Experimental analysis of tribological properties of chemically modified bio-based lubricant with nanoparticle additives

N.W.M. Zulkifli[1*], M.A.Kalam[1], H.H. Masjuki[1] and R. Yunus[2]

[1]Department of Mechanical Engineering, University of Malaya, Kuala Lumpur 50603, Malaysia
[2]Institute of Advanced Technology, University Putra Malaysia, 43400 Serdang, Selangor, Malaysia
[*]Corresponding author: nurinmz@um.edu.my

1. Introduction

There has been an enormous amount of research conducted on using vegetable oil as a lubricant. Vegetable oil has a positive impact to use as a lubricant has high biodegradability and reduces friction. In addition to that, the uncertainty of the crude oil supply, increasing crude oil prices, and issues related to environmental makes the vegetable oil more valued. However, vegetable oil has some drawback such as low oxidation stability, and low thermal stability.

Several techniques have been done to overcome the potential problem produced by vegetable oil such blending with other diluents such as polyalphaolephin, by chemical modification such as esterification, transesterification and epoxidized vegetable oil and adding additives.

It has been well known that addition of nanoparticle to lubricant is effective in reducing wear and friction.The mechanisms of friction-reduction of nanoparticles in lubricant have been reported as the colloidal effect, rolling effect, protective film and third body [1].

Therefore, this study is conducted to study the interaction between nanoparticles and chemically modified vegetable oil in terms of friction and wear.

2. Methodology

2.1. Constituents of tested oil

The nanoparticles WoS and MoSwere provided by Sigma Aldrich. The sizes of nanoparticles were less than <100nm. The lubricants used for this experiment were palm oil-based trimethylolpropane (TMP) ester andparaffin oil.

Glycol was employed as a solvent to mix the nanoparticle and prevent the nanoparticle form oxidizing with air [1]. The mixing conditions of the lubricants with nanoparticle are shown in Table 1.

Table 1 The constituents of nanoparticle lubricant additives

Nanoparticle	Base oil	Additive solution
MoS_2	90% Lubricant	10% solution (1% MoS + 99% glycol)
WS_2	90% Lubricant	10% solution (1% WoS + 99% glycol)

2.2. Experimental procedure

The test method to investigate the tribological properties focused on running in effect of lubricant was fourball machine. The test conditions were 392 N, rotational speed of 1770 rpm and operation time of 10 minutes with room temperature.

3. Results and Discussion

The friction coefficients of the lubricant with and without nanoparticles are shown in Fig.1. The friction coefficient containing WS_2 and MoS_2 are lower than lubricant without nanoparticles. This may cause by the nanoparticle acting as third body and protect the surface [3].

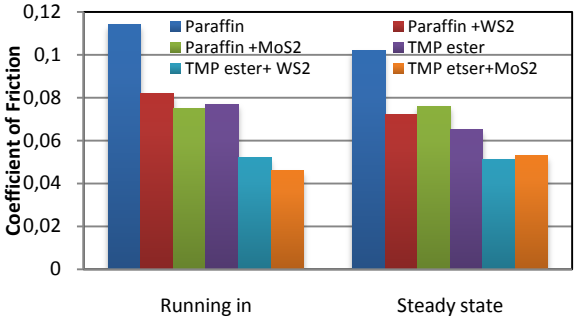

Fig.1 Coefficient of friction of lubricant for different condition

4. Conclusion

The experimental results showed that the nanoparticle added in chemically modified vegetable oil better performance in terms of reducing frictional constraints.

References

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