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Lubrication Characteristics of PTFE Film Coated Surfaces in Hydrodynamic Lubrication

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This study describes the investigation of lubrication characteristics of PTFE coated surfaces in hydrodynamic lubrication. Friction tests are conducted between a rotating disc and a stationary convex optical lens. The film thickness is measured by white light optical interferometry. A synthetic lubricant oil of poly-alpha-olefin is used without additives as lubricant. The lubricated area is in situ observed over the convex lens during tests. It is found that the disc with PTFE coated disc could reduce remarkably friction even in starved lubrication. In situ observation of the lubricated area shows that lubricant oil is more trapped around the lubricated area when PTFE coated disc is used.

Keywords: PTFE, hydrodynamic lubrication, friction, starvation

1. Introduction

Polytetrafluoroethylene (PTFE) is one of synthetic fluoropolymers which is widely used in numerous applications of mechanical parts. PTFE has many advantages of light weight, high thermal resistance, low surface energy and so on. PTFE has also been used in friction parts because of low friction and high wear resistance despite no lubricant oil. Much effort has mainly been conducted to investigate friction and wear characteristics in dry conditions while the impact of the use of PTFE with lubricant oil has not still been well understood. In this study, we focus on lubrication characteristics of PTFE in hydrodynamic lubrication. Simple friction tests are conducted using coated PTFE film on friction surfaces

2. Experimental

Friction tests are conducted with changing sliding speed at the constant load of 10 N and ambient temperature of 23 °C using a test rig which creates a point contact area between a rotating disc and a stationary convex optical lens. The contact area is captured by a colour CCD camera over the convex lens. The film thickness is also measured by white light optical interferometry. A synthetic lubricant oil of poly-alpha olefin which is equivalent to VG68 is used without additives. The amount of lubricant oil is precisely controlled by pipette and is put on the disc track before tests.

3. Results and Discussion

Figure 1 shows variations in friction coefficient at the amount of lubricant oil = 50 μL for three discs of a steel disc, a thin PTFE film coated disc, and a thick PTFE film coated disc. For the steel disc, the friction coefficient is greater than 0.1 because lubricant starvation occurs. On the other hand, the friction coefficient is remarkably reduced over the sliding speeds and is approximately 0.01. The friction coefficient does not change with increasing sliding speed besides low sliding speeds.

Figure 2 shows snapshots of the lubricated area during the tests at the sliding speed = 500 mm/s. The size of the meniscus pattern of lubricant oil formed around the lubricated area is larger for the PTFE disc than for the steel disc. Therefore, coating PTFE film can contribute to improve starvation of lubricant oil.

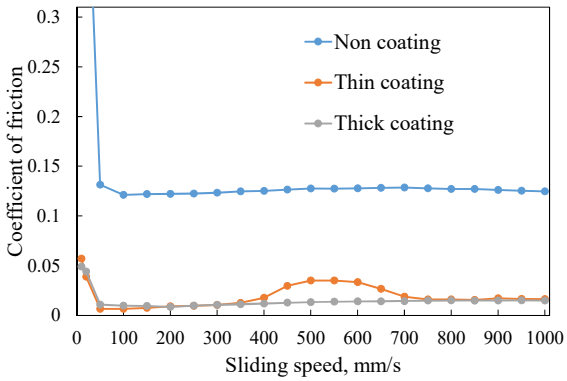
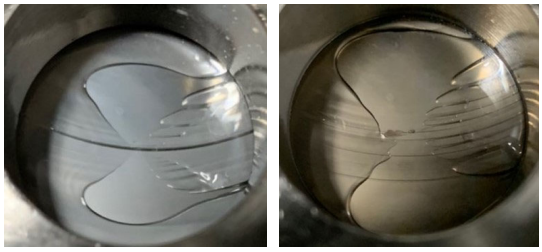


Figure 1: Variations in friction coefficient at different sliding speeds for three discs



(a) Steel disc (b) PTFE coated disc

Figure 2: Comparison in meniscus pattern between steel disc and PTFE film coated disc.