Frictional performance of a cottonseed-based fossil-free bio lubricant oil in a sliding tribopair

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Despite having harmful ecological characteristics, fossil-based lubricants have been used for centuries. Now, elevated environmental concerns invite an entirely new optimization to synthesize environmentally-friendly "green" machine oils that are not based on fossil extraction. However, to replace traditional massively used lubricants, the tribological performance of a green lubricant is critical. Friction is one of the crucial tribological characteristics because of energy losses that happen in a tribological contact. We developed a green lubricant oil from cottonseeds and evaluated its frictional performance in this study. The primary objective of this experimental investigation is to evaluate the friction and wear of bio-lubricant extracted from cottonseed. This green lubricant was prepared through two-step chemical modification—a mechanical process extracted raw cottonseed oil, and in the first transesterification step, the raw cottonseed oil was treated with methanol, a molar ratio of 6:1, and Potassium hydro-oxide produced FAMEs (fatty acid methyl esters). In the second step, bio-lubricant was produced by reacting FAMEs with isooctanol alcohol treated with 1% titanium isopropoxide as a catalyst. For purification purposes, vacuum distillation was carried out to 170 °C at 350 mmHg, and methanol was collected as a residual. Regionally available cottonseed oil is used, and no additives such as viscosity index improver, pour point depressant, and anti-wear additives were added to the base oil. A comparison is made between the frictional behaviour of a commercially available SAE 5W30 engine oil and newly developed green lubricant. Experiments were performed on a pin-on-disc tribometer based on ASTM G99. All tests were conducted at a constant average load of 50 N, 300 RPM at a constant flow rate of lubricant, i.e., 1.2 g/min. The wear of pins was measured by the weight loss method. Results have shown highly encouraging frictional performance compared with the fossil-based lubricant. After repeating measurements and comparing the available literature that reports for TMP ester-based cottonseed bio-lubricant, our lubricant shows nearly half the coefficient of friction of commercially available SAE 5W30, ultimately having a positive impact on energy loss and the environment.

Keywords: cottonseed oil, bio lubricant, friction, green lubricant.

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