Starvation consequences on EHD spinning contacts: Experimental evaluation

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The study presented herein focuses on the roller-end/flange contact. One of the defining traits of this contact is its complex kinematic field, integrating a spinning motion. While some experimental and numerical works have been conducted successfully on this topic, the studies did not consider the influence of the environment, which might lead the contact to operate under starvation. This work presents an experimental setup to induce and measure film thickness in starved spinning contacts. Interferograms obtained through this method are presented, together with an analysis of the mechanisms involved in the oil distribution in the contact area.

Keywords: film thickness, starvation, spinning, Tribogyr, EHD

1. Introduction

The roller-end/flange contact constitutes a critical design point for certain mechanical components, amongst which tapered, cylindrical and spherical roller bearings are included. At the same time, the literature review on the topic is still limited. Previous works have experimentally studied the influence of spinning on specific aspects of the roller-end/flange contact, notably, the friction levels, the thermal effects and the geometry [1]. In these cases, fully flooded conditions were always assumed, arguing the lack of information on these phenomena. However, the high curvature radii of the mating elements lead to narrow contact tracks. Thus, the contact might normally operate under starvation, whose effects could be further enhanced by the interaction with the environment and/or the application of eco-friendly measures. This study aims to develop a procedure to experimentally induce and control starving conditions on spinning contacts.

2. Methods

The operating and geometric conditions of the roller-end/flange contact are replicated by means of the Tribogyr test rig [2] at a 1:1 scale. The test rig consists of a tribometer provided with a glass disk and a steel spherical-end specimen. Tribogyr was originally conceived to perform fully flooded spinning contacts.

The present study takes inspiration from the experimental work from Svoboda *et al.* [3]. A roller with specific geometric characteristics is placed upstream of the contact studied. This serves two goals: (1) limit the amount of lubricant incoming into the spinning contact, and (2) generate a wide and relatively uniform film thickness layer to feed the aforementioned contact. The lubrication conditions of the specimen-disk contact are so defined by the conditions of the roller-disk contact. To vary the degree of starvation, lubricant is scrapped off from the disk's surface, upstream of the roller. The starved contacts are observed to be stationary.

Figure 1 shows two interferograms of a fully flooded and starved contact obtained with Tribogyr using this technique. Both images correspond to identical operating conditions (entrainment speed, load, etc.), but different oil supply.

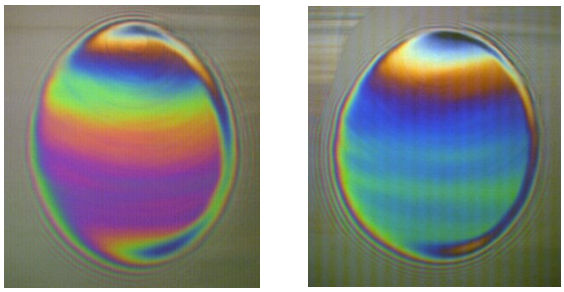

Figure 1: Interferograms of a fully flooded (left) and starved (right) spinning contact obtained with Tribogyr. Both images have identical operating conditions.

3. Discussion

Different spinning conditions under various degrees of starvation have been induced. The results show firstly a loss of symmetry in the oil distribution of the contact due to the spinning component of the kinematic field. Secondly, and as illustrated in Figure 1, the contact tends to present a more uniform oil distribution the more starved it becomes. The film thickness reduction rate in the contact area is not uniform and varies with the velocity profile, dependent on spin.

4. Acknowledgments

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5. References

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