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Biodiesel Blends for Fueling Diesel Engines

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Commercially produced biodiesel is a safe and reliable alternative fuel that can be used in diesel engines with little or no need for modification to existing engines and fuel systems. Most commercially available biodiesel fuels are actually biodiesel blends that are properly referenced with the letter B followed by a one- or two-digit number that represents the percentage of biodiesel used in the blend with petroleum diesel fuel. Pure biodiesel is sometimes called "neat" biodiesel and is also referred to as B100. The most common biodiesel blends are B2, B5, B10, B20 and B50. The remaining fraction is petroleum-based diesel fuel, which is often referred to as petrodiesel.

Biodiesel production

Biodiesel is typically derived from vegetable oil, but can also be derived from animal oils (lard and tallow). The most common feedstock for biodiesel production facilities in Missouri is soybean oil from the Missouri soybean crop. Biodiesel can also be derived from other vegetable sources such as rapeseed, corn, cottonseed and peanut; animal sources, such as tallow or lard; and waste cooking oils (yellow grease).

Biodiesel production plants in Missouri process raw soybean oil into a form suitable for use in diesel engines. Various extraction processes exist for converting raw soybean oil to biodiesel, but the most common commercial-scale facilities use 100 pounds of soybean oil and 10 pounds of methanol mixed with a catalyst. This results in 100 pounds of neat biodiesel and 10 pounds of glycerin. Glycerin is the primary byproduct or coproduct of biodiesel production and has value when further refined for other markets.

Raw or refined vegetable oil, or recycled greases that have not been processed to create biodiesel as described should be avoided. Vegetable oil or greases used in diesel engines at levels as low as 10 to 20 percent can cause long-term engine deposits, ring sticking, lube oil gelling, and other maintenance problems and can reduce engine life. These problems are caused primarily by the greater viscosity of the raw oils than of the diesel fuel for which the engines and injectors were designed. Vegetable oils and other feedstocks can be converted into biodiesel to avoid these viscosity-related problems. The use of commercially produced biodiesel blends avoids these problems and provides a quality fuel that is both reliable and compatible with the warranties for your diesel engine.

Unlike ethanol plants, which receive and process corn grain, biodiesel plants do not necessarily receive the soybean crop directly, but may receive soybean oil from an existing crushing plant. Soybean crushing plants produce soybean meal, a valuable livestock feed, and raw soybean oil, which may have many uses other than production of biodiesel.

Biodiesel storage

Biodiesel blends, like petroleum diesel fuels, should be stored in a clean, dry, dark environment. As with any fuel, steps must be taken to prevent water from entering the tank. Algae can grow in biodiesel fuels just as it does with pure petroleum diesel fuels.

Storage tanks for biodiesel blends should be cleaned, inspected and repaired before converting to biodiesel storage. Older tanks should be professionally cleaned to remove particles and deposits that might eventually contaminate the fuel supply. Tanks should be clearly labeled to display the type of fuel to be stored in the tank. Storage tanks for biodiesel can be constructed from mild steel, stainless steel, fluorinated polyethylene, fluorinated polypropylene and Teflon. Tanks or containers constructed from polyethylene or polypropylene should be protected from sunlight.

Inspect storage tanks to determine material composition. Biodiesel reacts in unfavorable ways with some materials. For example, aluminum, a nonferrous metal, reduces the shelf life of biodiesel; tin and zinc have the same effect. Biodiesel will also break down concrete, varnish and PVC tank linings.

Measures must be taken to ensure that the biodiesel will flow in cold weather. This is often accomplished by mixing the fuel with either Number 1 or Number 2 diesel fuel. Cold flow improvers (CFI) can also be added to enhance the cold flow characteristics of biodiesel.

Plumbing

The materials used in the construction of storage tanks are also suitable for plumbing. However, pure

biodiesel will readily dissolve rubber components that might be used in plumbing components. Degradation of rubber is reduced with low biodiesel blends, but little research has been conducted to determine the long-term effect of the compatibility of rubber components with low biodiesel blends.

Safety

Neat biodiesel is nontoxic, biodegradable and much less irritating to the skin than petrodiesel. However, the same safety rules that pertain to petroleum diesel fuel also apply to the use of biodiesel blends. The following list summarizes these safety issues:

- Store in closed, vented containers between 50 and 120 degrees F.
- Keep away from oxidizing agents, excessive heat, and ignition sources.
- Store, fill and use in well-ventilated areas protected from direct sun.
- Do not store or use near heat, sparks or flames.
- Do not puncture, drag or slide the storage tank.
- A drum is not a pressure vessel; never use pressure to empty a drum.
- Wear appropriate eye protection when filling the storage tank.
- Provide secondary containment.
- Provide crash protection (e.g., large concrete-filled pipe near the storage tank)

Engine and fuel system performance

Biodiesel contains less energy than petrodiesel. While a gallon of petrodiesel contains about 129,050 Btu/gal, a gallon of B100 contains 118,170 Btu/gal. The difference for small blends is not noticeable. Most users fueling with a relatively higher B20 blend do not even notice the small effect on engine power, torque or fuel economy, which is as little as 1 percent.

Older vehicles should be carefully inspected before using biodiesel blends. Because biodiesel is an excellent solvent, filters may need to be changed when beginning to use biodiesel blends. Some fuel lines may also need to be replaced because biodiesel reacts with the rubber used in some of these older materials.

Biodiesel also has less favorable cold flow properties than conventional diesel. The cold flow properties of both fuels are extremely important. Unlike gasoline, petrodiesel and biodiesel can both start to freeze or gel as the temperature gets colder. If the fuel begins to gel, it can clog filters or eventually it can become thick enough that it cannot even be pumped from the fuel tank to the engine. The careful planning of commercial biodiesel facilities and distribution channels minimizes the problems associated with gelled fuel. Most users of biodiesel will choose a relatively low biodiesel blend especially as the weather cools and will not experience any problems with cold flow properties.

Environmental and economic effects

According to the U.S. Department of Energy, there is a net return of 3.2 units of fuel energy from biodiesel for every unit of fossil energy used to produce the fuel. This estimate includes the energy used in farm and transportation equipment (trucks, locomotives), fossil fuels used to produce fertilizers and pesticides, fossil fuels used to produce steam and electricity, and methanol used in the manufacturing process. Biodiesel can extend petroleum supplies at least in some small but important way.

When we use biodiesel in place of diesel fuel derived from petroleum, the net effect is to reduce carbon dioxide (CO_2), which has the potential to cause global warming. Growing soybean plants remove CO_2 from the air during the growing season. The CO_2 produced from using the biodiesel returns to the atmosphere and becomes part of a continuing carbon cycle to grow the next crop. This continuing cycle reduces the CO_2 load in the atmosphere. The B20 blend reduces the CO_2 load on the environment by 15.66 percent.

Biodiesel also reduces the emission of particulate matter (PM), hydrocarbons (HC) and carbon monoxide (CO). Neat biodiesel contains 11 percent oxygen by weight, allowing the fuel to burn more completely and results in fewer unburned fuel emissions. The Environmental Protection Agency concludes that biodiesel has positive and predictable benefits to the environment.

Finally, as new laws reduce the sulfur in diesel fuel from 500 parts per million (ppm) to 15 ppm, low-level blends of biodiesel, such as 1 or 2 percent, are a logical way to reduce the loss of lubricity when converting to these "ultra low sulfur diesel" ULSD fuels. Engine manufacturers depend on the lubricity properties of diesel fuels to lubricate fuel pumps and injectors and to protect them from premature wear. Biodiesel blends have the necessary lubricity to provide the protection lost by removing the sulfur from petroleum fuels.

Summary

Biodiesel blends have a positive net effect on the environment, can reduce our dependence on imported fuels, can help improve lubricity as we switch to mandated low sulfur fuels and provide solid performance in modern diesel engines when obtained from reliable sources. Commercially available biodiesel fuels must meet strict standards that protect the consumer from potential problems. As with all fuels, for best results, buy clean fuel and keep it clean.

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