# BIODIESEL FOR GENSET APPLICATIONS

**Understanding how biodiesel interacts with today's diesel engines will maximize a generator set's performance and reliability.**

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**While we often think of biofuels as a new innovation, the very first diesel engines were designed to run on them. Rudolf Diesel, known as the father of diesel engines, stated, "In 1900 a small Diesel engine was exhibited by the Otto company which, on the suggestion of the French government, was run on Arachide [nut] oil, and operated so well that very few people were aware of the fact. The motor was built for ordinary oils, and without any modification was run on vegetable oil."[1] He went on to state they tested other oils like vegetable and fish oils with perfect success.**

Today, biodiesel remains an intriguing alternative to fossil fuels. Because biodiesel contains less carbon elements, it holds promise for reducing greenhouse gas emissions. Based on a 2014 White House report, a switch from petroleum-based fuels toward biodiesel is part of the overall strategy to mitigate greenhouse gas emissions. However, the diesel engines of the 21st century are more complex than the diesel engines of Rudolf Diesel's day. If you are considering incorporating biodiesel, it is essential that you first understand the fuel and how it will interact with your modern diesel engine.

## COMPOSITION

Biodiesels can be made from vegetable oil, plant oil, animal fats, waste cooking oils and greases. These oils can be virgin oils or refined from used deep-fryer oil. Biodiesel is a methyl/ethyl ester based oxygenate and known as Fatty Acid Methyl Esters, or FAMEs. There are industrial societies that have developed standards for biodiesel (DIN EN 14214, ASTM D 6751, ASTM D7467, and ASTM D975), and these standards define how to formulate biodiesel and how it is to be blended. Biodiesel can range from 0% (distillate diesel) to 100% (biodiesel in its purest form).

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This fuel can be burned in a typical reciprocating internal combustion engine. However, there are considerations to take into account. These include, but are not limited to: fuel composition, fuel lifecycle, fuel storage and effects on the engine. Keep in mind that familiarizing yourself with the issues associated with biodiesel is a bit like the reading the fine print about the side effects of a prescription drug. If you read them all, you can't help but think twice about actually using the product!

An operator or owner should refer to the manufacturer's specifications before using any biodiesel blends, as not all engines or equipment are suited or designed for this fuel. The typical blends of biodiesel commercially available today vary greatly due to local legislation and distribution networks. In most markets, biodiesel can be found in blending ratios from B2 (2% biodiesel) to B20 (20%). Be aware that the biodiesel concentration ratio can also vary with the season. For example, in the winter months in Minnesota, the biodiesel content changes to a lower percentage to aid with cold starting and resistance to "gelling."

## STABILITY

Another issue with biodiesel is its relatively high cloud and pour points in respect to standard diesel fuel. The cloud point is the temperature

[1] Chalkley, Alfred Philip. Diesel engines for land and marine work. 2nd ed. New York: D. Van Nostrand, 1912. Google Books. 5 May 2015.

An increasing number of commercial operations specialize not only in the recycling of slurry, but also the disposal of organic waste.

when fuel begins to form wax crystals that makes the fuel look cloudy. This effect can be seen if you take a bottle of vegetable oil and place it in the refrigerator. When crystals form, it can cause fuel filters to clog until the temperature rises. The pour point of a fuel is the point at which the fuel retains the ability to remain in a completely liquid state. The cloud point and pour point of 100% biodiesel can range between 12–60°F (-11–15°C) and between 5–55°F (-15–12°C) respectively. As a rule of thumb, problems begin around 40°F (4°C) with 100% biodiesel. By comparison, #2 diesel has a cloud point in the 15–34°F (-9–1°C) range.

Biodiesel will absorb water, oxidize, and promote microbial growth more than distillate diesel fuel. It is known that water and oil don't mix easily; however, biodiesel is hydroscopic, meaning it mixes with water. This means it is much harder for water/fuel separators to remove all of the water in the fuel. Water present in the fuel system causes issues with lubricity, such as injector nozzle seizure, corrosion of the fuel system, and fuel pump failure caused by water ingestion. As the boiling point of water is lower, it can cause issues with deposits within the injectors.

Biodiesel's density and viscosity is also higher, thus biodiesel is more likely to cause crankcase lube-oil dilution. When fuel is present in the lube-oil, the properties within the oil start to change and the lube-oil becomes less effective thus increasing oil drain intervals to mitigate this issue. Distillate diesel fuel will also dilute the lube-oil but its flash point is about half that of 100% biodiesel (300°F/149°C). During normal engine operation, the fuel in the oil will "flash off" and not cause an issue.

*"Generally speaking, there aren't any issues with actual engine performance when running on biodiesel, as most of the concerns about biodiesel are related to what happens when the unit is sitting in the standby mode."*

Many manufactures will recommend additives when biodiesel is used. Stabilizers, cold-flow enhancers and microbicides help mitigate each of these issues.

## OTHER CONSIDERATIONS

The heat content of biodiesel is less than that of distillate diesel. This means that to get the same power out of the unit, the engine must consume more fuel or the engine will have a "derate" proportional to the heat content change. Some engines may have ways to compensate for this the expected power loss.

Biodiesel has the tendency to degrade hoses, gaskets, seals, glues and plastics with extended exposure. Certain material types are more susceptible than others. These materials included, but are not limited to, natural or nitrile rubber, and polypropylene. Polymers are not the only materials susceptible to the effects of biodiesel. There are some metals that display undesirable reactions as well. Copper, bronze and zinc may accelerate the oxidation process of biodiesel, creating deposits in the fuel and fuel system. When using biodiesel, these items need to be taken into consideration when adding any ancillary components or devices to an OEM genset system. This is one of the reasons why an engine should be flushed with distillate diesel fuel after being run on biodiesel.

## STORAGE

With emergency power applications, fuel storage becomes a concern when using biodiesel, so the following recommendations are important to keep in mind.

Because of biodiesel's higher water solubility and the potential for a higher water content, all fuel systems should have a fuel water separator installed in them to mitigate the risk of increased corrosion and accelerated microbial growth in the fuel system.

Biodiesel has a tendency to oxidize. When this happens, the fuel begins to "rot" and biodegrade. The use of manufacture recommended additives can help prolong fuel life.

Biodiesel is a solvent, and as a result deposits in the fuel system or fuel tank could dislodge and enter into the filtering system on the engine. Therefore, it is also recommended to replace the fuel filters more frequently, as their typical lifespan could be reduced by the biodiesel.

If you are changing your product over to run on biodiesel from distillate diesel, it is recommended that you change all fuel filters, and change

the engine oil and filter prior to running the engine on biodiesel. The same recommendation applies if reverting back from biodiesel to distillate diesel fuel, and the manufacturer's recommendations should also be consulted. The engine should also be monitored for the first 50 running hours after any kind of fuel change over.

If the engine will be sitting for an extended period of time, it is often recommended to run the engine on 100% distillate fuel before shutdown.

## BENEFITS

Generally speaking, there aren't any issues with actual engine performance when running on biodiesel, as most of the concerns about biodiesel are related to what happens when the unit is sitting in the standby mode.

Biodiesel typically has better lubricity properties than distillate diesel. This can help reduce wear with fuel components that rely on the fuel for lubrication, such as fuel pumps and nozzles.

Pure biodiesel is about 10 times less toxic than table salt.

## CLARIFICATIONS

Nearly all diesel engine manufactures neither promote nor discourage the use of biodiesel. Their warranties exclude fuel-related issues from their warranties, but rather warranty the engine for material and workmanship.

E Diesel is not biodiesel. E Diesel is a mixture of diesel fuel with typically up to 15% ethanol. It is not considered biodiesel and may not meet ASTM or E.U. requirements. E Diesel is more like gasoline in terms of its flashpoint and volatility. E Diesel has other concerns, many of them the same as biodiesel, but the low flash point and volatility are the greatest risks.

Bi-fuel should not be confused with biofuel. With bi-fuel, the engine operates on the same principle as the standard diesel engine except that natural gas is mixed with the intake air to offset the amount of diesel being used.

## SUMMARY

There is a growing demand to use biodiesel in the generator set market. This is typically being driven by local requirements or customer demand. Before you start using biodiesel in your products, however, there are many things to consider. The use of this fuel can impact product life, emissions, power output, or the ability to operate when necessary in an emergency. Today's engines require high quality fuel to ensure they will operate properly when called upon. The use of biodiesel can add to this complexity, but there are ways to reduce the potential negative impacts associated with the fuel. Be sure to review the manufacturer's suggestions and have a plan in place before making the decision to switch to biodiesel.

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