EFFECT OF SURFACE TEXTURES IN HIGHLY LOADED GREASE LUBRICATED RECIPROCATING SLIDING CONTACTS

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ABSTRACT
The influence of surface textures on the friction and surface damage of grease lubricated ball on flat fretting and short stroke reciprocating sliding has been investigated. The tested steel and DLC coated steel specimens were given eight different texture patterns and were compared with untextured ground and polished surfaces.

The objective is to find optimum treatment of fretting surfaces to endure vibratory contact without suffering severe surface damage, by introducing lubricant supply between the surfaces within the area of contact.

The friction evolution was continuously recorded. The friction and surface damage behaviour is discussed.

1. INTRODUCTION
Lubricated sliding between two bodies requires the constant presence of a lubricant within the contact area. In many situations the lubricant is automatically fed into this area by the relative movement itself. However, in some situations the possibilities to feed lubricant into this area is very limited.

• If the load is high, the surfaces deform and adapt to each other and the interface between them becomes very tight.
• If the sliding distance is small relative to the extension of the contact area, especially in reciprocated sliding and fretting, the lubricant is not effectively fed into the interface.

• Greases are not able to flow into a contact zone in the same way as a lubricant.

Textured surfaces have earlier shown promising in unlubricated and oil lubricated fretting contacts [1-4]. This paper investigates the potential of using specific surface textures in increasing the supply of grease into such contacts. The friction and surface damage results are presented and discussed with respect to understanding the mechanism of textures in this type of contacts and their potential use in mechanical applications.

2. EXPERIMENTAL CONDITIONS
The tests were conducted in a ball-on-flat rig providing short stroke reciprocating sliding and fretting motion. Both the ø 10 mm ball and the flat samples were made of hardened steel. One set of flat and textured surfaces were further DLC coated to improve the wear life of the relatively shallow textures.

A load of 25 N (corresponding to a nominal elastic normal pressure of 920 MPa), a frequency of 100 Hz and stroke length of 50 µm was used for the majority of the tests. The friction force was continually measured and the worn surfaces subsequently investigated in the SEM. The formation of tribofilms were also analysed using EDS and XPS.

Polished and ground un-textured surfaces were compared to a set of textured surfaces. The textured surfaces involve parallel grooves and crossed grooves, each of four different spacings, 30, 60, 90 and 120 µm, respectively.
The textured surfaces were produced by a newly developed embossing technique, comprising micromechanically formed all-diamond embossing surfaces [5]. The embossing tools are pressed into the flat surfaces using a hydraulic press. Then the ridges formed around each indent are removed by a light polish.

3. RESULTS

The friction curves recorded typically showed a common qualitative trend involving three stages, see Fig. 1. Initially, the friction was low (µ around 0.08) corresponding to typical levels for sliding boundary lubricated friction [6]. After some critical number of strokes, depending on the conditions tested, the friction rapidly escalates to a new level (µ often > 0.3) typical of partial stick, or unsteady variations between sticking and slipping conditions. Two types of behaviour was shown after the transition. One very stable (constant sticking condition) and one very scattered, believed to correspond to unsteady variations between sticking and sliding conditions. The sliding friction here is much higher than the initial friction since the surfaces now have become quite rough due to transfer of material between the surfaces, see Fig. 2.

Both the critical number of strokes before transition from pure sliding to sticking conditions and the friction level after the transition varied between the different textures and greases tested, but also the scatter within a given set of texture and grease was significant.

5. REFERENCES