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Grease replenishment behavior on the ball-on-ring

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Nowadays, the most common device used for studying grease lubrication is ball-on-disc tribometer. This configuration is not particularly accurate for the grease lubrication in ball bearings due to the design of the ball bearings causes a different lubricant flow. The different flow is primarily caused by centrifugal forces. The experimental device was used with Ball-on-ring configuration and the grease was evaluated by fluorescent microscopy. Experiments confirm that the real geometry causes a significant difference in the replenishment mechanisms in comparison to ball-on-disc devices.
Keywords: grease, ball bearings, ball-on-ring,

1. Introduction

Rolling bearings falls amongst the most used mechanical parts in the industry. The grease is used mostly for lubrication of the contacts with a thin film and prevention of the wear. The proper operating conditions and amount of lubricant around the contact are essential for optimal film thickness. Nowadays, the most used device for studying grease lubrication is a ball-on-disc tribometer [1]. This configuration is inaccurate for studying grease distribution in ball bearings due to its different geometry. The specific position of grease might have an impact on the amount of lubricant near the contact area. The aim of this work is to extend the state-of-the-art insights into the film thickness during the initial phase of the ball bearing running.

2. Methods

Experiments were performed on a tribometer with Ball-on ring configuration (Figure 1). Geometry of the glass ring was derived from a real deep grove ball bearing 6314. The optical imaging system for capturing contact area consisted of an industrial microscope, digital camera (sCMOS), mercury lamp and PC. Fluorescence microscopy was used for the film thickness evaluation and contact surrounding analysis. Fluorescence dye was mixed into the grease to improve observation.

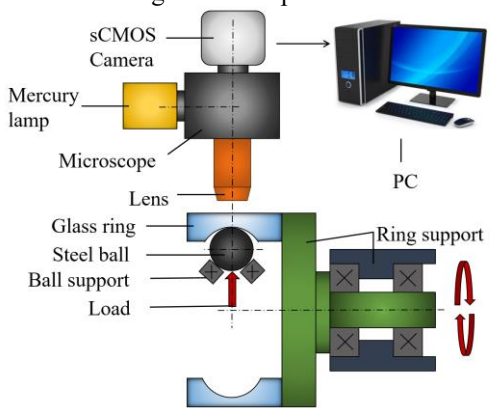

Figure 1: Schema of experimental apparatus.

3. Experiments conditions

The experiments were carried out at two different speeds (0.1 and 0.5 m/s). Each measurement was carried three times for ensuring repeatability and 0.5 g of fresh grease was applied on the rolling element each time. Li-complex type grease was selected with NLGI grade 2-3 and with base oil kinematic viscosity of 50 mm^2s^{-1}. The contact pressure developed between the rolling element and glass ring was 0.5 GPa. The temperature during experiment time was constant 25±1 °C. Behavior as examined in two different configurations ((A)with cage and (B) without a cage)

4. Results

The results are plotted in Figure 2. The configuration (A) without a cage shows a different trend than (B) with a cage configuration. The film thickness is lower in both configurations in the slower speed conditions. In case (A) with the 0.1 m/s speed, the grease lost the capability of sufficiently supply the contact. Contrarily, in 0.5 m/s and after several revolutions, lubricant supply return. In case (B) in both speeds was grease supply sufficient all the time.

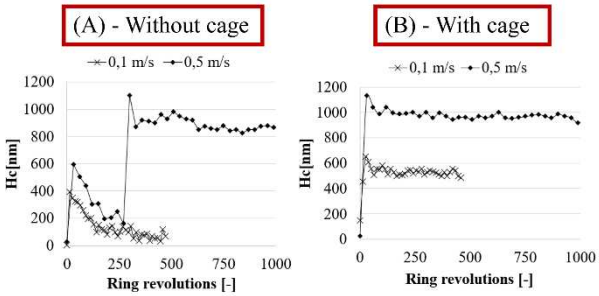

Figure 2: Comparison of configurations

5. Conclusion

The experiments showed the cage has a perceptible influence on lubrication supply and film thickness in contact. The grease supply is more efficient than the case ball-on-disc tribometer in both configurations. The main reason for better supply is centrifugal force, which causes the grease to flow in the direction of the contact area. A rapid increase of amount lubricant is shown in configuration (A). This increase is likely caused by the grease property, which begins to act after a specific time of operation. The higher amount of lubricant at this time can be caused by higher bleeding of base oil from grease.

6. References

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