EFFECT OF NANO LUBRICANT ON THE TRIBOLOGICALBEHAVIOUR USING PIN ON DISC TEST RIG

S. NITHYA POORNIMA[1], . V. SHANTHA[2]

[1] Assistant Professor, Department of Mechanical Engineering, BMS Institute of Technology and Management, Bengaluru-560064, India

[2]. Professor, Department of Mechanical Engineering Sir M. Visvesvaraya Institute of Technology, Bengaluru-562157, India

. Correspondence should be addressed to: S. Nithya Poornima.

Abstract:

The Science and application of Nano technology and nano materials have been blooming and explored in all domain there by attracting wide range of researchers to experiment and introduce a better improved alternative to the existing macro material. A small introduction to the nano compound to any of the base material have pro found to exhibit supernatural properties in all possible fields In this paper, there is being chance to try and enhance the tribological properties of the nano compound with the base as there is a need to improve anti wear mechanism there by ameliorate the lubrication properties, process and mechanism

Keywords: Nanomaterials, Tribology, Blending, Nano compound

1. Introduction

Lubricant and lubrication process are the two important challenges faced by all the automobile sector. The consumption of macro materials has almost reached the culmination in the field of research of tribology. As a consequence, the nanomaterials and nanotechnology have pro found to show significant recent advances in the material science community thereby leading the researchers to experiment with nanomaterials and understanding behavioral changes and their fundamental properties that has showcased enhanced properties while in comparison with macro materials

How ever the machines are stable, they are prone to wear and tear. The inserts and cutting tips have to be considered to resist wear and tear. The shape and size of the material have enhanced influence on the properties of the materials. Previous research and experiments have convinced with the fact and the role of nano materials in enhancing intrinsic characteristic of the materials especially in the atomic structure The several blends along with nanomaterials have shown to improve friction and wear.

2. Methodology

Blending

The use of nanoparticles/nanomaterials as lubricant additives are known as nanolubricants. Typically, their diameter particle size is between 1 and 100 nm. In laboratory tests, the use of nanolubricants in base oils or coatings promotes a significant reduction of friction and wear, which exhibits interesting tribological properties. nanoparticles and base oil lubricants can beblended by the first procedure which is magnetic stirrer for about 30 mins and the second procedure is ultra sonification for about 25 mins.

Magnetic Stirring

A magnetic stirrer or magnetic mixer is a laboratory device that employs a rotating magnetic field to cause a stir bar (or flea) immersed in a liquid to spin very quickly, thus stirring it. Therotating field may be created either by a rotating magnet or a set of stationary electromagnets,placed beneath the vessel with the liquid. Much of the current magnetic stirrers rotate the magnets by means of an electric motor. This type of equipment is one of the simplest to prepare mixtures. Magnetic stirrers are silent and provide the possibility of stirring closed systems without the need for isolation. Blending was performed in a 100 mL glass beaker equipped with a magnetic stirrer and carriedout as semi-batch method. After adding the required volumes of SAE20W40 to each beaker, the beaker is placed on the platform of the magnetic stirrer and the switch is turned on and theRPM of the device is increased beyond 1000 for 30 mins.

Fig.1 Magnetic Stirrer

Ultra-sonification

Sonication is the method of applying sound energy via an ultrasonic bath or an ultrasonic probeto agitate particles in a sample. Ultrasonicator are found in academic, clinical, and forensic laboratories that need to disintegrate cells, bacteria, spores, or tissue. The stability of the particle depends on the size of the nanoparticle thus the vibrator effects are peculiar.

The dispersion quality, mass size and stability are dependent on various factors like nano particle size and properties. After mixing nanoparticle and base oil in magnetic stirrer for about 30 mins, ultra sonification process of blending for 25 minutes under room temperature.

Fig.3 Ultrasonicator

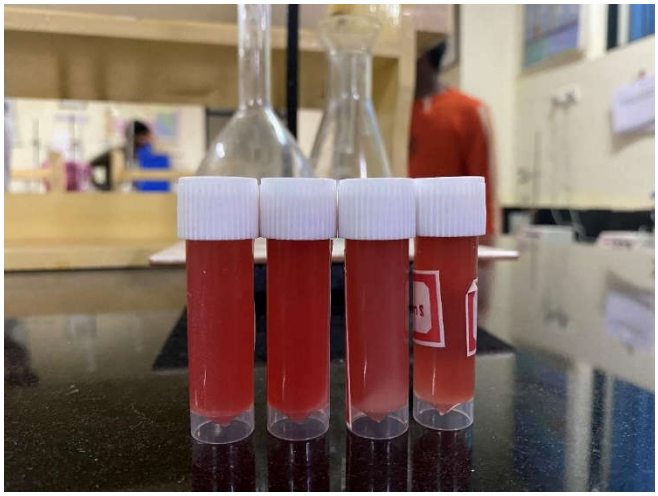


Fig.4 Nanolubricant samples

Wear Test on Pin on Disc Test Rig

Pin on disc tribometers are the most common types of tribometers being used to investigate thefriction and wear properties. A typical pin on disc tribometer consists of a stationary pin and a rotating disc. A normal load is applied on the pin and the friction readings are recorded using aload cell. The wear rate is recorded using a LVDT (Linear Variable Differential Transformer).The pins attached are generally hemispherical, however flat faced pins are also used. The pins can be of varied shapes flat, triangular etc however, the most commonly used pins arecylindrical or spherical. The main advantage of using a pin on disc is that a variety of materialscan be tested. The only requirement is that the specimen is to be made as per the requisite dimensions and it must withstand the stresses which the pins withstand during the tribotests.

Fig.5 Wear Testing Machine

Results and Discussions

Several trials of experiments were conducted to study the friction characteristics of the Nano blend. The experiment was conducted in two conditions that is in dry condition and wet condition. The wear rate of aluminum was studied. The values from the table 1 depicts that the lubricant behavior tended to be same and more or less constant for the various combination of lubricants used.

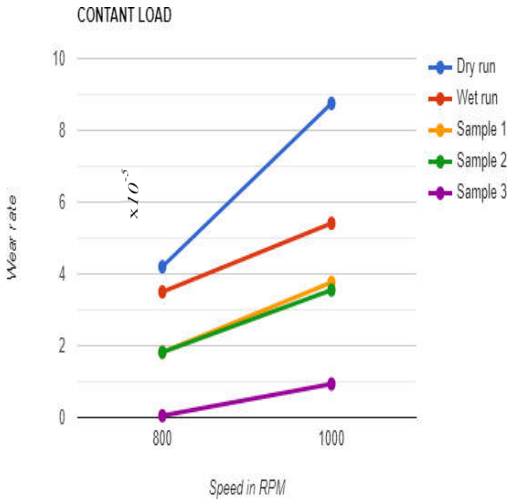
The outcomes of having erratic load for various lubricants on the friction behaviors was studied and analyzed. This analysis with respect to time shows from the graph that the values are all similar for the different lubricants used. There has been a significant difference in its frictional force for a certain

period of time up to 10 minutes in the at its initial phase and then the gears up to a steady state by the end of the experiment High frictional force tends to develop after several run rather than the initial ones. The combination of mixing lubricants with SAE with certain load carrying capacity that is the sample 3 has resulted in reduced wear rate when compared to other samples and hence can be recomended.

Speed: 1000 RPM Load: 2Kg	Dry	Wet	Sample 1	Sample 2	Sample 3
Lubricants		SAE20W40	30ml SAE20W40: 1gm of SiO_2 nanoparticles	35ml SAE20W40: 2gm of SiO_2 nanoparticles	25ml SAE20W40: 4gm of SiO_2 nanoparticles
Wear percentage %	0.4098	0.2788	0.1953	0.1855	0.0490
Wear Rate in gm/sec	8.75×10^{-5}	5.4166×10^{-5}	3.766×10^{-5}	3.55×10^{-5}	9.33×10^{-6}

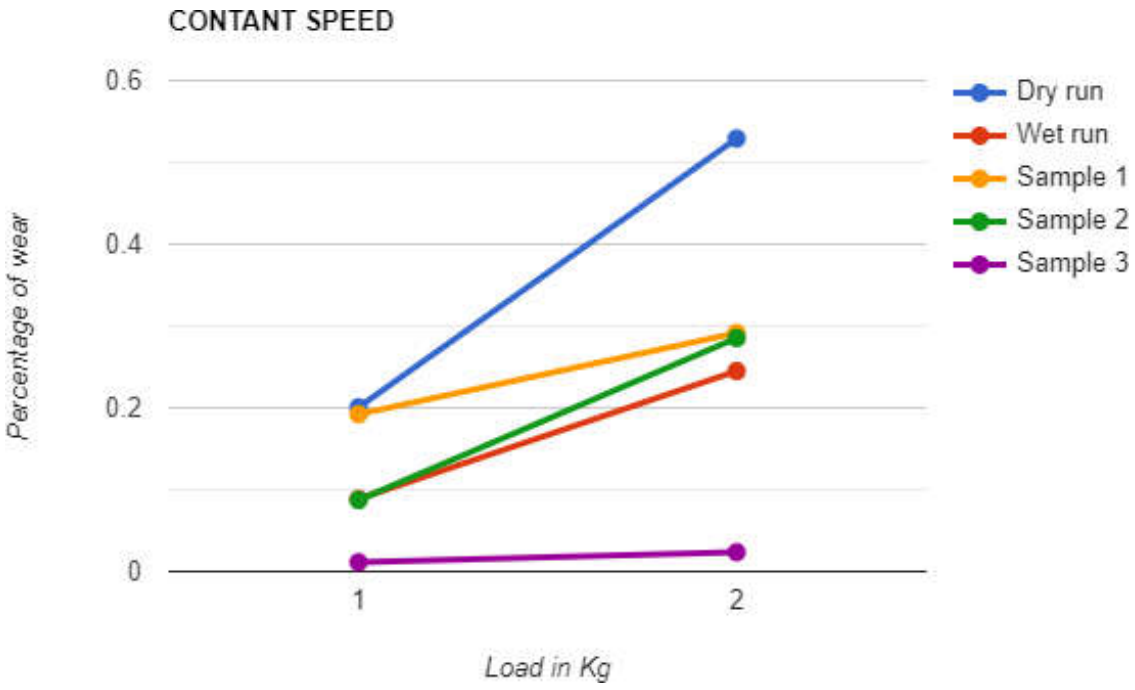
Table 1. Comparision table

GRAPHS



Wear rate Vs Speed

Wear rate Vs Load



Percentage of Wear Vs Load

Wear increases with time and be stable or follow slightly negative trend with respect to time. Surface irregularities increase the real contact area between the sliding surfaces which cause maximum wear. After travelling some distance, surface of the specimen becomes smooth and the stable fluid film can be generated, result is reduced wear. When SAE20W40 lubricant and different combination of nanolubricant samples is applied between the surfaces, some pressurewill generate during running condition which will help the surface apart and prevent surface contact. Hence, fluid film will resist the load and reduce the wear.

Conclusions

It is observed that, sample 3 (25ml:4gm) gives better performance than the sample 1 (30ml:1gm), sample 2 (35ml:2gm) and SAE20W40. But manual of two-wheeler recommendssample 1 (30ml:1gm), sample 2 (35ml:2gm) and SAE20W40 because sample 3 (25ml:4gm) have more viscosity improver, which will cause more sludge than the sample 1 (30ml:1gm), sample 2 (35ml:2gm) and SAE20W40. In winter, oil flow problem may occur which effect some cold starting issues may occur due to their high viscosity. This is because today's standard engines are built with tighter bearing clearances to take advantage of the fuel economybenefits of lower viscosity oils. It is not really a good idea to use thicker oil in one of these engines because it will disrupt the oil flow characteristics of the engine and may create excessively high oil pressure.

By comparing the constant and incremental load. similarly constant and incremental speed forvarious lubricants, it is clear that, incremented load and incremented speed offers friction and wear. The specimen shows high weight loss. By comparing the tribological properties of theselubricants, it is cleared that sample 3 (25ml:4gm) is more efficient and have better performance than sample 1 (30ml:1gm), sample 2 (35ml:2gm) and SAE20W40.

REFERENCES

[1] Shailesh Kumar Singh - Effect of Lubricating Oil on Tribological behaviour in Pin on Disc Test Rig, March 2017 - https://www.researchgate.net/publication/315882758 Effect of Lubricating_Oil_on_Tribological_behaviour_in_Pin_on_Disc_Test_Rig .

[2] Sumit Sharma - Investigation of Wear Characteristics of Aluminum Disc with Pin on Disc Tribometer – May 2015 - https://www.ijser.org/paper/Investigation-of- Wear Characteris tics -of-Aluminum Disc- with-Pin-on-Disc-Tribometer.html .

[3] Sandhya D. Ramasamy - Ultrasonication an intensifying tool for preparation of stable nanofluids and study the time influence on distinct properties of graphene nanofluids – May 2021 - https://www.sciencedirect.com/science/article/pii/S1350417721000201 .

[4] Celso Cruz - Nanoparticles of Zn and ZnO as extreme pressure (EP) additives for lubricants– March 2017 - https://www.sciencedirect.com/science/article/pii/S1350417721000201 .

[5] Md. Masud Parvez - Applications of Nanolubricant in lubricants. – March 2020 - https:// www.ijser.org/ paper/Investigation-of-648658468 -of-Aluminum Disc- with-Pin-on- Disc-Tribometer.html .

[6] Yosef Jazaa - Effect of nanoparticle additives on the tribological behavior of oil under boundary lubrication – January 2018 -https://dr.lib.iastate.edu/ entities/publication/a10 0f334 -e108-468a 8041-eb57a2a30ed3.

[7] Mohammad Asaduzzaman - Experimental Investigation on Friction and Wear Properties of Different Steel Materials – March 2013 - https://www.researchgate .net/publication /288371043_Experimental_Investigation_on_Friction_and_Wear_Properties_of_Different

Steel_Materials.