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Tribological Performance Of Engine Oil Blended With Various Non-Edible Vegetable Oils

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Manufacturing industries have recently raised worry about the usage of mineral-based lubricants due to a variety of detrimental environmental and human health implications, as well as a scarcity of mineral resources. As a result of this scenario, researchers have focused on non-edible vegetable oil-based lubricants as a possible replacement for mineral-based lubrication because they are low in toxicity, biodegradable, and renewable resources. Concerns about the viability of edible vegetable oil feedstocks, such as their role in the human food cycle, as well as harnessing for non-food purposes such as fuel or lubricant, have disrupted household balance. Non-edible vegetable oils such as castor oil (C100) and jatropha oil provide an option (J100). J100 has a high oleic acid and linoleic acid content, whereas C100 has a low oleic acid and linoleic acid content. J100 contains a high concentration of oleic acid and is effective as a lubricant. Meanwhile, C100 contains low linoleic acid levels and encourages low oxidation, which was required for the lubricant. Therefore, combining mineral oil with a high oleic acid content of J100 and a low linoleic acid concentration of C100 hyphothesisly improved lubricant performance.

According to the preceding discussion, the aim of this study is to develop eco-friendly lubricants by blending non-edible vegetable oils with mineral oil, as well as to investigate the influence of these lubricants on friction and wear characteristics.

Using the sonication technology, eco-friendly lubricant is developed by blending commercially available SAE 15W40 engine oil with non-edible vegetable oils (castor oil and jatropha oil) in a range of 0-100 vol.%. A four-ball tribometer was used to conduct the tribological test in accordance with engineering standard (ASTM D4172-94). A digital microscope was used to measure the diameter of the wear scar.

Fig.1 depicts the variation of COF for eco-friendly lubricant samples. COF values for eco-friendly lubricant samples varied from 0.07 to 0.12. Meanwhile, pure S100, C100, and J100 COFs were employed as comparison samples. In comparison to S100, C100, and J100, S80C10J10 has the lowest COF of 0.076. It was also revealed that eco-friendly lubricants aided in the formation of a thin lubricating coating, shifting the mode of friction from sliding to rolling. C100 and J100 have the maximum density and viscosity, making them acceptable as replacements for traditional lubricating oils. However, the formulation of eco-friendly lubricants at specific concentrations dramatically raises the COF value. This is because fatty acid molecules do not form a soap film on a surface test, an insufficient concentration of S100, C100, and J100 resulted in reduced wear resistance with a greater COF.

The running-in period is the period of COF fluctuated between its initial and reasonably constant values. At 100 s, the running-in period for eco-friendly lubricants was smaller than that of S100, C100, and J100. S80C10J10 remained stable during the friction test. As a result, the formulation of eco-friendly lubricants was found to be successful in stabilising the COF during the initial operation. Mineral oil has anti-wear additives, which boost the COF, but vegetable oil contains long-chain fatty acids, which have far better inherent boundary lubrication properties.

As summary. eco-friendly lubricants have influenced friction and wear characteristics. When compared to control samples such as pure SAE 15W40, castor oil, and jatropha oil, the eco-friendly formulation with 80 vol.% SAE 15W40, 10 vol.% castor oil, and 10 vol.% jatropha oil has the lowest coefficient of friction and wear scar diameter of 0.076 and 386.3 μm, respectively. As a result, eco-friendly lubricant composition displayed exceptional lubrication performance.

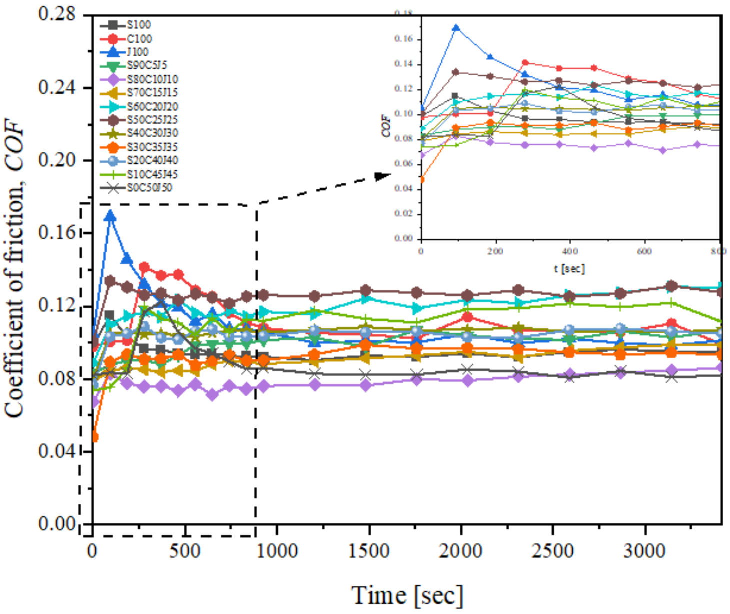

Fig.1 COF variations for the eco-friendly lubricant samples.

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