

Biodiesel Blends

Best Management Practices



Properly managed, high quality biodiesel blends are used successfully in the coldest of climates. By following a few simple guidelines, you can manage your use of biodiesel for cleaner, trouble-free use of renewable, sustainable biodiesel.

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What is Biodiesel



B20

Biodiesel is a clean-burning alternative fuel made from domestic, renewable resources. It is made primarily from soybean oil, but it can also be made from other vegetable oils, recycled frying oils and animal fats. The term “biodiesel” refers to the pure, unblended fuel and is referred to as B100. Like petroleum diesel, before biodiesel is accepted into the fuel distribution system, it must meet strict quality standards to ensure trouble-free performance. Unprocessed, raw vegetable oils and animal fats are NOT biodiesel — they can leave deposits and cause engine damage and are not registered fuels approved by the U.S. Environmental Protection Agency (EPA).

Biodiesel contains no petroleum, but it can be blended with petroleum diesel in any percentage. Biodiesel blends from 2 percent to 20 percent can be used in most diesel equipment with no modifications. Biodiesel blends are indicated by a “B” with a number following that represents the percentage of biodiesel in a gallon of fuel. The remainder of the gallon can be No. 1 diesel, No. 2 diesel, kerosene or heating oil. Biodiesel blends higher than B20 require special handling and may require equipment modifications.

Working with Your Fuel Supplier



- Buy your biodiesel blend pre-blended from your fuel supplier.
- Always retain a one-quart sample of fuel at delivery. Look at a sample of the fuel in a clear Mason jar. The fuel should be clear and bright. Save this sample until the next load of fuel is received. Discard the sample by adding it to the fuel tank.
- Be sure your fuel storage tank is clean and free of water at all times.
- As with any ultra low sulfur diesel fuel (ULSD), biodiesel has a shelf life of six months to avoid microbial growth and product degradation. With the proper housekeeping and additives, the shelf life can be extended. Consult your fuel supplier for proper recommendations and testing.
- Make sure diesel fuel or biodiesel blends meet cold flow operability and any operational needs by discussing your needs requirements with your supplier prior to purchase. Determine how long your fuel will be in storage. Fuel purchased in July does not contain cold flow additives. If you will be using this fuel in winter months, you may need to add cold flow additives or blend the fuel with No. 1 diesel.
- If you use a biodiesel blend of more than 5 percent, check with your Original Equipment Manufacturer (OEM) for compatibility with your chosen blend.

Myth: *Biodiesel is an experimental fuel and has not been thoroughly tested.*

FACT: Biodiesel is one of the most thoroughly tested alternative fuels on the market. A number of independent studies – performed by the DOE, NREL, USDA and Standyne Corporation – have shown that biodiesel performs comparably to petroleum diesel but with greater benefits to the environment and human health.

Myth: *Biodiesel doesn't work in cold weather.*

FACT: Properly managed, high quality biodiesel blends are used successfully in the coldest of climates. Biodiesel will gel in very cold temperatures, just as common No. 2 diesel does. Although pure biodiesel has a higher cloud point than No. 2 diesel fuel, typical blends of 20 percent biodiesel are managed with similar management techniques as No. 2 diesel. Blends of 5 percent biodiesel and less have virtually no impact on cold weather operability.

Blending Your Own Fuel



Temperature is important!



Top loading



Bottom loading

■ Before blending, the temperature of the biodiesel should be a minimum of 60°F or 10°F above its cloud point, whichever is greater.

■ Biodiesel (B100) and biodiesel blends should be clean in appearance and free of water and sediment.

■ In-line blending, done properly, is the best way to ensure complete blending of biodiesel and diesel fuel. Splash blending (blending of diesel and biodiesel in separate streams into a transport or truck tank) may be used in locations where in-line blending is not available.

■ For top-loading trucks in warm weather: If possible, load both products at the same time through separate lines at high enough fill rates to sufficiently mix the products in the tank. If diesel and biodiesel must be added separately or at separate locations, it is recommended that the diesel fuel be loaded first, then biodiesel be introduced with as high volume and velocity as possible to enhance thorough blending. It is important that B100 is kept at least 10°F above the cloud point while blending takes place.

■ For top-loading trucks in cold weather: If in-line blending for top loading trucks is not available in cold weather, first add half the diesel (warm, if possible). Then, as quickly as possible, add warm (60°F or more) biodiesel at high pressure and volume to enhance thorough mixing, followed by the other half of the diesel fuel. An empty truck tank can be so cold that, in a short time, biodiesel can cool and gel on the tank bottom before blending takes place.

■ For splash blending in bottom-loading transports in warm weather: The biodiesel is loaded in the tank through the manifold system first, followed by the diesel fuel. A homogeneous mixture should be obtained if the flow rate of the diesel fuel is adequate (several hundred gallons per minute).

■ For splash blending in bottom-loading transports in cold weather: It is important that the B100 is kept at least 10°F above the cloud point (preferably 60°F or more) while blending takes place. Introduce half the diesel fuel (warm, if possible) through the manifold first, then add warm biodiesel (60°F) at a high volume and pressure through a port in the top of the tank to get maximum turbulence. Finally, introduce the other half of the diesel through the bottom manifold with as high pressure and volume as possible.

■ Further agitation may be necessary to achieve a homogeneous blend.

For more detailed recommendations on splash blending, talk to your supplier.

Myth: Biodiesel use voids manufacturers' engine warranty coverage.

FACT: All major U.S. automakers and engine manufacturers accept the use of up to at least B5, and many major engine companies have stated formally that the use of high quality biodiesel blends up to B20 will not void their parts and workmanship warranties. For a listing of the specific statements from the engine companies, please visit the National Biodiesel Board Web site at www.biodiesel.org/resources/oems.

Storage Tanks and Materials Compatibility



Tank must be protected from excessive heat!

- Above-ground storage tanks should be sheltered or painted with reflective paint to resist excessive heat in the summer. High temperatures during storage accelerate fuel degradation.
- Brass, bronze, copper, lead, tin and zinc may accelerate the oxidation of diesel and biodiesel fuel and potentially create sediments, gels or salts when they react with some fuel components. Acceptable storage materials include stainless steel, aluminum, Teflon® and most fiberglass.
- Lead solders, zinc linings, copper pipes, brass regulators and copper fittings should be avoided.
- Most elastomers are compatible with biodiesel blends of 20 percent or less, and normal monitoring of seals and gaskets is sufficient.
- Higher biodiesel blends may negatively impact natural or nitrile rubber. Monitor seals and gaskets for leaks and swelling.

Fuel Tank Maintenance



Keep tank and system free of contaminants!

The importance of keeping your tank and fuel system free of contaminants has never been more important than with the introduction of ULSD and biodiesel. Water and sediment can cause fuel filters to plug prematurely and/or fuel quality issues. The presence of free water can promote fuel system corrosion and microbial growth. Microbes live in the interface that forms between the fuel and the free water. Since the introduction of ULSD, microbial contamination in diesel fuel has become a more common problem. It is recommended that storage tanks have a dispenser filter installed to keep any contamination from being passed along to vehicles. Inspections and basic housekeeping practices will help promote a problem-free experience. Tank venting is a source for water and contaminants to enter into the tank. Vents should be inspected for proper operation and to make sure water cannot enter the tank.

Checking Tanks for Water and Sediment

At minimum, it is recommended that storage tanks be checked for water and sediment prior to each fuel delivery. If fuel is not delivered frequently, it is recommended to check the fuel tank at least once a month. In both cases, the tank should be checked by obtaining a tank bottom sample. This sample should be visually inspected for water and sediment. Use a clear Mason jar for visibility. The sample should look clear and bright. If any free water and/or sediment is found or the sample appears hazy, the water should be removed. If free water is present, the fuel should be tested for microbial contamination. Your fuel supplier should be able to provide this test for a fee or recommend a lab.

Myth: *Biodiesel has fuel quality problems.*

FACT: A study released in 2008 by the National Renewable Energy Laboratory (NREL) shows the biodiesel industry has substantially met national fuel quality standards. The study demonstrated plants certified under BQ-9000 consistently hit the quality mark. BQ-9000 is a voluntary fuel quality assurance program that couples the foundations of universally accepted quality management systems with the biodiesel product specification (ASTM D6751). Biodiesel production facilities certified as producers under the program cover nearly 80 percent of the U.S. biodiesel market volume.

Tank Cleaning

If sediment is found, a vacuum truck should be used with a scavenger device to effectively navigate around the tank and remove the contamination. Tank cleaning should take place one of two ways: (1) with the use of a high pressure hose with fuel, or (2) by physically scrubbing the inside of the tank. Both cleaning methods will use impingement cleaning, meaning all surfaces are cleaned with either high pressure or physical scrubbing.

Housekeeping Tips



- Always install a dispenser filter on a storage tank. If there are any issues with contaminants, the dispenser filter will plug but keep contaminants from progressing to the vehicle tank.
- Fuel tanks should be kept as full as possible to reduce the amount of air and water entering the tank.
- Monitor hoses, fill/vapor caps, gaskets for leaks.
- Check for water and sediment in tanks PRIOR to fuel delivery.
- Visually check tanks monthly for free water by obtaining a tank bottom sample.
- In the fall before colder weather sets in, check tanks for water concentration and microbial contamination. Check again in the spring.

Cold Weather Operability



Like petroleum diesel fuel, biodiesel blends will gel in very cold temperatures. The cloud point of a fuel is the temperature at which the first solids form and are visible to the naked eye. Typically No.2 diesel fuel has a cloud point in the range of -10 to 20°F, and No.1 diesel fuel has a cloud point of -40°F or below. That means, without the use of cold flow improving additives, No.2 diesel will begin to gel and plug filters at its cloud point. Diesel users must utilize blends of No.1 and No.2 diesel fuel, the use of cold flow additives and/or fuel heating systems to keep fuel from gelling at temperatures below the cloud point.

The cloud point of biodiesel blends up to 5 percent will be virtually the same as those of the diesel fuel used in the blend. Biodiesel blends of more than 5 percent may have higher cloud points and require the use of cold flow additives or No.1 diesel in order to operate in Iowa winters. All diesel fuel is different. Your fuel supplier should be able to tell you the cloud point of the fuel. Work with your fuel distributor to achieve the desired cold weather protection needed. Proper tank maintenance and housekeeping practices will further ensure cold weather operability.

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Diagnosing Sources of Filter Failure or Plugging



Water Contamination and Icing- *Swollen, frayed filter media may be covered with glycerin.*

High water concentration in the fuel can lead to a buildup of water in the filters. When excess water is present, fuel filters will swell, causing a distortion of the filter. This distortion is visible as the media will be swollen and separating from the end caps. Water that builds up in the filter can also cause icing problems. When the temperature of the filter gets below 32°F, the excess water freezes and blocks the flow of fuel through the filter. When the filter is removed and examined, the ice has usually melted. The presence of water can also pull solid elements of biodiesel out of solution. When filters swell with water, glycerin can become attracted to the water on the filter. The glycerin builds up until the filter plugs. Water is the number one cause of filter-plugging issues in diesel engines. Routinely checking and removing water in tanks and filters can help minimize problems with plugged filters.



Microbial Contamination - *Slimy filter with odor, or a black, slimy filter with or without odor.*

Since the introduction of ULSD in 2006, microbial contamination has become a more common problem associated with diesel fuel. Previously, higher sulfur levels acted as a natural antimicrobial. Bacteria and fungus grow in the water/fuel interface. They can be present in supply tanks and vehicle tanks, supply lines and fuel system components. Microbial contamination may be accompanied by a brown/black/beige jelly-like byproduct created by the growth. This issue can be avoided by routine water maintenance. If microbial contamination is suspected, it is recommended you treat the contamination with a reputable biocide at twice the kill/shock rate. It is suggested you contact your fuel distributor to perform a microbial test or recommend a lab that can.



Oxidation - *Fine, black sediment on the filter. Black, smooth filter looks like it has been colored with a black magic marker.*

Oxidation is caused by hot fuel returning to the tank and could cause something similar to coking the fuel (burning of the fuel causing it to breakdown and create sediment). In many newer fuel systems, the time it takes to return unused fuel back into the tank has decreased. The first remedy of this situation is to have the fuel system checked to determine if it is functioning properly. If the system is performing as it should, it may be necessary to use a stability additive for the fuel.

Myth: *Biodiesel contributes to rising food prices.*

FACT: Produced from a variety of renewable resources, such as plant oils, fats, recycled grease and even algae, biodiesel is the most diverse fuel on the planet. Soybean-based biodiesel actually has a positive impact on the world's food supply. Processing biodiesel from soybeans uses only the oil portion of the soybean, leaving all of the protein available to nourish livestock and humans. By creating a new market for soybean oil, we increase the availability of protein-rich meal for humans and livestock.



Paraffin Wax - *Clean filter and hazy fuel. Wax substance in the folds of the filter in temperatures at or below the cloud point.*

Paraffin is a naturally occurring material in diesel fuel. When the temperature of the fuel is at or below its cloud point, paraffin material can precipitate out and collect on the bottom of the tank. Fuel experiencing filter-plugging problems will appear hazy. In this situation, filters will often show no signs of filter plugging. When the filter is brought into a warm location to be examined, the paraffin melts and leaves no evidence. When warmed to room temperature, the paraffin wax will return to liquid. There is no paraffin in biodiesel. Wax Anti-Settling Agent (WASA) additives are used to keep paraffin suspended in solution rather than collecting at the bottom of the tank where they can cause filter plugging.



Mono/Diglyceride Build Up - *Brown Vaseline-like substance in the folds of the filter.*

Biodiesel that does not meet the specification of ASTM D6751 can cause a mono/diglyceride build-up on the filter. In this case, the filters are plugged with a brown substance similar to brown Vaseline. If this is the case, it is recommended you check with your fuel distributor to ensure the fuel meets all specifications. Specifically, it should be checked for free glycerin. Another cause of this type of filter plugging: water-absorbing filters hold water on the filter media and then attract glycerin. Glycerin will continue to accumulate and won't go back into liquid. Unlike the wax dropout caused by paraffin, it takes temperatures of 150°F or more to melt glycerin back into liquid. Sediment on the filter also attracts glycerin. In both of these instances, glycerin may not be the result of off-specification fuel.



Sediment - *Granules, sediment in the folds of the filter.*

Sediment caused by rust, tank scale and other contaminants will plug fuel filters. Filters plugged by sediment are characterized by sediment in the folds of the filter and solid particles in the filter casing. Sediment on the filter also attracts glycerin, which further plugs the filter. It is recommended that tanks be monitored and cleaned when necessary to reduce tank contaminants.

Changing fuel filters before the winter season, is recommended.

Helpful Resources:

The Diesel/Biodiesel Helpline

1-800-929-3437

This helpline exists to assist diesel users with diesel and biodiesel-related questions, troubleshoot and diagnose filter plugging problems and provide guidance on proper fuel handling and tank maintenance practices.

National Biodiesel Board

www.nbb.org

The National Biodiesel Board (NBB) is the national trade association representing the biodiesel industry in the United States. This site contains useful information, the latest biodiesel news and links to other valuable resources.

MEG Corp Fuel Consulting

www.megcorpnmn.com

MEG Corp is a fuel consulting company that manages the NBB Biodiesel Hotline, conducts more than 100 educational seminars per year about diesel and biodiesel throughout the Midwest and operates its own fuel testing laboratory to diagnose fuel quality issues.

Photos courtesy of United Soybean Board and MEG Corp



Funded by the soybean checkoff.

