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FRICTION AND WEAR PROPERTIES OF LUBRICATING OIL WITH NANOPARTICLES ADDITIVES A REVIEW

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Abstract – *In current equipment reducing of wear and friction is critical to the correct working. The equipment which functions with more complexes requires a serious lubrication. With the use of best quality lubricants in automobile parts allows to withstanding extreme pressures and high temperatures. To improve the friction and wear performance and reducing surface damage different additives with conditions are added to fluid lubricant. Ongoing research work papers have reported that the addition of nano-particles to lubricant oils is successful for the reduction of tribological properties in automobile components. However, in organic solvents or oils the inorganic nano-particles may collect easily in many forms and have poor spreading capacity, with this reason applications of many nano-particles are limited. Whereas the spreading problem can be solved using some physical and chemical approaches. The investigation of tribological properties of lubricating oil with eco friendly additives has been done.*

Key Words: **Tribology, friction, wear, lubrication**

1. INTRODUCTION

The friction and wear property of a lubricant significantly depends on the additives it involves [1]. However, the additives which are used in lubricant produce severe pollution when they are burned. Therefore it is required to develop new generation pollution-less additives such as green additives. Friction is the main cause for the loss of energy in every mechanical system [2]. Therefore for reducing friction and wear in mechanical systems, one of the most adopted techniques is mineral derived oil (MDL) based lubricants, however, MDL are non-bio degradable in nature and toxic which leads to the foundation for developing eco-friendly lubricants. With this reason the research significantly carried out by adding nanoparticles into the base oils. Whereas, the effectiveness of lubricant greatly depends on the particle size of the additives. Moreover, it is observed that nanoparticles addition in base oil improved the load carrying capacity and reduced coefficient of friction.

2. CURRENT THEORIES

A brief review of some selected references on various types and there an application of nanoparticles is presented below.

2.1 Charoo et al. [3] performed wear studies on piston ring and cylinder tribo-pair at different concentrations of IF-MoS^2 additive and reported that at 0.5wt% of IF-MoS^2 showed high lubrication properties and low COF value.

2.2 Khorramian et al. [4] examined the effect of h-BN nanoparticles as an additive in SAE20W40 oil at various concentrations on piston ring and cylinder liner tribo pair. From the results, it is observed that with h-BN nanoparticles the lubrication properties improve significantly.

2.3 Fan et al. [5] explained that the tribological properties were improved by fabricating graphene.

2.4 Kinoshita et al., [6] reported that a significant change in tribological behaviour observed when monolayer graphene oxide sheets were used as additives in water based lubricants against tungsten/stainless steel sliding pair.

2.5 Malleswara Rao, K.N.D et al., [7] conducted experiments on Al-17Si under by adding the GO nano particles in the base oil and reported that addition of GO nanoparticles in base oil significantly improves the lubrication properties.

3. USED MATERIALS

For this experimental work, proper types of nanoparticles and base oil has been selected as follows.

3.1 Graphene Oxide (GO)

3.2 Base Oil

The finest, highest quality especially SAE20W50 base oils are used to produce the highest performance, superior quality lubricants from Lubrication Engineers. Although these base oils are expensive, no other type of petroleum base oil can match their performance [8-12].

3.3 Test Procedure

Before starting the experiment a small amount of prepared solution was applied on Al-Si alloy disc and the experiments were carried out using SAE20W50 engine oil. Each experiment was carried out by three times and an average value was taken.

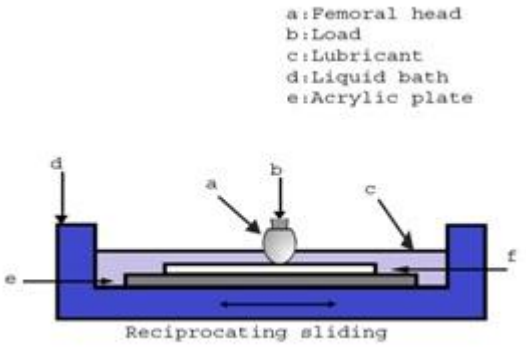

Fig 3.3 Experimental set up of Linear reciprocating Tribometer

For the analysis of the wear scars of samples (Al-Si disc) were cleaned initially with acetone to completely remove all of the lubricant materials, and then the microstructures were studied using optical microscope and SEM. After the completion of test to estimate the wear coefficient of the alloy disc the wear volume was calculated using weight balance method[13-17].

4. RESULTS AND DISCUSSION

It is observed that the friction coefficient of Al-Si alloy in ethanol under lubrication sliding condition was maintained constantly of 0.29 whereas constant friction coefficient value of 0.093 was attained in the case of SAE20W50. It is clear that from Figure 4 the lowest COF value of 0.093 was attained in the case of SAE20W50.

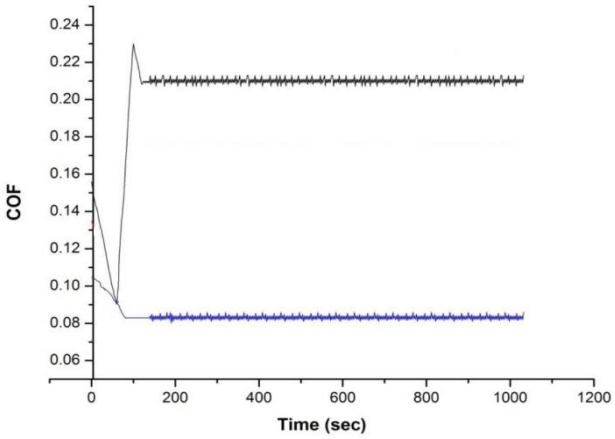

Fig 4 Coefficient of friction (COF) vs. time

Figure 5 shows the experimental values of wear coefficient of Al-Si under lubricated sliding conditions. It can be observed that the highest wear coefficient 1.89 . 10^{-3} (mm^3/N.m) was obtained for ethanol whereas for SAE20W50 the attained wear coefficient values is 6.27 . 10^{-5} (mm^3/N.m). From the observation, it is clear that for SAE20W50 the lowest wear coefficient (6.27 .10-5 mm^3/N.m)) was obtained.

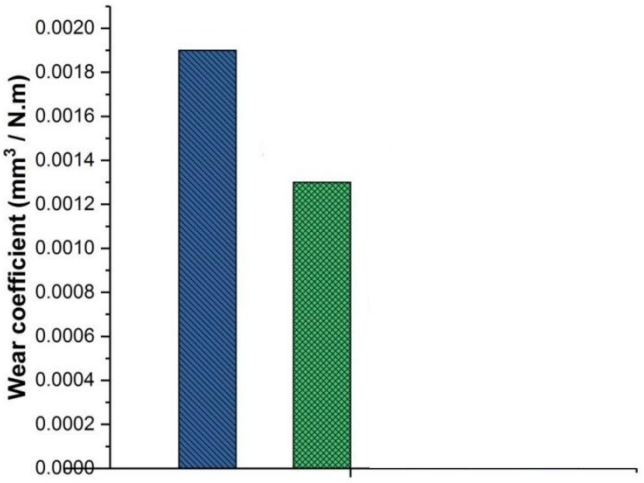

Fig 5 Wear coefficient

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5. CONCLUSION

The lubricating ability of GO nanoparticles as an additive in the SAE20W50 base oil depends upon experimental conditions. Anti wear, High load carrying capacity and friction reduction can be achieved if nanoparticles are present in SAE20W50 base oil under increasingly serve conditions such as time, load and speed. The following conclusion can be drawn on the basis of the tribological tests and SEM wear surface analysis conducted in this research.

- Adhesion between the contact surfaces was reduced with the presence of nanoparticles.

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