TRIBOLOGICAL INVESTIGATIONS ON ZINC ALUMINIUM 27 ALLOY UNDER NANO AND NANO BIO LUBRICANTS

ABSTRACT

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ABSTRACT

In the current scenario, every industry wants to become sustainable through effective control of friction and wear via green tribology. In all Industries, the component bearing plays an important role in the life cycle of machinery through the reduction of friction and wear. The traditional bearing materials containing brass and copper alloys needed to be replaced with alternate materials because of environmental laws. ZA 27 from the family of zinc aluminium alloys, has been found to have the potential to replace traditional bearing materials. The major constraint in using ZA alloys was the reduction in their dimensional instability at a temperature, above 120 °C, and a large coefficient of thermal expansion. To improve the wear behavior with the above limitation, the use of a suitable lubricant is one of the solutions. The mineral lubricants available in the market do not meet all the requirements of the current engineering applications. Despite this, the growing concern about the pollution caused by the use of mineral oil-based lubricants and the depletion of mineral oil resources has stimulated research on finding alternatives. This paved the way for the development of bio lubricants that are renewable and biodegradable. The addition of nano-sized additives to lubricants shown to enhance the thermo-physical and tribological properties.

In this study, an attempt was made to develop nano lubricants for ZA27 alloy-bearing applications using mineral oil SAE 40 and bio lubricant oils, namely, rice bran oil and soya bean oil. Nano graphite particle (50 nm and 100 nm) was used as lubricant additive as graphite has superior lubricating properties. The viscosity of SAE40, rice bran oil, soyabean oil, nano graphite added mineral, and bio lubricants were experimentally investigated and the results revealed that the viscosity of soya bean oil blended with 50 nm nano lubricant exhibited maximum thermal conductivity as well as density enhancement in the measured temperature regime.

The sliding wear test results confirmed the influence of the size of nanoparticles on the tribological characteristics. Compared to 100 nm graphite

nanoparticles dispersed in SAE 40, 50 nm size graphite nanoparticles mixed with SAE40 lubricant contributed to significant enhancement in the tribological characteristics in the ranges of load, speed, and sliding distance investigated. The sliding wear tests carried out on ZA 27 alloy with bio lubricants

The inclusion of graphite nanoparticles in soyabean oil resulted in the lowest wear rate, an average of 75% than the mineral oil SAE40, under varying load, speed, and sliding distances, which was confirmed by the absence of third body abrasion on their worn surfaces as observed in SEM images, flatter roughness profiles, and through the Stribeck curves.

Based on the results of investigations, this study recommends the utilization of the nano graphite-added soyabean nano lubricant as an environmentally friendly lubricating agent along with ZA27-bearing materials for obtaining enhanced load-carrying capability and tribological characteristics. The preference for biolubricants instead of mineral oil is because of their renewable nature or in other words the abundance of availability, which leads to sustainability. But this won’t be the same if the nanoparticles are mixed with it in terms of cost, as the cost of nanoparticles is high because of their production method and size. Using the latest production technology methods, if cost can be reduced, the combination of ZA27 with bio-nano lubricant will be strong eco-friendly alternative in all aspects.