Mechanics & Industry **16**, 302 (2015)

DOI: 10.1051/meca/2015001
www.mechanics-industry.org

Mechanics & Industry

Surface texturing effect comparative analysis in the hydrodynamic journal bearings

Nacer Tala-Ighil[1,a] and Michel Fillon[2]

[1] Welding and NDT Research Centre (CSC), BP 64, Cheraga, Algeria
[2] Institute Pprime, CNRS, University of Poitiers, ENSMA, Poitiers, France

Received 25 May 2014, Accepted 23 November 2014

Abstract – The journal bearing is a complex system with high film convergence and with cavitation hydrodynamic phenomena. The surface texturation influence study on journal bearing performances requires unavoidably experimental investigations followed by a numerical modelling of the problem. This work consists in modellization and understanding of the journal bearing characteristics in both cases of presence or absence of textures onto the bearing surface. The finite difference method is used as numerical approach in the analysis. The textured bearing performance enhancement passes essentially by an improvement of a minimum film thickness, a maximum pressure and a friction torque through an appropriate surface texture geometry and appropriate texture distribution on the contact surface. It is found that the simulations results are in good concordance with litteratures. The texture area position on the bearing surface is the primary endpoint for journal bearing performance enhancement. The best design of textured area depends strongly on the geometrical parameters and the journal bearing operating conditions.

Key words: Journal bearings / Reynolds equation / hydrodynamic lubrication / Stribeck curve / texture

1 Introduction

Nowadays, there is a strong need to make machines more efficient by looking for power losses and trying to reduce them. The most important losses in a machine come from the bearings [1]. These bearings have several advantages such as low friction and wear, good heat dissipation through the oil and noise and vibrations reduction. The bearing temperature field and pressure field are considerably influenced by the journal bearing parameters [2]. Their lubrication is really important because the contact between surfaces would cause rapid wear [3]. The deterministic roughness that is known as surface texture was introduced deliberately on the bearings using micro-fabrication techniques. Surface texturing is claiming progressively more attention and is expected to be a major component in future bearing structure design as demonstrated by the authors [4, 5]. Patterned or artificially textured surfaces have been studied extensively for many applications, particularly in rotating machinery [6, 7]. Just recently, such textures were engineered in order to improve the machine elements tribological performance [8,9]. Microtextures act as micro-hydrodynamic bearings, enhance load support and increase film thickness, which leads to lower friction compared to untextured surfaces. Lu and Khonsari [10] have presented experimental results concerning the dimples effect on the Stribeck curve. Load, oil type, dimple size, depth and shape were varied to explore their influence on the friction characteristics. By means of the new technology as chemical etching [10], laser surface texturing [11] and novel dressing technique [12], it is now possible to produce controlled micro-geometries (textures) on journal bearing surfaces to enhance the overall tribological performance including friction reduction, reliability improvement, severity of operating conditions, and the energy consumption reduction. Some other and recent studies [13–19] have established that the surface texture geometry such as texture depth, width, textures number, and textures location influence the bearing performance. In recent works, many authors show that the most significant characteristics can be improved through an appropriate arrangement of the textured area on the contact surface [20].

2 Theory

In a hydrodynamic lubrication problem, the governing equations for a full hydrodynamic lubrication region can be described by the known Reynolds' equation. The journal bearing geometry is shown in Figure 1.

[a] Corresponding author: ntalaighil@gmail.com