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TRACTION IN SOFT EHL CONTACT WITH GREASE

Reduction gears with a combination of a steel worm and an engineering plastic wheel are widely used. Their higher reliability and lower friction loss are required. In tribological terms, to reduce EHL traction is of current concern.

The traction between a steel ball and a PC disk was measured at a mean entrainment speed of 0.3 or 0.5m/s under a load of 20N at room temperature 25°C, and the slide-roll ratio changed from 0 to 50%.

Four sample oils a to d are listed in Table 1. Three sample greases A, B and C were made with the same base oil and different thickeners as shown in Table 2.

The traction in the soft EHL with three sample oils b, c and d is compared in Fig. 1, where difference in the traction coefficient with different type of oil is clearly observed showing the order c>d>b, in accordance with the order of the pressure-viscosity coefficient.

Figure 2 compares the traction with three sample greases and their base oil alone, at a mean entrainment speed of 0.5m/s. The traction coefficient with the greases is a little higher than that with their base oil, and the difference among the greases is insignificant.

The piezo-viscous effect must be taken into account. The reason is the traction is governed by the flow within a parallel region, under high pressure comparable to the Hertzian pressure. This suggests that theories on the traction proposed by Muraki and Kimura in the hard EHL

Table 1 Sample oils

Sample oil	a PAO	b PAO	c *N-oil	d *P-oil
Viscosity @25°C, mPa·s	125	79.4	121	75.1
α @25°C, GPa^{-1}	15	14	26	20

*N-oil: naphthenic oil, P-oil: paraffinic oil

Table 2 Sample greases

Sample grease	A	B	C
Base oil Viscosity @25°C, mPa·s	PAO 49.5		
Thickener Concentration, mass%	Li-St 12	Li-OHSt 9.5	Urea 11
Penetration (60w)	296	297	294
Additive	None		

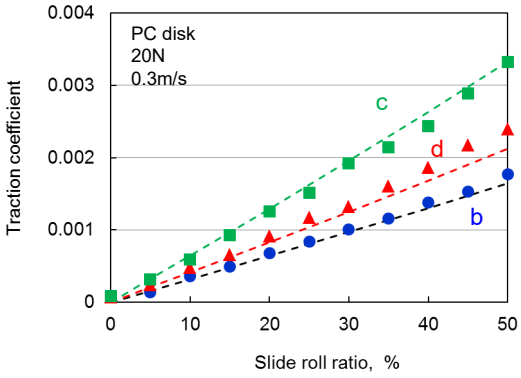

Fig.1 Traction coefficient with different oils

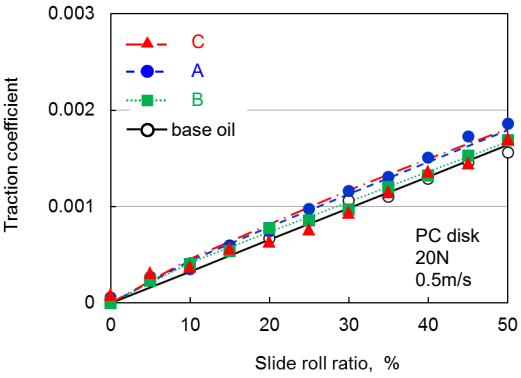

Fig.2 Traction coefficient with different greases

can be used in the present case. For the linear viscous and isothermal region, the traction coefficient μ is further simplified to give

$$\mu = \eta_0 \exp(\alpha P_{mean}) \times \Delta u / h_c \times 1 / P_{mean}$$

where η_0 is the apparent viscosity, α is the viscosity-pressure coefficient, P_{mean} is the mean Hertzian pressure, and Δu is the speed difference between the ball and the disk. The central film thickness h_c is given by previous issue (KYTB 11). The predicted results are shown in the Figs.1 & 2 as corves, and reasonable agreement with the experimental results.

Kochi, Ichimura, Yoshihara, Dong and Kimura: Film thickness and Traction in Soft EHL with Grease, Tribology Online, **12**, 4(2017), 171.