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GREASE MARKEDLY REDUCES FRICTIONAL TORQUE OF BALL BEARINGS AT LOW SPEEDS

In the preceding issue it was reported that, at low speeds, grease formed elastohydrodynamic(EHL) film which was much thicker than that with base oil alone. In its consequence, grease markedly reduces frictional torque of the bearings at low speeds. Although its contribution to energy conservation seems limited, it will improve operability of devices.

The same setup was used as that for measuring EHL film thickness in ball bearings, Fig.1. A couple of deep-groove ball bearings 6204 were run under an axial load of 400N and rotational speed was changed. A bar extending from the floating housing pushed a load cell fixed on the frame to constrain the rotation of the housing and to monitor the frictional torque of the bearings.

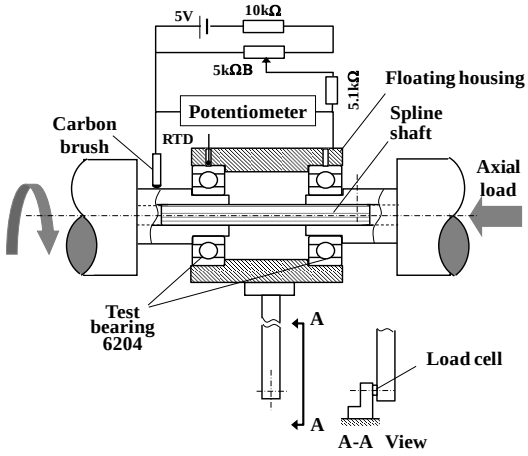

Fig.1 Experimental setup

Three sample greases A, B, C were prepared with synthetic hydrocarbon of different viscosity, A:25mm^2/s, B:81mm^2/s, C:741mm^2/s, as the base oils and lithium 12-hydroxystearate as the thickener; the concentration of the thickener was adjusted to have a consistency number 3. Experiments were made with each of the three sample greases and their base oils as lubricant.

Measured frictional torque is plotted in Figs.2 and 3 against the theoretical central EHL film thickness at the ball-race interfaces when lubricated with the base oil $h_{c,oil}$ after Hamrock and Dowson. Figure 2 shows that the three base oils exerted the same torque at high and medium speeds irrespective of their different viscosity, and it gradually decreased with decreasing speed. At low speeds when $h_{c,oil}$ was less than 40nm, the torque

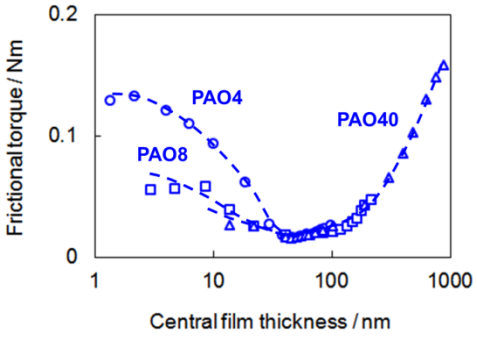

Fig.2 Change in frictional torque with $h_{c,oil}$: base oil

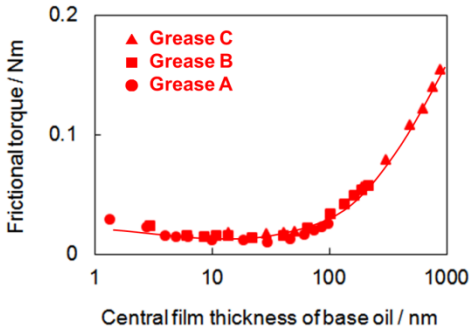

Fig.3 Change in frictional torque with $h_{c,oil}$: grease

increased with decreasing speed to different extents depending on their viscosity. When lubricated with grease, Fig.3, the change in the torque was similar to that with the base oil at high and medium speeds. At low speeds, however, the torque increased only slightly with decreasing speed, where the three sample greases showed practically the same torque being much smaller than that with base oil. Figure 2 for base oil represents the transition from EHL to mixed lubrication. In contrast, prevalence of EHL over the whole speed range characterizes the curve in Fig.3 for grease.

D. Dong, T. Komoriya, T. Endo and Y. Kimura, "Formation of EHL film with grease in ball bearings at low speeds", J. JAST, vol.57, no.8 (2012) pp.568-574 (*in Japanese*).