U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY & RENEWABLE ENERGY

Biodiesel Basics

Biodiesel is a domestically produced, renewable fuel that can be manufactured from new and used vegetable oils, animal fats, and recycled restaurant grease. Biodiesel's physical properties are similar to those of petroleum diesel, but it is a cleaner-burning renewable alternative. Using biodiesel in place of petroleum diesel significantly reduces lifecycle carbon emissions. Research shows that it also reduces emissions of toxic air pollutants in older on-road vehicles and in many off-road applications.

Hundreds of biodiesel fueling stations are available in the United States. Find a station near you by visiting the Alternative Fueling Station Locator. *Photo from National Biodiesel Board, NREL 38601*

Biodiesel blends

Biodiesel can be blended and used in many different concentrations, including B100 (pure biodiesel), B20 (20% biodiesel, 80% petroleum diesel), B5 (5% biodiesel, 95% petroleum diesel), and B2 (2% biodiesel, 98% petroleum diesel). B20 is a common biodiesel blend in the United States.

Using biodiesel in diesel engines

For vehicles manufactured after 1994, biodiesel blends meeting ASTM standards can be used with minimal impact on operating performance. Diesel vehicles manufactured before 1994 may include elastomers (hoses and gaskets) that could break down with repetitive use of blends above B20. Higher blends should be avoided in these older vehicles, or their elastomers should be upgraded to a compatible material.

Currently, every original equipment manufacturer (OEM) of diesel vehicles approves blends of up to B5 in their vehicles. Nearly 80% of OEMs already approve blends up to B20 in some or all of their diesel vehicles, and some even approve the use of B100 in certain types of farm equipment. Ongoing research aims to gain approval for the use of B20 blends in all on-road diesel vehicles.

Check your OEM's website or speak with a dealer to determine which biodiesel blend is right for your vehicle. You can also find general and manufacturer-specific information on the National Biodiesel Board website (*www.biodiesel.org*). It is up to you to determine the right blend ratio for your vehicle and application.

How can I find biodiesel?

Biodiesel is available in all 50 states. The Alternative Fuels Data Center (AFDC) website has information on fueling sites across the country that offer blends of B20 and higher. To find biodiesel stations in your area, use the Alternative Fueling Station Locator (*afdc.energy.gov/stations*).

How well does biodiesel perform?

Engines operating on B20 exhibit similar fuel consumption, horsepower, and torque to engines running on conventional diesel. Biodiesel also has a higher cetane number (a measure of the ignition value of diesel fuel) and higher lubricity (the ability to lubricate fuel pumps and fuel injectors) than conventional diesel fuel, so it combusts easier and lubricates the fuel system better. Generally, a blend of diesel fuel and biodiesel, such as B20, will have a slightly lower energy content than petroleum diesel, although the impact on fuel economy is insignificant.

Will biodiesel perform well in cold weather?

The cold-flow properties of biodiesel blends vary depending on the amount of biodiesel in the blend and the types of fuel used in the blend. This issue is not limited to biodiesel, as diesel fuel exhibits the same behavior. All diesel and biodiesel blends can have compounds that crystallize in very cold temperatures, causing operability issues if not properly monitored. However, fuel blenders have a number of options available to improve the cold-flow properties of biodiesel blends, including adding flow improvers, blending in more No. 1 diesel, or blending in less biodiesel. Users should consult with their fuel provider with questions about the cold weather performance of their fuels.

Will biodiesel plug my vehicle filters?

Biodiesel has a solvent effect. It cleans your vehicle's fuel system and could release deposits accumulated from previous diesel fuel use. The release of deposits may initially clog filters, so you should be proactive in checking for and replacing clogged fuel filters. Once the build-up is eliminated, return to your regular replacement schedule. This issue is less common with B20 and lower-level blends.

Will long-term biodiesel use affect my engine?

Studies of B20 and lower-level blends in approved engines have not demonstrated negative long-term effects. Higher-level blends (above B20) may impact fuel system components in vehicles manufactured before 1994. The effects are lessened as the biodiesel blend level decreases. For more information, visit *www.biodiesel.org*.

Are there standards for biodiesel?

BQ-9000 is the voluntary industry quality assurance program, and information can be found at *bq-9000.org*. Biodiesel blends should start with B100 biodiesel that meets ASTM International Specification D6751. When blended for B5 and lower-level blends, the finished blend must meet ASTM D975, which requires these blends to meet the same fuel-quality specifications as conventional diesel fuel, so they have the same physical properties. For blends containing 6%–20% biodiesel, the finished blend needs to meet ASTM D7467.

Does biodiesel burn cleaner than diesel?

Prior to the 2010 model year (MY), some studies showed contradictory results for emissions of nitrogen oxides with B20 compared to diesel fuel. With new emission control technologies, this is no longer an issue, because diesel fuel burns as cleanly as B20 in MY 2010 and newer engines. In older engines, biodiesel blends may offer some additional emissions reduction benefits, particularly for particulate matter, carbon monoxide, and unburned hydrocarbons. The amount of the benefit will depend on the engine's emission control technology, the age of the engine, the percent of biodiesel in the blend, and how the vehicle is operated. As Figure 1 illustrates, the oldest engines and technologies will reap the greatest emissions benefits from the use of biodiesel.

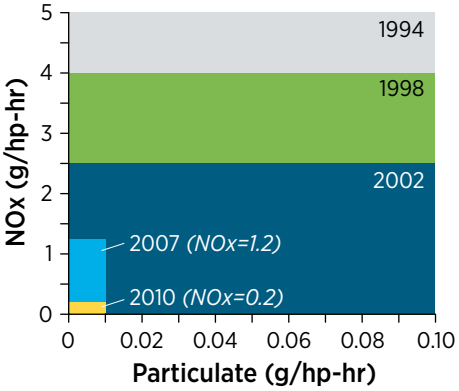

Figure 1: Emission Standards for Heavy-Duty Highway Engines. U.S. emissions limits for nitrogen oxides (NOx) and particulate matter (PM) have been reduced significantly over the last 20 years. Biodiesel's benefits are maximized in engines older than MY 2010.

Biodiesel also reduces greenhouse gas emissions on a lifecycle basis. This is because the carbon dioxide released during combustion is offset by the carbon dioxide sequestered while growing the feedstocks that are used to produce the fuel. Greenhouse gas emission reductions are an important component of being an advanced biofuel under the Renewable Fuel Standard. The U.S. Environmental Protection Agency does not differentiate among the various biodiesel feedstocks—vegetable oils and waste fats, greases, and oils—in defining biodiesel as an advanced fuel.[1]

Is biodiesel the same as renewable diesel?

No. Although most renewable diesel is produced from vegetable oil, animal fat, and waste cooking oil, biodiesel is a mono-alkyl ester and has different fuel properties than diesel and hence, a different fuel specification (ASTM D6751 for 100% biodiesel). Renewable diesel, on the other hand, behaves nearly identically to petroleum diesel and meets the same fuel quality specification ASTM D975.

Can I use straight vegetable oil in my diesel engine?

No, straight vegetable oil is not biodiesel and is not a legal motor fuel. It does not meet biodiesel fuel specifications or quality standards. For more information, see the fact sheet, *Straight Vegetable Oil as a Diesel Fuel?* (*www.nrel.gov/docs/fy14osti/54762.pdf*).

Where can I read more?

For more information on biodiesel, including production, distribution, and fueling station locations, see the *Biodiesel Handling and Use Guide (Fifth Edition)* (*afdc.energy.gov/uploads/publication/biodiesel_handling_use_guide.pdf*) or visit the biodiesel section of the AFDC (*afdc.energy.gov/afdc/fuels/biodiesel.html*).

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[1] *EPA Lifecycle Analysis of Greenhouse Gas Emissions from Renewable Fuels*, Washington, D.C.: U.S. Environmental Protection Agency. Accessed September 14, 2017: *www.epa.gov/sites/production/files/2015-08/documents/420f10006.pdf*