Accepted Manuscript

Influence of surface form deviations on friction in mixed lubrication

S. Fricke, C. Hager, S. Solovyev, M. Wangenheim, J. Wallaschek

PII: S0301-679X(17)30269-4

DOI: 10.1016/j.triboint.2017.05.032

Reference: JTRI 4751

To appear in: *Tribology International*

Received Date: 4 September 2016

Revised Date: 19 May 2017

Accepted Date: 22 May 2017

Please cite this article as: Fricke S, Hager C, Solovyev S, Wangenheim M, Wallaschek J, Influence of surface form deviations on friction in mixed lubrication, *Tribology International* (2017), doi: 10.1016/j.triboint.2017.05.032.

Influence of Surface Form Deviations on Friction in Mixed Lubrication

S. Fricke[1,2*], C. Hager[1], S. Solovyev[1], M. Wangenheim[2], J. Wallaschek[2]

[1]*Central Research, Robert Bosch GmbH*
[2]*Institute of Dynamics and Vibration Research, Leibniz Universität Hannover*

Abstract

The focus of this study is on the effect of form deviations of a partial journal bearing's sliding surface on the friction force in mixed lubrication conditions. The measured friction varied considerably when the bearing was rotated in the opposite direction at the same speed and normal load. This unexpected observation motivated the presented simulation study. The overall form deviations of the surface of the test bearing were measured with white light interferometry and used as simulation input. The two-scale simulation approach considers the effect of the surface roughness on a microscopic and the global bearing geometry with the surface form deviations on a macroscopic scale. Simulation results show that the surface form deviations can have a noticeable effect on the pressure distribution of the lubricant and hence on the size of the asperity contact area which leads to the differences in friction. The influence of the lubricant viscosity, the clearance gap and the surface roughness were analysed in a parametric simulation study. Results show that the clearance and the surface roughness control the impact of the surface form deviations on the friction force. All in all, the results show the necessity to include all scales of surface form deviations in the simulation of journal bearings in a mixed lubrication regime.

Keywords: mixed lubrication, friction force, form deviations, journal bearing

*Corresponding author: Sebastian Fricke (Sebastian.fricke@de.bosch.com)

1 INTRODUCTION

In many applications, friction forces are relevant for the efficiency, functionality or reliability of a machine element. A considerable amount of research effort has been devoted to the determination of friction forces by simulations instead of experiments to reduce development time and cost. Simulation models have to be validated before they can be applied to product development processes. This paper presents first results of a study with the goal to validate the computation of the friction force of a journal bearing.
Stribeck [1], [2] identified three friction regimes of lubricated contacts depending on the sliding speed as illustrated in figure 1: boundary friction, mixed lubrication and hydrodynamic friction. The simulation results of contacts in the hydrodynamic friction regime are reliable for most material combinations [3]. Contacts in mixed lubrication conditions are, however, more complex and include a combination of hydrodynamic and boundary friction. Many physical and chemical mechanisms appear which are very difficult to include in simulation models. Understanding complex tribological systems in mixed lubrication still requires a combination of experiments and simulations.

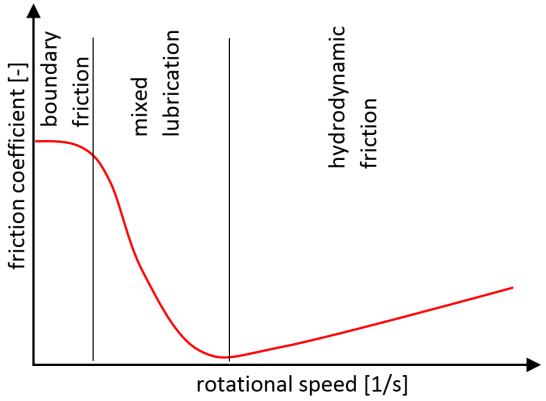

Figure 1: *The Stribeck curve*