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Review of effective Lubricants mixed with Nano Metal Powder

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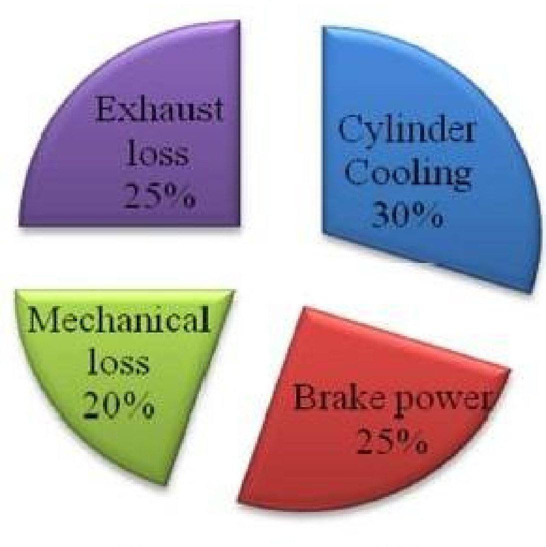
Abstract: By means of effective lubrication, mechanical design seeks to minimize friction in devices such as engines, skis and computer hard disc drives. On the other hand, high friction is essential for the traction and braking of rubber car tyres against the road surface. From the above, it clearly indicates the two main constituents of tribology: friction and wear, when controlled and reduced, automatically increase the service life of machine elements. This in turn saves money. The awareness of the subject, the identification of tribological problems and their solution can give rise to significant saving. For this reason many industries are placing emphasis on economic aspects of tribology.Piston compression ring is placed on the top position of the piston assembly. It accounts for 80 % of piston subsystem loss due to mechanical friction developed because of simultaneous sealing and sliding action.
Keywords: Nano metal powder, wear, friction, lubricants.

I.INTRODUCTION

The word tribology was first reported in a landmark report by scientist Sir Jost in 1966. The word is derived from the Greek word tribos meaning rubbing, so the literal translation would be "the science of rubbing". Its popular English language equivalent is friction and wear or lubrication science, alternatively used. The latter term is hardly all-inclusive. Dictionaries define tribology as the science and technology of interacting surfaces in relative motion and of related subjects and practices. Tribology is the art of applying operational analysis to problems of great economic significance, namely, reliability, maintenance, and wear of technical equipment, ranging from spacecraft to household appliances. Surface interactions in a tribological interface are highly complex, and their understanding requires knowledge of various disciplines including physics, chemistry, applied mathematics, solid mechanics, fluid mechanics, thermodynamics, heat transfer, materials science, rheology, lubrication, machine design, performance and reliability. It is only the name tribology that is relatively new, because interest in the constituent parts of tribology is older than recorded history. It is known that drills made during the Palaeolithic period for drilling holes or producing fire were fitted with bearings made from antlers or bones, and potters' wheels or stones for grinding cereals, etc., clearly had a requirement for some form of bearings. A ball thrust bearing dated about AD 40 was found in Lake Nimi near Rome.More recently, a 1964 British government-appointed committee was set up to find ways of reducing the untoward effects of friction on the British industrial economy. The committee invented the word Tribology to emphasize the scientific nature of studying the interactions of solid contacting surfaces in relative motion, these being covered by the three disciplines of Friction, Lubrication and Wear, so making the prefix Triappropriate. The postfix -ology refers to a branch of learning, whilst the prefix tribo- pertains to or results from friction. Friction can be considered as a part of physics or mechanical engineering, Lubrication is covered by mechanical engineering and chemistry, whilst Wear is a part of material science. Tribology is, therefore, a multidisciplinary subject that draws upon a large section of the syllabus of a typical undergraduate science or engineering course. A slight improvement in ring design and its manufacturing method could save significant amount of energy lost due to friction Fig. 1

Fig. 1 Sources contributing to losses in an engine



II. LITERATURE REVIEW:

A lots of research work has been reported on nanoparticles preparation and development. However, a few little works has been reported on nanoparticles used in tribology for friction reduction and anti-wear properties. A brief review of some selected references on various types and there an application of nanoparticles is presented below. Y.Y. Wu examined tribological properties of lubricating oils an API-SF engine oil and base oil with CuO, TiO2 and Nano-Diamond nanoparticles used as additives. Friction and wear experiments were performed by using reciprocating Tribotester. CuO added in standard oil exhibit good friction-reduction and anti-wear property. The additions of CuO nanoparticles in the API-SF engine oil & the base oil decreased the friction coefficient by 18.4 and 5.8% respectively, and reduced warn depth by 16.7 and 78.8% respectively as compared to the standard oils without CuO nano particles. The anti-wear mechanism is attributed to the deposition of CuO nano particles on the worn surface, which may decrease the shearing stress, thus improving the tribological properties. R. Chou investigated the influence of addition of 20 nm diameter nickel nano particles on the tribological behaviour of synthetic oil (polyalphaolefin, PAO6). A TE53SLIM tribometer (block-on-ring configuration) for testing at medium loads and a four-ball machine (ASTM D2783) were used in this research. Wear surfaces were analysed by SEM and EDS. The study leads to the conclusion that the addition of nickel nano particles to PAO6 results in a decrease in friction and wear and an increase in the load-carrying capacity of base oil. This tribological behaviour is closely related to the deposition of nano particles on the rubbing surfaces. According to result and discussion it was concluded that all suspensions decreased the average friction coefficient and wear with respect to PAO6. The friction reduction was between 7% and 30% and wear was decreased between 5% and 45%. The PAO6+0.5% Ni20 suspension showed the highest friction and wear reduction with regard to PAO6. The load–wear index for all studied suspensions is higher than that of the base oil, with increments between 3.4% and 30.8%. The analysis of the wear scar by SEM and EDS. Nano particles deposition on the wear surfaces with an improvement of the tribological behaviour. Ashkan Moosavian in this paper's study the effects of piston scuffing fault on engine performance and vibrations are investigated in an internal combustion (IC) engine ran under a specific test procedure. Three body abrasive wear mechanism was employed to produce piston scuffing fault it caused the engine performance to reduce significantly. According to Continuous wavelet transform (CWT) analysis ''dmey" wavelet, piston scuffing fault appeared in the scales of 7–14 (frequency band of 2.4–4.7 kHz) and more at the scale of 9 (frequency of 3.7 kHz).P.C. Mishra in this paper's study the piston compression ring tribology and the theoretical and experimental works developed to analyse ring liner contact friction. Because of micro conjunction effect the friction is comparatively less in case of a rough liner 80 % Power Loss is in compression and power stroke together of total power loss in an engine cycle. Broad literature survey is carried out in the research area of piston compression ring to know about the simulation and experimental methods developed to study its performance. Dr. D.V. Bhatt added Titanium dioxide and P25 additives to re-refined base oil and the friction and wear characteristics were examined at a constant applied load and rate of reciprocation using reciprocating pin-on-disk apparatus. From this investigation it was found that the nanoTiO2 particles addition to the base oil slightly reduced the coefficient of friction. Ming Zhan developed SRV4 oscillating friction and wear tester to examine the tribological properties of blank PAO (Poly-alpha-olefin) and PAO containing CaCo3 nanoparticles. The friction test conducted in reciprocating "ball on mode". The results showed that CaCO3 nanoparticles can dramatically improve the load carrying capacity, as well as the anti-wear and friction-reduction properties of PAO base oil. In addition, higher applied load, moderate frequency, longer duration time, and lower temperatures are beneficial to the deposition of CaCO3 nanoparticles accumulating on rubbing surfaces. X-ray photoelectron spectroscopy (XPS) reveals a boundary film composed of CaCO3, CaO, iron oxide, and some organic compounds on the worn surfaces. Under a lower sliding frequency, the friction coefficient of the PAO containing CaCO3 is lower, but at a frequency of 50Hz, the friction coefficient is higher than that of PAO. The relative sliding speed of the specimens remarkably affects the formation of a hydrodynamic film if the applied load is not too high. The ECR value of PAO at a sliding frequency of 50 Hz is higher than that of a 10 Hz sliding frequency, which is obviously a hydrodynamic effect When CaCO3 nano particles were incorporated into the PAO, a higher ECR value was attained where the highest ECR value corresponds to a frequency of about 30Hz According to this, when CaCO3 nano particles are added to the PAO, a balance between rub-off and film formation is established when the frequency is no higher than30Hz.J.C. Sanchez-Lopez reported work reports the employment of metallic nano particles (palladium and gold) with a mean particle size of 2.2nm surface-protected with tetra-alkyl-ammonium and alkanethiolate chains respectively, as lubricant additives. Dispersions of both types of nano particles (5 wt. %) are prepared using tetra-butyl-ammonium acetate (TBA) and paraffin as base oils, respectively. The tribological properties are then evaluated by a ball-on-disk Tribotester at two different loads (7 and 15N) with excellent results. In order to evaluate the load bearing capabilities of the metallic nano particles an insight of the ball counter faces at the end of the tests was accomplished by SEM analysis as shown in figure below (Fig. 2.3). Summarizes the SEM micrographs taken from the ball surfaces for the studied cases Pd studied cases Pd (a), TBA (b), Au (c) and PAR (d) and conclusion that can be extracted from the observation of SEM images. Good lubrication and reduction of mechanical wear are critical for technologies at the micro and nano scale. The dispersion of surface-modified metallic nanoparticles in base oils could be easily incorporated into existing lubricant compositions by appropriated design of the core-shell structure. The procedure that we report here allows effective anti-wear performance by using surface-modified Pd and Au nano particles (2 nm-core size) with alkylammonium and alkanethiolate hydrocarbon chains, respectively. The nano particles help to accommodate× the sliding motion, increasing the load capacity, and decreasing the wear rate. The tribological tests under extreme load conditions (up to 1.6 GPa) yield wear rates better than 3 10-3 mm3 /Nm and friction coefficients below 0.1. The presented surface metallic nano particles can be very useful to extend life of sliding surfaces due to their high strength resistance providing as well a gateway to electrical conduction for the case of Pd.D.X. Peng discussed on Tribological properties of diamond and SiO2 nanoparticles added in which were prepared by surface modification method using oleic acid had been added and observed by scanning electron microscopy (SEM) and infrared spectroscopy (IR). The measurements of the dispersion capacity and the dispersing stability of oleic acid-modified diamond and SiO2 nanoparticles are seen The tribological properties were evaluated using a ball-on-ring wear tester. The results show that both nanoparticles as additives in liquid paraffin at a tiny concentration have better anti-wear and anti-friction properties than the pure paraffin oil. Also, SEM was used to observe the ploughing of nano scale grooves of worn surfaces by diamond and SiO2 nanoparticles. The optimal concentration of diamond particles that minimizes the wear scar diameter is 0.2–0.5wt% and that of SiO2 nanoparticles is 0.1–1wt%.

III.CONCLUSION :

According to present theories and practices, we can conclude nanoparticles used in lubricating oil as an additives to improve tribological properties. The following outcomes can be drawn from the literature review of the nano-lubricants. Nano particles used as additives in lubricating oil exhibits good friction reduction and anti-wear behaviour.The anti-wear mechanism is attributed to the deposition of nanoparticles on the worn surface, which may decrease the shearing stress, thus improving the tribological properties. Lubrication film that form on worm surfaces and nano particles in the film not only bear the loading, but also separates rubbing faces and avoid direct contact. Nano particles can be very useful to extend life of sliding surfaces due to their strength and also it provides high strength resistance.

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