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The effect of nanoclay additive on pressure profile in journal bearing test rig

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ABSTRACT – Malaysia is well known for their production of palm oil and makes them the third in place in ranking for the whole world that produces palm oil. This palm oil has lots of benefit and can be used in many ways. The depletion of the world crude oil reserve, increasing crude oil prices and issues related to conservation has brought about renewed interest in the bio-based materials. Emphasis on the development of renewable, biodegradable, and environmentally friendly industrial fluids, such as lubricants has resulted in the use of natural oils and fats for non-edible purposes. In this study, the effect of nanoclay as additive in palm oil lubricant to oil pressure profile in journal bearing test rig were investigated. Palm oil bio-lubricant with nanoclay was mixed using an ultrasonic mixer. Result obtain were compared with commercial mineral oil lubricants.

1. INTRODUCTION

A lubricant is a material used to facilitate the relative motion of solid bodies by minimizing friction and wear between interacting surfaces. In addition to the primary purposes of reducing friction and wear, lubricating oils are also required to carry out a range of other functions, including the removal of heat, corrosion prevention, and the transfer of power [1].

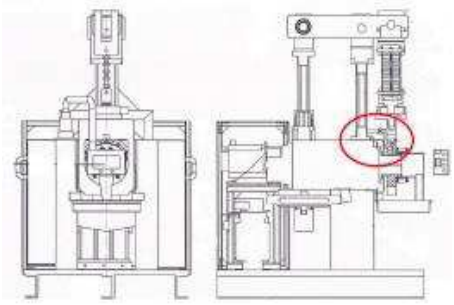
Nowadays, palm oil (PO) has been identified as a biodegradable lubricant. This causing high demand in making the palm oil as the replacement for the mineral oil that been used for many years. This is due to the characteristics of the palm oil which is non-toxic, biodegradability, and renewable base stocks. They can be products from fatty acids from fats and oils, reacted with synthetic alcohols to produce esters. Not only that, natural vegetable oils can be treated through several processes to produce modified products that is renewable and biodegradable [2,3].

Nanoclay is nanoparticles of layered mineral silicates that belong to a wider group of clay minerals. Having nonmetric thickness and diameter of 50–200 nm, the clay minerals may simply be described as fine-grained with sheet like structure stacked over one another [4]. Due to the availability and environmentally friendly properties, nanoclays have been adopted in numerous applications as performance improver, yet only few efforts been placed to study the potential as lubricant performance enhancer. Hence, in the present work, nanoclay has been used as the additives in palm oil bio-lubricant. The palm oil bio-lubricant with suitable composition of nanoclay was tested to observe pressure lubricant profile in journal bearing test rig.

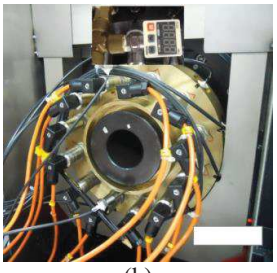
2. METHODOLOGY

In current study, palm cooking oil from the shelf was mixed with nanoclay as additive. Ultrasonic mixer was used to ensure the additive evenly dispersing with nano-particles in liquids.

The Journal Bearing test rig in Figure 1(a) was used in this experiment. The U5100 series of pressure transducers were used to measure the pressure distribution inside the bearing. Twelve units of digital stainless steel pressure sensors were fixed on the front face of the bearing as shown in Figure 1(b). It was tightened to the bearing with BSP ¼" thread at 30° interval. A pneumatic bellow is used to apply the required load. The maximum speed of the journal test rig is 1000 rpm. The speed values used for testing were 300, 400 and 500 rpm.



(a)



(b)

Figure 1 (a) Journal bearing test rig diagram and (b) pressure transducers assembly.

The tests were conducted at load 10 kN. Oil pressure inlet supply remained in the range of 180 to 200 kPa. Details of test bearing dimensions, lubricant properties and operating parameters are given in Table 1.

Table 1 Bearing Dimensions, operating parameters and sensor specifications.

Parameter	Values
Journal bearing, D	100 mm
Bearing length, L	50 mm
Radial clearance, c	52 µm
Load, W	10 kN
Journal speed	300, 400 and 500 rpm
Pressure sensor	
Model	MEAS (M5156)
Range	10 MPa
Accuracy	0.001± 1% MPa
Lubricant Nanoclay concentration	0.07%wt

3. RESULTS AND DISCUSSION

Figure 2 shows the oil pressure profile of journal bearing at 10 kN for different lubricants at different speeds.

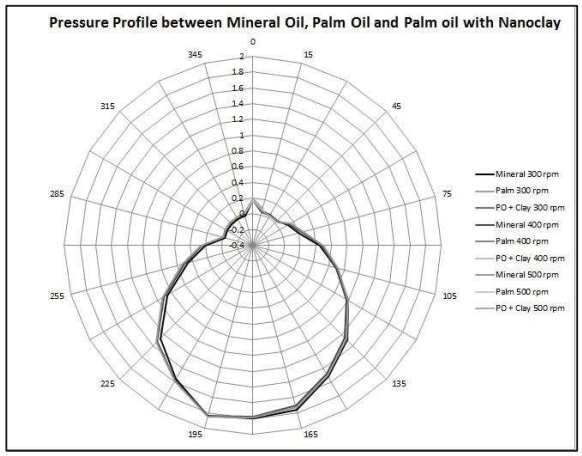


Figure 2 Pressure profiles of mineral oil,palm oil in and palm oil with Nanoclay at 10 kN for different speeds.

It was observed that changing the speed were not affected the pressure profiles. Nanoclay as additive has less effect in hydrodynamic lubrication. Different type of lubricant (different viscosity) mineral and palm oil show provide a similar trend of pressure profiles.

4. CONCLUSION

From the results, it can be concluded that pure palm oil has less different in pressure profile for different speeds compared to mineral oil. Nanoclay additive has less significant effects to the pressure profiles.

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