SOY LUBRICANTS

Soy lubes address a combination of environmental, economic, conservation and performance issues.

DRIVING ISSUES

Increasing market penetration of soybean oil lubricants will be driven by a combination of environmental, economic, conservation and performance issues. Petroleum-based oils, also known as mineral oils, will continue to be the most economical choice for many producers, meeting original equipment manufacturer (OEM)-desired performance characteristics in many uses. However, soy and other vegetable oils show the ability to compete in significant segments of this market.

The need for readily biodegradable lubricants that are low in toxicity for environmentally sensitive areas has been recognized in Europe and by the U.S. government and is a research priority of the United Soybean Board (USB). Regulations have been adopted in some European areas, and both synthetic and rapeseed oil lubricants have been developed to substitute for mineral oils. Growing regulatory pressure to reduce or eliminate certain emissions of petroleum lubricants, along with U.S. Presidential Executive Order 13101, which instructs federal agencies to use environmentally preferable biobased products, should combine to encourage increased use of renewable oils.

COMPETING PRODUCTS

Soybean oil will compete for a share of any emerging renewable lubricants market with other vegetable oils, particularly rapeseed or canola, and with synthetic oils.

Vegetable oils have performance limitations, particularly in thermal, oxidative and hydrolytic stability. These problems are being overcome by the use of additives and by modification of the vegetable oil.

When compared with petroleum oils as lubricant base stocks, vegetable oils show the potential to provide performance advantages over finished lubricants:

- Higher viscosity index (less viscosity change with changes in temperature).
- Lower evaporation loss.
- Indications of higher lubricity (the ability to reduce friction and wear).

Vegetable oils, including soybean oil, are lower in cost than synthetic oils and will likely be the product of choice for this market segment when they can meet performance requirements. Development of a commercial scale process to provide an economical and stable base stock is the key to the commercialization of soy-based lubricants.

SOY COMPARED WITH RAPESEED AND CANOLA

Lubricants made from rapeseed/canola oil have already been tried in Europe with some success. The chemical composition of rapeseed oil and its offspring, canola oil, are different from soybean oil, which allows them to be modified more easily for stability. Much of this development work on rapeseed/canola has been done.

Typical Chemical Composition of Oils (Fatty Acid Profile):

	16:0	18:0	18:1	18:2	18:3	22:1
Soybean oil	12	3	23	56	6	0
Mid-oleic soy*	9	4	60	28	.5	0
Rapeseed oil	4	1	19	22	8	45
Canola oil	3	1	64	22	8	1

*Tentative specifications for new USDA varieties under development by the BBI

In the above table, the important acids for stability are those labeled 18:2 and 18:3, which indicate the number of active sites for attack on each chain. The more sites, the less stable the chain. The important acids for freezing point are those labeled 16:0 and 18:0. These fully saturated acids freeze easily and limit the low-temperature capabilities of the oil. As can be seen, conventional soybean oil has the most challenging profile from this standpoint. Mid-oleic soybean oil is improved in many aspects. The physical properties are an extension of the profiles.

Soybean oil has a significant advantage in cost and availability in the United States over rapeseed/canola oil. These advantages make it possible that soybean oil could capture a larger share

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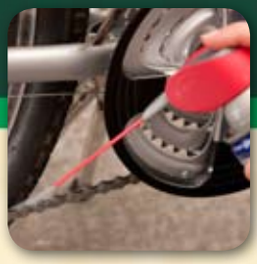

SOY LUBRICANTS

of an emerging U.S. market for renewable lubricants, if the performance can be improved to mineral-oil standards.

The applications where lubricants are lost directly to the environment, such as from railroad rails and switches, wire cables on cranes, and the bars of chain saws and other power equipment, are the most likely to initiate the use of soy-based lubricants. In these limited-life applications, the stability of the lubricant is not a factor, giving soybean oil an advantage as the base oil.

IMPROVING SOYBEAN OIL

The key to acceptance of vegetable oils as high-volume lubricants, such as crankcase oils or hydraulic fluid, is the development of a commercial-scale process to provide an economic and stable base stock from soy. Four possible avenues for improved soy-based oil are being investigated:

- Biotechnology to produce seed that provides more stable oil. DuPont/Pioneer has developed a genetically modified soybean that produces high levels of oleic acid (18:1). This may overcome the first hurdle of developing a base oil with monosaturated levels superior to rapeseed/canola. Pricing and supply issues have prevented high-oleic canola oil from gaining wide market acceptance in lubricants. Other high-oleic-acid soybean varieties have been developed through USB-supported research at the University of Nebraska and elsewhere. Potential entry of this oil into the market could provide a needed source of high-oleic product.
- Non-biotech modification to produce more stable oil. USB-sponsored work by the Agricultural Research Service of the USDA and multiple university cooperators has resulted in new varieties with superior oil traits using genes from wild and commercial soy varieties. Among the new varieties being developed are those with higher levels of oleic acid (18:1) and lower levels of unsaturates.
- Modification of the oil through chemical or mechanical processing to improve oxidative stability, while maintaining good oil properties, is under investigation by Archer Daniels Midland Company and others.
- Chemical additives that improve stability offer the most rapid and cost-effective route to commercialization. USB-sponsored researchers studying potential additive combinations to overcome performance limitations. Additives may offer a low-cost route to commercialization. Renewable Lubricants, the AgroManagement Group and Valvoline have made strides in the use of additives.

A combination of several of these areas offers the greatest opportunity for achieving the use of significant levels of soybean oil in finished lubricant formulations. Coordinating the efforts of diverse groups is the challenge to commercialization.

SOYBEAN COMPARED WITH SYNTHETIC OILS

Synthetic oils, used in lubricants as the base oil, offer improved stability and performance over refined petroleum oils and current vegetable-oil-based lubricants, but at a price. Most of the environmentally friendly synthetic oils are polyalphaolefins or chemical esters that offer superior thermal and oxidative stability.

Prices for these niche products are higher than those for vegetable oils and significantly higher than those for petroleum-based lubricants. Improved soybean oil should be able to compete effectively against the synthetics.

USED-OIL DISPOSAL

Testing by Safety Kleen has shown soybean-based lubricants can be disposed and re-refined along with conventional mineral-oil-based lubricants.

SOYBEAN OIL POTENTIAL

If the European model is followed, some regulatory efforts around readily biodegradable lubricants may be made in the United States in the next five to 10 years. Regulations are more likely to be passed at the state level than at the federal level, as well as in environmentally sensitive applications or locations.

With an annual U.S. crop over 3 billion bushels, the potential supply of soybean oil could surpass 31 billion pounds (4 billion gallons) if the entire crop were crushed domestically. This availability, coupled with the price advantages over most other vegetable oils and synthetics, makes it logical that soybean oil will find a place in the market as a substitute for mineral oils.

ABOUT USB

USB is made up of 68 U.S. farmer-directors who oversee the investments of the soybean checkoff, a U.S. soybean research and promotion program, on behalf of all U.S. soybean farmers. Checkoff funds are invested in the areas of animal utilization, human utilization, industrial utilization, industry relations, market access and supply. As stipulated in the Soybean Promotion, Research and Consumer Information Act, USDA's Agricultural Marketing Service has oversight responsibilities for USB and the soybean checkoff.

For more information, visit: soynewuses.org

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