Elastic Behavior of the Plain Journal Bearing Coated With a Textured Surface and a Non-Textured Surface: Plain Journal Bearing at Textured Surface Behavior

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ABSTRACT

Surface texturing technology has been newly explored technique in the tribological domain, and this method is carried out to improve the displacement and performance of the Babbitt plain journal bearing with a textured surface. The numerical analysis is carried out to study the textured surface effect on the elastic behaviour of the journal bearing. First, the bearing is tested without texture; second, it is examined completely textured, by varying the operating parameters of the bearing. The performance is observed in a pressure profile, displacement, and shear stress, generated for each combination of radial loads, and rotational velocity of the shaft. The numerical modelling is used by solving the displacement equations by the finite element method to analyses bearing displacement for severe operating conditions. The results show that the elastic deformations for textured bearing, are important and preponderant for higher rotational speeds, and shear stresses are important for higher hydrodynamic pressures.

KEYWORDS
Displacement, Plain Journal Bearing Coated, Pressure, Shear Stresses, Surface Texture

INTRODUCTION

The hydrodynamic plain journal bearings are components that provide the guiding in rotation of rotating machines, such as turbines, the reactors. This equipment works under very severe operating conditions: high rotational speed and high radial load. In order to improve the hydrodynamic performance of these rotating machines, the industrialists specialized in the manufacture of hydrodynamic plain bearings, have designed a bearing model with its textured interior surface.

The present works is a numerical analysis tested the influence of hydrodynamic pressure on the elastic behavior of a textured surface plain bearing subjected to heavy radial loads and heavy rotation

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velocities, while showing the displacement evolution which is due to the hydrodynamic pressure effect, deformation as well as shear stresses using the ANSYS Workbench calculation code, by solving the displacement equations using the finite volume method.

The mechanical displacements of the contact surfaces affect the oil film geometry and therefore the performance of the hydrodynamic plain bearing. The displacements that we will present in this study are geometrical modifications, which occur during the operation of the plain bearing, as well as the shear stresses. These elastic displacements which are due to the hydrodynamic pressure field modify the geometrical shape of the plain bearing by inducing an increase or a reduction of the oil film thickness.

BACKGROUND

Bouyer presented in 2003 an experimental and numerical study on the thermal and elastic effect on the hydrodynamic performances of a non-textured misaligned bearing. This research shows that the misalignment very significantly modifies the operating parameters of the bearing. He also tested a worn bearing that is to say a desired geometric modification on the performance of the bearing. These results show that in the case of a very loaded bearing, the generated displacements may be of the order of the minimum thickness of the oil film, and the heating of the lubricant film leads to a significant decrease in viscosity. Fluid and at a differential expansion of the elements of the non-textured bearing.

Bendaoud et al show in 2006 the effect of the pressure field on the stresses distribution in an untextured hydrodynamic journal bearing. This study is carried out by solving displacement equations using the finite element method. Their results show that elastic deformations are important and preponderant for higher rotational speeds, and shear stresses are important for higher hydrodynamic pressures. In 2014, Bendaoud conducted a search on behavior elastohydrodynamic plain bearing hydrodynamic very loaded. Mehala et al treats in 2016 the effect of the non-Newtonian flow Performance and thermal effect on a bearing coated with a high tin content.

In 2016, Shahab Hamdavi and collaborator, presents the effect of partially textured surface of hydrodynamic long journal bearing on the pressure distribution and load carrying capacity was studied. The equations of pressure distribution and load carrying capacity were derived and their trends were represented. The results show that, applying partial surface texture had a positive and remarkable effect on functional characteristics of hydrodynamic journal bearings, i.e. load carrying capacity and lubricant film pressure.

Rufei et al treated in 2016, analyzed the influences of flexibility and surface texture on the performances of a finite-long journal bearing. Reynolds equation has been solved by using finite difference method and Winkler foundation model has been used to calculate the elastic deformation of the bearing bush or housing. They are indicated that the surface texture can appreciably change the shaft center-line locus and oil film pressure distribution comparatively to the smooth case. The texture arrangements on the bearing surface, the texture number according the circumferential axis or axial axis, also the texture depth in the radial direction, all of them have significant influences on the static characteristics of a flexible journal bearing.

In 2018, Zhang et al. presented research on the effect of the thermal and elastic for misaligned bearing with texture surface. The bearing is subjected under high-speed and heavy-load conditions. As well, they take on consideration the effects of cavitation and viscosity-temperature. Zhang and collaborators show that the maximum oil film pressure and load-carrying capacity of a journal bearing increase with journal misalignment. Meanwhile, the oil film temperature increases sharply while considering misalignment.
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