injected and the hydrodynamic oil film is formed, N. B. Naduvinamani and S. Santosh (2010). Lin and Hwang (1993) studied the lubrication of porous journal bearing using Brinkman extended Darcy model. Kaneko, et al. (1999) 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. Elsharkawy and Guedour (2001) investigated a numerical solution for the hydrodynamic lubrication of finite porous journal bearings using a modified Brinkman-extended Darcy's model. Ertugrul (2003) investigated experimentally the behavior of porous bearing under different lubricants and lubricating conditions. Marian, et al. (2009) investigated rigorously two theoretical mass-conservative models for the tribological evaluation of porous journal bearings. Boubendir, et al. (2010, 2011) studied numerically the thermo-hydrodynamic lubrication in self-lubricated porous journal bearings. Their results performed that the thermal effects are non-negligible. Balasoiu, et al. (2013) studied a 3D, isothermal numerical analysis of a cylindrical porous journal bearing characterized by a self-circulating lubricating system that eliminates the necessity of an external circulating pump. Rao, et al. (2013) investigated the influence of surface porous layer configuration for a journal bearing with double layer porous lubricant film. In most theoretical investigations of hydrodynamic lubrication, it has been supposed that the journal and the bearing axis are aligned.