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Enhancing Lubrication Characteristics of Soybean-Based Oils as a Multifunctional Bio-Based Lubricant

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Funded Project $46,500

Why this Research is Important to North Dakota Soybean Farmers

This research project addresses the importance of developing bio-based lubricants, focusing on soybean oil as a next-generation bio-lubricant. With increasing global concerns about the environmental influence and depletion of mineral oil, there is a growing need for alternative lubricants. Vegetable oils, including soybean oil, have gained popularity as potential base oils. This study aimed to develop a soybean-based oil as a next-generation, multifunctional bio-lubricant and as a significant substitute for mineral-based lubricants.

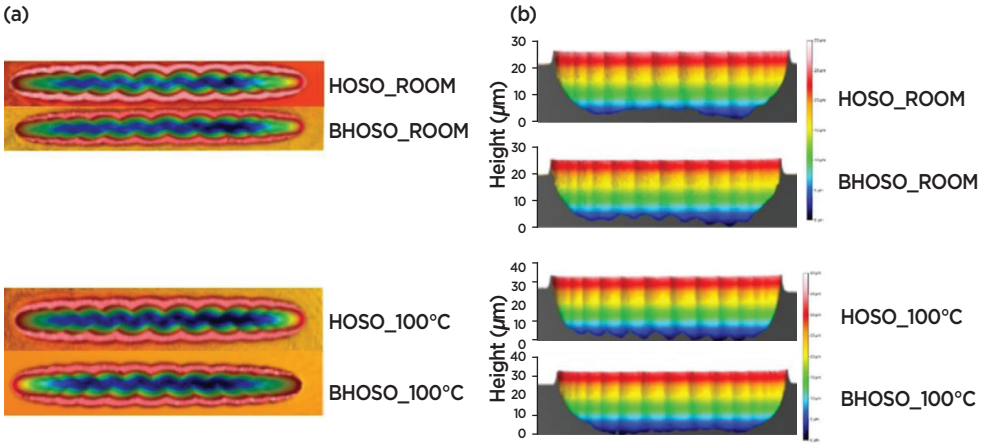
Research Conducted

The research involved conducting tests on regular soybean oil (RSOY), high-oleic soybean oil (HOSOY) and modified high-oleic soybean oil (BHOSOY). BHOSOY was produced by introducing isopropyl groups onto the double bonds of unsaturated fatty acids.

Findings of the Research

The research revealed that BHOSOY exhibited improved oxidative stability (resistance to oxidation), a lower pour point (temperature of solidification), and a lower cloud point (temperature of cloudiness or haze appearance) compared to HOSOY and RSOY. In friction and wear tests, BHOSOY demonstrated a higher coefficient of friction due to its increased viscosity but showed more stable friction behavior in all conditions. Moreover, BHOSOY exhibited 10.6% greater wear resistance than HOSOY, indicating less material loss or damage under similar friction and wear conditions. Scanning Electron Microscopy based analysis showed that BHOSOY had no cracks or metal flakes in the flat samples tested at room temperature while the other oil samples did. At high temperatures, BHOSOY exhibited significantly lower amounts of metal flakes compared to the other oils. The wear observed with the flat samples resulted from rubbing or abrasion between the contacting surfaces. In the ball samples, adhesion wear occurred, with iron transferring from the flat samples to the ball samples, as confirmed by Energy Dispersive X-Ray Spectrometry and mapping analysis. BHOSOY demonstrated the lowest wear width for both ball and flat samples.

Figure 2. White light interferometry images of wear tracks: (a) top view and (b) cross-sectional view.



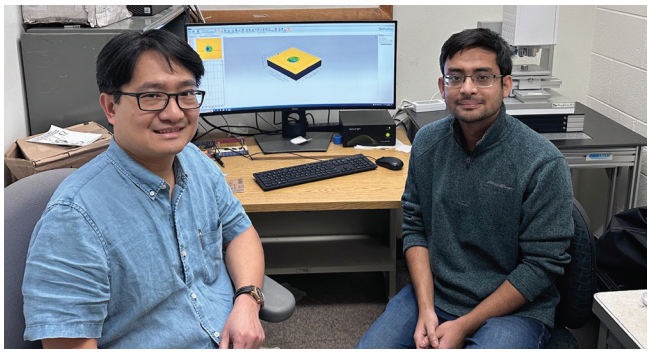
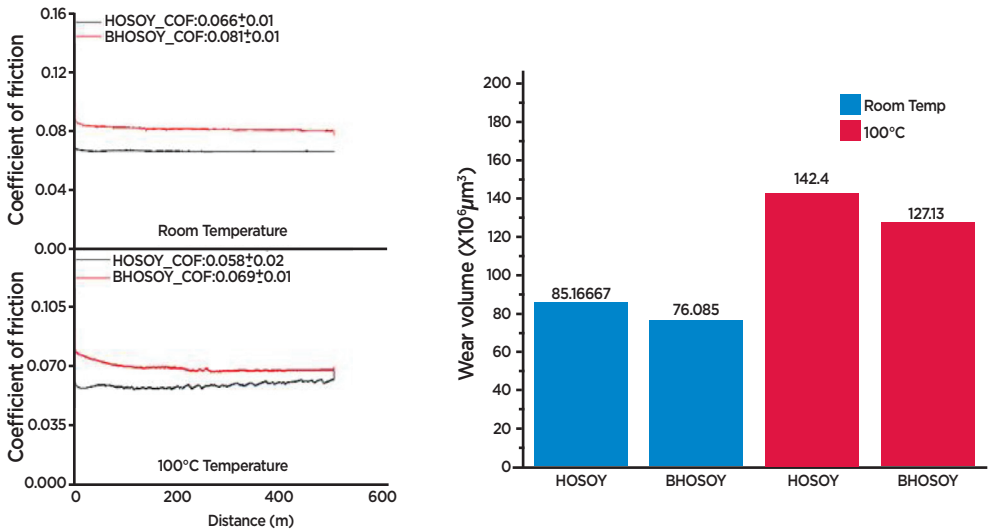


Figure 3. Research team at UND.

Figure 1. Coefficient of friction results: (a) room temperature, (b) high temperature and (c) wear volume loss.



Benefits to North Dakota Soybean Farmers

By tapping into the market for soybean-based lubricants, farmers can increase profitability and stimulate economic growth. The utilization of soybean oil for lubricant production can create new opportunities, potentially leading to a surge in soybean market prices.