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Lubrication Characteristics of Oil-based Magnetic Fluid Retained on Sliding Surface under Surface Contact Condition

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Friction generated at the sliding parts results in significant energy loss in various machineries. There are many studies for reducing friction at the sliding surface such as surface texturing, improvement of lubricants and so on. In recent years, nano-oil, which is a lubricant (base-oil) added with nanoparticles, has been attracted attention for reduction of sliding friction. For example, Choi et al.[1] reported that nano-oil, which is the dispersion of copper nanoparticles in base oil, achieved large friction reduction compared with the base oil. Oil-based magnetic fluid is a kind of nano-oil, and we attempt to apply it as a lubrication oil in this study. The advantages of using oil-based magnetic fluid as a lubrication oil are "the ability to retain the magnetic fluid only on the sliding surface by magnetic field,"and "the expectation of reducing friction by the effect of unique feature of magnetic fluid under magnetic field such as generation of magnetic body force and change in physical properties." Yang et al. [2] applied magnetic fluid as a lubricant to the point contact sliding parts, and reported friction reduction under the condition in which large wear occurs. With considering properties of magnetic fluid, it can be thought that large surface contact area is more effective against sliding friction by using magnetic fluid as a lubricant. In this present study, we constructed a friction testing machine under surface contact condition by ourselves, and evaluated the lubrication characteristics of oil-based magnetic fluid retained at the sliding surface. Since various methods can be considered for retaining magnetic fluid on the sliding surface by magnetic field, experiments were carried out by changing three holding methods such as "pin-mag,""disc-mag,"and "repulsive."These are the methods for retaining magnetic fluid on only upper test pin with embedding magnet in the test pin, on only lower disc with setting ring magnet under the disc, and on both upper test pin and lower disc with placing two magnets facing the same poles in test pin and disc, respectively. The results showed that frictional force of low-viscosity-type- Polyol-ester-oil-based magnetic fluid is reduced by applying magnetic fluid. Particularly, repulsive condition showed the lowers friction compared among three methods. Further detailed results and discussion will be held in presentation.

References

[1] Y. Choi et al., Current Applied Physics, 9-2 (2009), pp. e124-e127.
[2] Y. Yang et al., Tribology International, 161 (2021), 107086.

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