Soy-Based Lubricants Ready for Industrial Role

Soy-based engine oil does not readily boil off and resists heat degradation. In tests, it caused a significant drop in hazardous air emissions, compared with petroleum-based oil.

The 2002 Farm Bill signed by President Bush encourages the use of biobased products, including those made from soybeans. Soybean-based fluids offer numerous environmental benefits. For example, they are biodegradable, low in toxicity, and can be added to or replacements for metalworking and hydraulic fluids. Formulated to provide the same functions of any standard petroleum-based metalworking fluid, soy-based fluids lubricate and cool cutting tools. They flush small metal chips away, providing more accurate machining. Also, some data suggest that engine emissions are lowered when using soy-based oils.

The Farm Bill establishes a new program for the purchase of biobased products by Federal agencies. The guidelines will designate items that are biobased or can be produced with biobased products. They will also provide information on availability, relative price, performance, and environmental and public health benefits of biobased products. This should increase the use of biobased products where applicable, including lubricant markets.

Although performance limitations create a barrier for soybean oil to be used in all lubricants, there have been successful developments of soy-based lubricants for niche uses. These include commercial rail, flange and switch lubricants, wire rope lubricants and top-of-rail lubricants, as well as two-cycle engine oils, for use in both water- and air-cooled engines. All are gaining acceptance as viable alternatives.

"Finding targeted markets in which performance, economics and the environment are primary drivers of commercialization is where soy-based lubricants will have the most success," says David Smith, commercialization manager at Omni Tech International, a Michigan-based consultant to the chemical and biobased products industries. "Current research is focusing on resolving performance issues and making the modifications necessary to increase stability of soybean lubricants."

Addressing limitations

Increasing the viability of soy-based lubricants requires addressing the performance limitations of soybean oil. USB is researching ways to modify the oil traits of soybeans through a project called the Better Bean Initiative. This is a coordinated effort with university and government researchers and the soybean industry to accelerate the development of soybean seed with enhanced compositional traits. Currently, soybean oil has limitations in thermal, oxidative and hydrolytic stability, as well as low-temperature flow characteristics.

USB is also sponsoring work for nontransgenic modification to produce a more stable soybean oil. This involves using genes from wild and commercial soy varieties to develop a new variety with superior oil traits. Other ways for modifying soybean oil include chemical or mechanical processing or the use of chemical additives. Currently, chemical additives offer the most rapid and cost-effective way to improve stability.

Metalworking/hydraulic fluids

Soy-based metalworking fluids can perform as well as or better than standard petroleum-based fluids in metalworking operations. Several formulations have even shown better machining characteristics when used on steel and aluminum. Others are so effective that the same benefits can be found by using only half of the volume expected.

By fully or partially replacing petroleum with soybean oil, biodegradability is increased, toxicity is reduced and the level of volatile organic compounds is lowered. In addition, soy-based metalworking fluids provide a high flash point, easy disposability, soap-and-water clean up and no offensive odor.

Soy-based hydraulic fluids offer many of the same benefits, and are manufactured by several companies. These include Terresolve Technologies and Renewable Lubricants, Inc., both based in Ohio.

Terresolve offers three lines of soy-based hydraulic fluids, all of which are biodegradable and non-hazardous, making them useful in applications where leakage or spillage causes environmental damage. This helps reduce insurance costs and reduces the disposal fees commonly associated with petroleum-based hydraulic fluids. These products can be used in any conventional hydraulic system, without modification.

Renewable Lubricants has also developed three lines of hydraulic fluids. Its Bio-Hydraulic Oil line is biodegradable and formulated to perform in hydraulic systems that require anti-wear, rust and oxidation properties. The company's Renew-Hydraulic Fluid line combines vegetable-base oil and renewable re-refined mineral

base oil to improve the performance of both. It has patented its anti-oxidant/anti-wear technology as Stabilized High Oleic Base Stocks. This technology boosts the high-temperature stability of the formula and increases load capacity. All of these formulations meet OEM specifications.

A vegetable-based engine oil that contains soybean oil has also been created. AgroManagement Group (AMG) of Colorado has tested its product to investigate the efficiency of emission reduction. The soybean/vegetable-oil blend features a molecular structure that doesn't readily boil off and resists heat degradation. Tests indicate that it also caused a significant drop in hydrocarbon, carbon monoxide and nitrogen oxide emissions, compared with traditional petroleum-based engine oil.

As more companies work to comply with the mandate of the Farm Bill, the use of renewable resource, plant-based, non-toxic and readily biodegradable products is expected to increase dramatically. For more information about industrial uses for soybean-based products, visit www.unitedsoybean.org.

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