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COLLAPSE BEHAVIOUR OF SOLIDIFIED FILM IN ELASTOHYDRODYNAMIC LUBRICATIUON CONDITIONS

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EHL; solidification; film shape; slippage

ABSTRACT
The film thickness is one of most important factors to estimate the severity and efficiency of lubricated contacts. The fluid film in elastohydrodynamic lubrication (EHL) conditions, found in gears, rolling bearings, and cam-tappet systems, is formed under high pressure of the giga-pascal order. The significant high pressure causes large elastic deformations of bounding surfaces and an increase in viscosity. The pressurized lubricant behaves in the non-Newtonian manner as the response to shear motion. During the last decade, anomalous film shapes have been found under high sliding conditions when fatty alcohols are used as lubricant [1-3].

In the current study, the authors investigates precisely the film formation of a solidified film in EHL conditions. A fatty alcohols of 1-dodecanol is used as lubricant, which has low viscosity and a clear melting point of 24 ºC. A circular contact is produced between a rotating transparent disc and a rotating steel ball, which are independently driven by AC servo motors. Optical interferograms formed between the disc surface and ball surface are captured by a digital camera attached to a microscope. A Xenon flashing light is used as a light source to produce optical interferograms between the bounding surfaces.

Figure 1 shows a representative result of optical interferograms of EHL films at different slide-to-roll ratios defined as $S = (u_b - u_d) / u_m$. In pure rolling conditions, the shape of film is the typical EHL shape, having a flat part at the centre and a constriction at the exit. As the slide-to-roll ratio increases with faster speeds of the steel ball surface, the inhomogeneous colour of optical interferograms appears around the centre. As the high slide-to-roll ratio increases furthermore, inhomogeneous film collapses gradually around the centre and exit. In the current study, the trend of the collapse behavior of the solidified EHL film is investigated.

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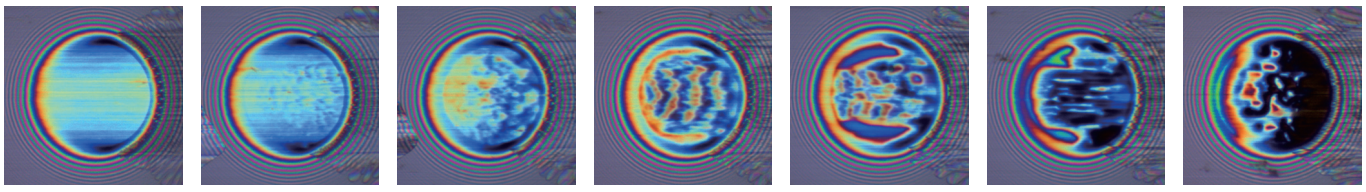

$S = 0$ $S = 0.3$ $S = 0.6$ $S = 0.9$ $S = 1.2$ $S = 1.5$ $S = 1.8$

Fig. 1 Collapse behaviour of EHL film at different slide-to-roll ratios (u_m = 1.8 m/s, p_{hmax} = 0.57 GPa, T = 30ºC)