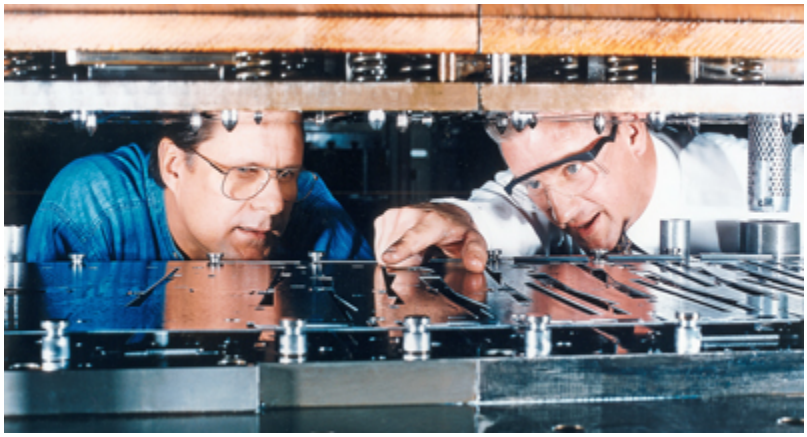
Tower Oil
& Technology Co.

Green Fluid Technology – Tower Oil & Technology has been the industry leader, creating numerous metal stamping lubricants that lessen environmental impact, increase production rates, and lower your overall costs. Read more below to see how Green Fluid Technology can make an impact in your business.

Stamping parts with vegetable oil is becoming more a reality every day. For a metal working lubricant—whether it be soluble, semi-synthetic, or synthetic—to be USDA-classified as biobased, it must contain, at minimum, 40 percent to 57 percent of renewable resources. Just because a product is biobased, made from a varying percentage of renewable resources, it does not necessarily make it readily or ultimately biodegradable. Green lubricants offer enhanced lubricity and a high viscosity index. These oils are less toxic to the environment and are easier to dispose.



Biobased, vegetable oil lubricants have enhanced lubricity and a higher viscosity index (VI) than comparable mineral-based oils; however, they also are not as thermally stable at the higher temperatures as lower temperatures when left untreated and may oxidize.

Your mother always told you that vegetables were good for you. You just never knew that it would pertain to your metal stamping operation.

Stamping parts with vegetable oil? This may seem like a strange and off-the-wall prospect, but it is becoming more a reality every day. Most of the renewable-resource lubricants common in metalworking lubricants come from vegetable seed oils grown in the U.S., Canada, and Europe. The use of vegetable oils in metal stamping fluids is showing a steady increase in their acceptance and range of applications.

These renewable-resource lubricants have found a niche in the lubricants industry that includes the tried-and-true petroleum oils, and typically they are less expensive than synthetic oils. The widely accepted definition of synthetic oil is "any oil that is free of

petroleum." However, while vegetable oils technically are synthetic oils because they do not contain petroleum, the terms renewable-resource or green best describe this source and type of oil.

Minimum Content

The U.S. Department of Agriculture (USDA) has been using the term biobased to describe the composition—in whole or in significant percentage—of a vegetable oil-based green lubricant, and it determines the minimum content a product must contain to be classified as biobased when it consists of plant, animal, or marine products.

For a metalworking lubricant—whether it be soluble, semi-synthetic, or synthetic—to be USDA-classified as biobased, it must contain, at minimum, 40 percent to 57 percent of renewable resources. (The lower percentage is considered general-purpose; the higher percentage is classified as high-performance.) Straight oil products must have a minimum oil content of 66 percent.

Biobased Doesn't Mean Biodegradable

Another misunderstanding that needs clarification concerns the biodegradability of these biobased products. All too often biodegradable becomes synonymous with biobased, renewable resource, and green. Just because a product is biobased, made from a varying percentage of renewable resources, does not necessarily make it readily or ultimately biodegradable. Other additives and ingredients, such as petroleum products, esters, amines, glycols, and extreme-pressure additives that are not biodegradable may be mixed with the biobased ingredients.

The lubricant industry has used terms like green and biobased to promote the environmental benefits of metal forming lubricants, but these terms do not guarantee their acceptability, safety, biodegradability, or biobased content. It is important to have a full understanding of the lubricant you are considering.

Benefits of Biobased Lubes for Metalworking

These green lubricants offer certain benefits over the petroleum-based lubricants:

- Enhanced lubricity. Enhanced lubricity reduces friction and wear, lowering the required levels of additives and extreme-pressure agents in the fluids.
- High viscosity index. The viscosity index (VI) is a measure of an oil's stability over a range of temperatures. Vegetable oils have a higher VI than comparable mineral-based oils. Standard petroleum-based metalworking oils have a VI of 40 to 75, while many vegetable-based oils are in the 200 to 250 VI range. High-VI petroleum oils are available, but at a higher cost.

The lower an oil's VI, the more change in viscosity will occur at both low and high temperatures. Oils with a high VI will undergo little change in viscosity over a wider

range of temperatures, maintaining the target viscosity throughout the metal forming process.

The heat generated during forming or cutting thins out the lubricant. This lowered viscosity increases the potential for metal-to-metal contact.

Limiting Factors of Biobased Lubes

Figure 1
Biobased oils oxidize, possibly staining certain types of materials; however, additives and antioxidants can be added to reduce the staining.

While vegetable oils may increase the performance of stamping lubricants, they also have limits.

Thermal Instability at High Temps. Vegetable oils are not as thermally stable at the higher temperatures as lower temperatures when left untreated. This has led to the creation of bioengineered seed oils and the use of bioprocessing technologies to create oils that withstand high temperatures.

Oxidation. Biobased oils may oxidize if untreated; possibly staining some types of materials (see **Figure 1**). The addition of additives and antioxidants to the oils can reduce or eliminate staining.

New Shades of Green

Mixtures. Although straight, or neat, oils derived from renewable resources have been available for many years, the most recent trend in green lubricants has been water-soluble oils. With the advantages of reduced friction and greater wear resistance, vegetable oils can be used in a typical oil-based, water-soluble lubricant. Substituting some of the petroleum oil with vegetable oil formulated a greener product.

Figure 2compares a chlorinated, water-soluble oil to a similar lubricant in which a significant portion of the extreme-pressure (EP) additives has been replaced with a

vegetable oil. A twist-compression test (TCT) effectively matches metal contact pressures to the metal forming process. Also, the test can be run with a minimal amount of lubricant, ensuring boundary contact with the lubricant and workpiece. A TCT was used to measure friction and evaluate adhesion.

With only a reduction in EP additives, the results are a higher friction coefficient and decreased tool performance. However, reducing the amount of the EP additives and adding a biobased oil achieves very similar results.

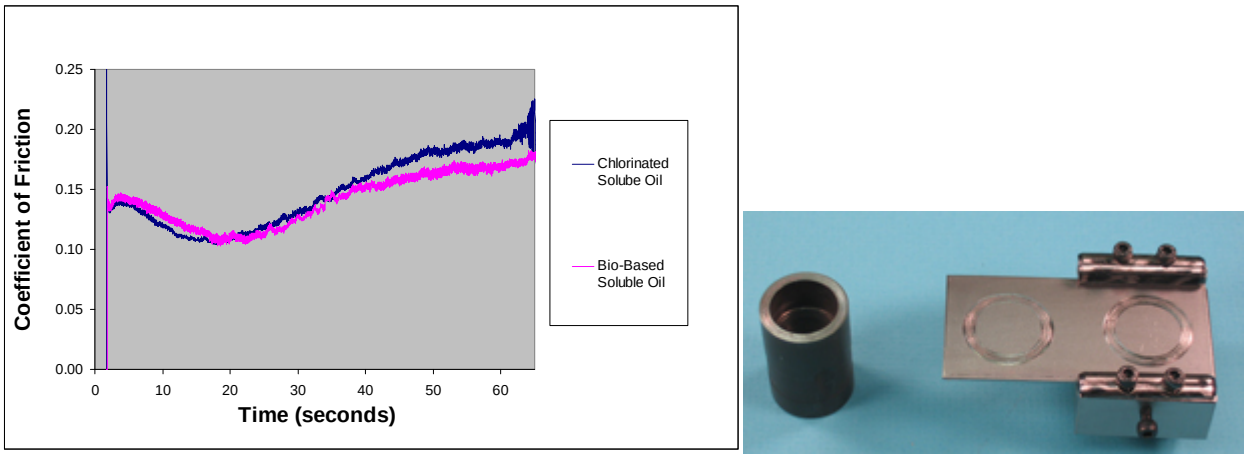


Figure 2

A twist-compression test shows that a lubricant in which a significant portion of the extreme-pressure (EP) additives have been replaced with a vegetable oil has friction and adhesion performance characteristics similar to chlorinated, water-soluble oil.

The average friction coefficients of the two lubricants are very close. The chlorinated, water-soluble oil is 0.123, and the biobased, water-soluble oil is 0.119. These numbers then can be used in a number of software programs to determine metal flow and identify potential weak areas of the final part.

Pure Renewables. Another trend that has developed is to create a green product using exclusively renewable-resource chemistry, without the use of EP additives such as chlorine, sulfur, or phosphorus. These lubricants rely wholly on the boundary film properties of the vegetable oil for protection. The vegetable oil in this lubricant creates boundary film lubrication typically provided by the petroleum oil and EP additives.

Soy-based. From June 2005 through 2007, the state of Iowa passed legislation creating a tax credit program for companies using soy-based metalworking lubricants. Manufacturers were eligible to receive a $2-per-gallon credit based on the purchase and

replacement costs associated with the transition from petroleum-based to soy-based metalworking oils. This legislation helped to foster the creation and acceptance of soy-based fluids for metal forming. The National Ag-Based Lubricants Center at the University of Northern Iowa was instrumental in getting this legislation passed.

As more uses are discovered for renewable-resource lubricants, the U.S.'s demand on foreign oil lessens, and the opportunity for U.S. farmers to contribute to the American industrial engine grows.

The benefits of switching to biobased lubricants warrant continued interest and research. Their performance characteristics definitely have been proven. These oils are less toxic to the environment and are easier to dispose of. The work force health risk is lessened, creating a safer workplace.

Making the switch to biobased lubricants takes some research and testing, but no different than changing to any other lubricant. Your lubricant supplier can help you evaluate biobased lubricant technology to determine if it can be a fit for your operations.

And best of all, you will be heeding your mother's advice that vegetables are good for you. And they're good for the environment, and your company's bottom line.

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