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Full Length Article

Waste cooking oil blended with the engine oil for reduction of friction and wear on piston skirt

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HIGHLIGHTS

- Bio-lubricant viscosity increases and wear decrease as the concentration of WCO decrease.
- Dewatering process reduced water in WCO that can contribute to the corrosive engine.
- Coefficient of friction increased under 5% and 10% volume concentration of WCO.
- Speed, load, and volume composition effect on coefficient of friction and specific wear rate.
- Mild abrasion, pitting corrosion, and severe delamination of the specimen surface increased.

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ABSTRACT

Currently, development of recycling, renewable, and sustainable products to replace fossil fuel products is an essential matter for industrial profiteering as well as environment protection. In the present study, waste cooking oil blended with SAE10W-40 should reduce the wear and friction on the piston skirt. Wear and friction performance were evaluated using piston skirt-liner contact tester, and the piston material was aluminum 6061. The design of experiment (DOE) was constructed using the response surface methodology (RSM) technique. Influence of different operating parameters such as rotational speeds (200 RPM, 250 RPM, 300 RPM), volume concentration (5% and 10% of waste oil), and loads (2 kg, 5.5 kg, and 9 kg) were optimized. Based on the results of moisture content and viscosity; as the concentration of waste cooking oil increases, the viscosity of the lubricant decreases. The lowest moisture content was at the 5% volume concentration. The increase in the coefficient of friction occurred in 5% and 10% volume concentration of waste cooking oil for both pairs. The RSM model showed that the speed, load, and volume composition have a significant effect on the coefficient of friction (COF) and specific wear rate (WR). The optimum obtained for both output (COF and WR) were 0.0596μ for COF and 0.6827μ for WR. The relevant parameters such as speed, load, and volume composition are 200 rev/min, 9.0 kg and 0.7071% of volume concentration respectively. Afield emission scanning electron microscope (FESEM) analysis shows mild abrasion, pitting corrosion, and severe delamination of the specimen surface increased when running at higher load.

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