Determination of the Friction Coefficient of Mixed Lubricated Contacts by Means of the Finite Element Analsyis

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1. INTRODUCTION

Using the finite element analysis for contact simulation is an unconventional way to determine the friction coefficient in non-lubricated resp. lubricated contacts. Present approach developed in previous years focuses on the calculation of the friction coefficient of mixed lubricated contacts.

Main task of present paper is to use previous developed model in order to calculate the friction coefficient of mixed lubricated contacts in function of different parameters such as:

- Average lubricant film thickness
- Pressure
- Sliding velocity
- Roughness

For this, surface roughness has been taken into account in the model as well as thermal boundary conditions and heat generation.

In addition to this, topography evolution is calculated in order to predict topography evolution in function of all four listed parameter. The whole numerical investigation is taking place at the microscopic scale, where rough surfaces are imported and modeled as displayed in next section.

2. MODEL AND SIMULATION

The model itself is considering two microscopic bodies whose rough profiles were measured with an optical device. The Coupled-Eulerian-Lagrangian method (CEL), enables changes of the fluid domain topologies, an opportunity to model mixed lubrication. Fluid flow is considered as strictly laminar and cavitation phenomena are here not taken into account.

Solid-solid interaction is assumed to be ideal and so enables it to be modeled with the Bowden and Tabor adhesion model. Heat generation is also taken into account as well as its impact on material behavior.

3. RESULTS AND DISCUSSION

To calculate the friction coefficient and real average film thickness, a post processing step had to be implemented as such complex operations are not foreseen in such operations.

Trend shows that the higher this friction area is, the higher the friction coefficient is (see Figure 1). Evolution of real average lubricant film thickness in function of the ideal film thickness shows that profile flatness increases highly with smaller film thicknesses.

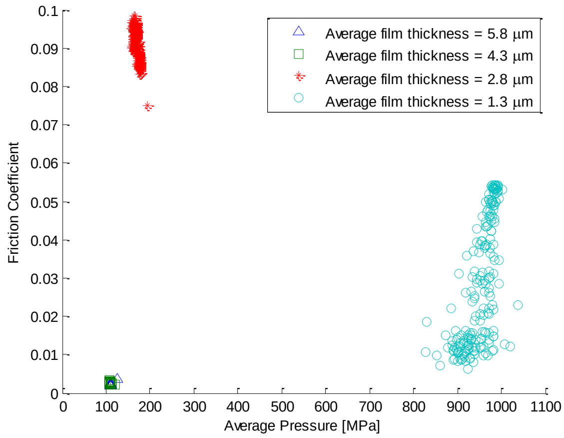

Figure 3.1: Example of impact of film thickness on friction coefficient and load (sliding velocity of 2 m/s and Ra of 0.800 µm)

The method showed a realistic behavior which is in accordance with pin on disk tests as well as with system tribometer tests like journal bearing tests.

Further planed analyses consist in

- extend the approach to the macroscopic scale
- taking into account more realistic adhesion forces occurring in the solid-solid interface
- taking into account, in addition to plasticity, contact fatigue, which is essential to model wear phenomena.