Lubricant film thickness in EHL contact with oil-impregnated sintered steel

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Oil-impregnated sintered materials are often used in conformal contacts, e.g. in journal bearings. However, their application in highly loaded contacts and usability of the self-lubricating mechanism is questionable. The aim of this work is to investigate the lubricant film forming capability of the oil-impregnated sintered steel in elastohydrodynamically lubricated (EHL) contact. Optical tribometer in the cylinder-on-disc configuration and thin film colorimetric interferometry are used to evaluate the lubricant film thickness distribution. The global and local effects of the porous structure on lubricant film thickness are discussed.

Keywords: EHL, lubricant film thickness; optical interferometry; sintered material

1. Introduction

Sintering is the procedure allowing to produce open-pored structure suitable for the oil impregnation. So-called self-lubricated parts are widely used in conformal contacts, e.g. journal bearings. There is an increasing demand for the use of self-lubricating properties also in highly loaded contacts, e.g. in sintered gears. Recently, tribological behaviour of sintered materials in concentrated contacts were investigated [1-2]. The aim of this contribution is to summarise the findings of the effect of the oil-impregnated sintered steel material on the lubricant film thickness distribution in line EHL contact.

2. Methods

EHL contact is simulated experimentally between the sintered steel cylindrical sample and the glass disc under rolling-sliding conditions using the optical tribometer shown in Fig. 1. Sintered specimen is impregnated with ISO VG 32 mineral oil to provide self-lubrication.

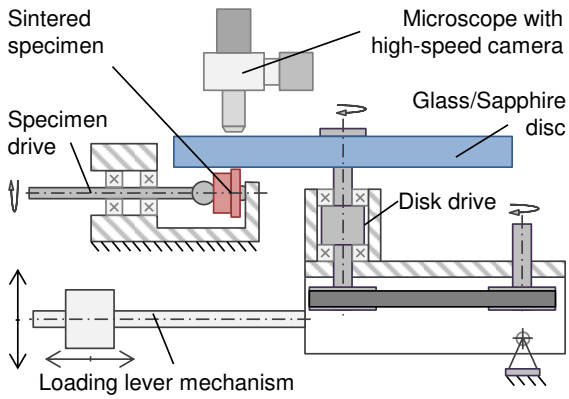

Figure 1: Scheme of the optical tribometer.

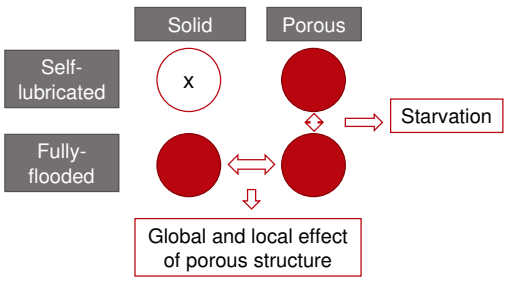

Figure 2: The comparisons made in the study.

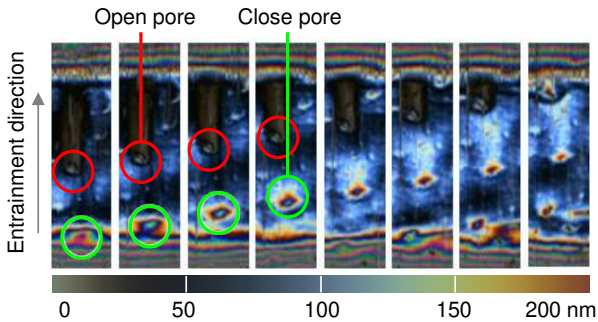

Figure 3: Different behaviour of open and closed pores under rolling-sliding conditions.

The issue can be divided into two separate questions, as indicated in Fig. 2. The first one deals with the comparison of the behaviour of porous material to the solid one under fully flooded conditions and the second one concerns the comparison of the fully flooded and self-lubrication conditions.

3. Results and Discussion

The comparison between self-lubricated and fully flooded conditions indicates that lubricant film thickness is mainly governed by oil bleeding capacity, while the relationship between oil starvation parameters corresponds well with the classic starved EHL theory. The local effect of porous structure on lubricant film thickness depends on whether the pores are so-called "closed" or "open". As shown in Fig. 3 for rolling-sliding conditions, the lubricant is emitted from the "closed" pores in the sliding direction. The effect is analogous to the behaviour of micro-dimples. However, "open" pores that are connected to the porous bulk structure, are much more serious, as they cause local lubricant film breakdown, no matter which surface moves faster.

4. References

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