ONLINE ISSN : 1349-273X
PRINT ISSN : 1346-8804

Journal of the Japan Petroleum Institute
Vol. 49 (2006) , No. 5 pp.268-273

[PDF (2022K)] [References]

Additive Effect for Environmental Lubricants—Decreased Phosphorus Contents in Low Viscosity Base Oils for Antiwear Performance—

Ichiro Minami[1)], Hiroyuki Murakami[1)], Hidetaka Nanao[1)] and Shigeyuki Mori[1)]

1) Dept. of Chemical Engineering, Iwate University

(Received: February 22, 2006)

Low viscosity base oils are one of the candidates for fuel saving lubricants for internal combustion engines. These lubricants reduce viscous friction under hydrodynamic conditions, so reduce total energy loss at tribological contact. However, these oils provide thinner oil films resulting in magnified wear. Therefore, wear protection of rubbing surfaces is very important to apply low viscosity oils in practice. Effects of phosphorus-containing additives on antiwear properties of low viscosity base oils were evaluated under boundary lubrication conditions using a four-ball type wear tester according to ASTM D 4172. For mineral based oils, dialkyl phosphonates considerably reduced wear whereas trialkyl and triaryl phosphonates did not. Compatibility of additive with mineral based oil depends on the refining process of the oil. Wear prevention by phosphorus-containing additive in solvent-extracted mineral oils was sometimes unpredictable. Additive response for hydrogen-refined mineral oils was better than that for solvent-extracted oils. The results showed good accordance with phosphorus contents on the worn surfaces obtained by surface analysis. At least 0.062 mass% (620 ppm) of phosphorus is required to achieve sufficient antiwear properties in hydrogen-refined mineral oils. Synthetic esters have good lubricity in comparison with mineral oils. However, conventional antiwear additives for mineral oils are not always effective for synthetic esters, especially low viscosity esters. Hydroxyalkyl phosphates, with a polar functional group in the molecule, reduced wear effectively even at 0.016 mass% (160 ppm) of phosphorus in low viscosity synthetic esters. The new additives provided boundary films with high phosphorus contents. Kinetics of the boundary film formation were examined by the electric contact resistance method.

Formation of the boundary film from the new additives was higher than that from conventional additives. The replenishment process of the boundary film under dynamic conditions is very important for low viscosity lubricants.

Keywords: Antiwear additive, Phosphorus compound, Synthetic ester, Lubrication mechanism, Tribo-chemistry, Environmental lubricant

To cite this article:
Ichiro Minami, Hiroyuki Murakami, Hidetaka Nanao and Shigeyuki Mori, *Journal of the Japan Petroleum Institute*, Vol. **49**, No. 5, p.268 (2006) .

doi:10.1627/jpi.49.268
JOI JST.JSTAGE/jpi/49.268