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IN BALL BEARINGS, GREASE FORMS THICK ELASTOHYDRODYNAMIC LUBRICATION FILM AT LOW SPEEDS

Ultrathin-film optical interferometry revealed that, at extremely low speed, grease formed elastohydrodynamic(EHL) film which was much thicker than that with base oil alone. It was confirmed that that this characteristic behavior occurred in real ball bearings by electrical potential measurement.

Instead of the optical interferometry, electrical potential across the ball-race interfaces was measured. It keeps open-circuit potential in perfect EHL, but its time average lowers caused by occurrence of metal-to-metal contact. The potential was converted into the EHL film thickness with a master curve previously prepared by the relation between the measured potential in EHL with oil and the theoretical prediction by the Hamrock-Dowson theory.

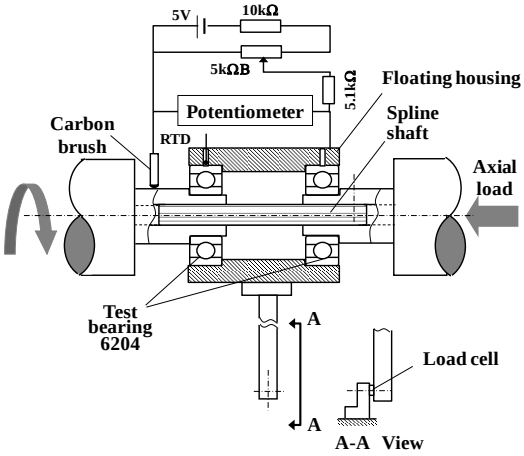

Fig.1 Experimental setup

As Fig.1 shows, two deep-groove ball bearings 6204 were mounted on each of the co-axial spindles connected by a splined shaft. Electrical potential was applied to the bearings in parallel, while in series to the ball-outer race and ball-inner race interfaces.

The sample grease, grease A was prepared with a synthetic hydrocarbon of viscosity 25mm^2/s, PAO4, as the base oil and lithium 12-hydroxy stearate as the thickener to have a consistency number 3.

At the high-speed range in Fig.2, the average potential with grease A ● was only slightly higher than that with PAO4 ○. Both ● and ○ lowered with the decrease of speed, but the lowering of ○ was more marked than that of ●. At the low-speed range below

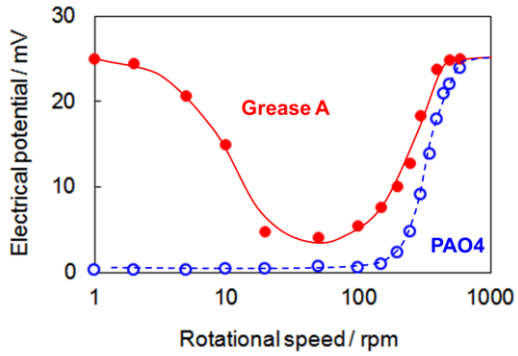

Fig.2 Change in electrical potential with speed

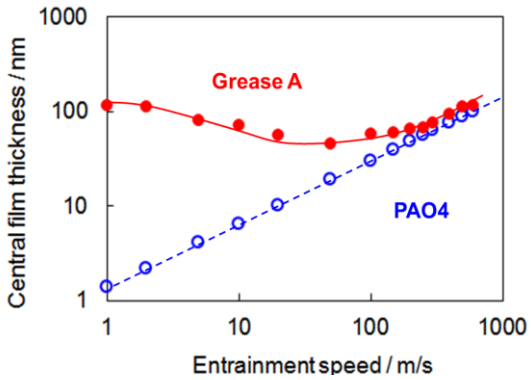

Fig.3 Change in central film thickness with speed

20rpm, while ○ remained almost nil, ● appreciably increased with further decrease in speed.

The average potential was converted into the central EHL film thickness, Fig.3, by using the master curve mentioned above. This result shows a common feature to that of the optical interferometry; that is, grease forms thick EHL film at low speeds caused by the increased viscosity at low shear rates.

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*).