

平成14年度修士論文

環境調和型潤滑油の実用化
に向けた添加剤の検討

Investigating of Additive Technology for Environmentally
Friendly Fluids Toward Practical Application

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Abstract

Vegetable oils have been used as lubricating fluid from ancient Egypt, BC 1880. Recently, they are recognized as ecologically acceptable lubricating fluids. Therefore they are expected to apply machines where exposure of lubricating oil is a problem. Zinc dialkyldithiophosphates (ZDTP) improve antiwear properties of vegetable oils. The additive performance depends on quality of the base oil. Careful analyses of base oils revealed that peroxide affects the additive response, whereas peroxides themselves do not promote wear. Vegetable oils have unsaturated carbon-carbon bonds, which are ready to undergo autoxidation.

In this work, we investigated influence of degradation products on performance of anti-wear additives. Our attention was also paid to improve antiwear effect of additives by combination of antioxidants. Oxidation test of vegetable oil was performed by tracing peroxide value (POV) to understand the mechanism. Antiwear properties of oxidized oil were evaluated by means of four-ball wear test, which is regulated by ASTM D 4172. Peroxide value (POV) of the oxidized sample was obtained by the iodometric titration.

We found that POV increases rapidly at the beginning of reaction. It reaches the maximum value of approximately 1500ppm within 50 hours. Then it decreases to reach an equilibrium value of 400-500ppm within 200 hours. Decrease of POV can be explained by the conversion of peroxides into organic oxides. Then at the equilibrium stage, rate of peroxide generation, and the rate of peroxide consumption are almost equal. Antioxidants were examined to prevent the peroxide generation. Phenolic antioxidants and Zinc dibutyldithiocarbamate (ZDTC) exhibit good results in preventing peroxide generation, whereas aromatic amines and vitamin E gave poor results. Almost no effect on antiwear was observed with

antioxidant-free sample and VE-containing sample. PNA-containing sample showed a little effect, however it is not an acceptable level. Excellent wear reduction was observed with the oxidized sample in the presence of phenolic antioxidants and ZDTC. The synergistic effects of antioxidants with antiwear additives can be confirmed by formulate better lubricants based on vegetable oils.

Keywords: Vegetable oils, Anti-wear additives, Antioxidants, Auto-oxidation, Peroxides,