

# Biodiesel

## Introduction

Biodiesel is a fuel equivalent of petrodiesel with the exception of its derivation from biological sources. Both non-toxic *and* renewable, biodiesel essentially comes from plants and animals. The major source of biodiesel is soybean oil, but other oils include rapeseed, canola, palm, cottonseed, sunflower, and peanut. All of which can be replenished through farming and recycling. Biodiesel can even be made from recycled cooking grease! Although biodiesel can be used in its pure form, it is usually blended with standard diesel fuel. Blends are indicated by the abbreviation Bxx, where xx is the percentage of biodiesel in the mixture. Much attention has been focused on the thought of it one day replacing fossil fuels as the world's primary transport energy source. Biodiesel is safe and can be used in diesel engines with few or no modifications needed. Now that you know what biodiesel is, let's move on to how it is made.

## Making Biodiesel

There are three main ways to make biodiesel for a modern diesel engine. Vegetable oil can be mixed with another fuel, straight vegetable oil (SVO) can be used, or cooking grease can be converted. The first choice, the mixing of vegetable oil with other fuels may sound easy, but it is not that simplistic. The purpose of mixing the oil is to lower the viscosity, making the oil thinner and allowing it to flow more freely through the fuel system. The combinations vary from mix to mix depending on how much fossil fuel one wants to save. Despite the advantage of less fossil fuel used, most diesel engines have precise fuel requirements that may not be met by the mixes. The second choice is making biodiesel using straight vegetable oil, or SVO. To do this, one would have to take a single-tank SVO system, replace the injectors and glow plugs, and add fuel heating. A two tank SVO system can also be used, which allows the oil to pre-heat and become thinner. With this system, the vehicle starts and stops using regular diesel and then switches to the SVO when it is hot enough.

The third choice is to convert used cooking grease. Used cooking grease can be acquired through a local restaurant for

free and put into a processing system. The grease is put into a cleansing unit, which heats the grease and separates the waste from the oil. Once the grease is cleaned, certain chemicals must be added in order to finalize the biodiesel process. A typical kit can cost from \$1,500 to \$3,000, ranging in sizes of about 40 to 160 gallons per batch. The pay back period for the price of the units is phenomenal considering the price of diesel is about \$2.00 per gallon and the price to make your own biodiesel is about \$0.70 per gallon. Kits and instructions on making your own biodiesel can be found through the link described in the references section. A diagram of the steps of making biodiesel is shown below in Figure 1.

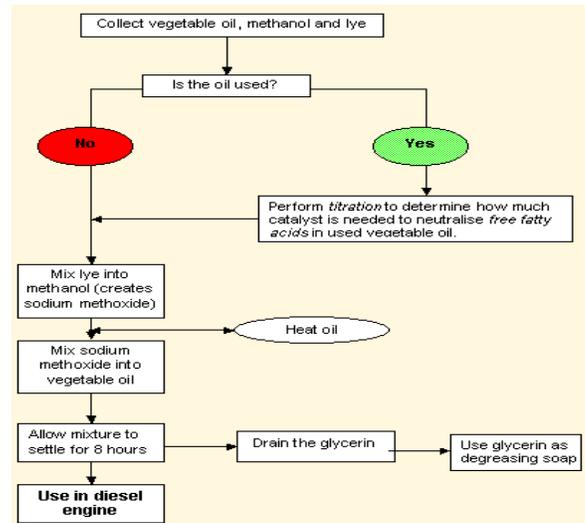


Figure 1: Steps in Making Biodiesel

## Advantages

Biodiesel has many major advantages, and some minor disadvantages. B<sub>100</sub> can reduce CO<sub>2</sub> emissions by 78% and lower the carcinogenic properties of diesel fuel by 94% [1]. According to the EPA, biodiesel degrades at a rate four times faster than conventional diesel fuel. Biodiesel could also lower U.S. dependence on imported oil and increase our energy security. It also contributes to an engine's ease of movement. It acts as a solvent, which helps to loosen deposits from the insides of an engine that may normally cause clogs. It is estimated that a biodiesel blend of just 1% could increase fuel lubricity by as much as 65% [2]. Biodiesel is also safer, it is non-toxic (about 10 times less toxic than table salt) and has

a higher flashpoint than conventional diesel. Because it burns at a higher temperature, it is less likely to accidentally combust. This makes movement and storage regulations easier to accommodate. Table 1 compares emissions of B<sub>100</sub> with B<sub>20</sub> biodiesel.

**Table 1: B<sub>100</sub> and B<sub>20</sub> Emissions**

<b>Average Biodiesel Emissions Compared to Conventional Diesel</b>		
<b>Emission Component</b>	<b>B<sub>100</sub></b>	<b>B<sub>20</sub></b>
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
NOx	+10%	+2%
Sulfates	-100%	-20%
PAH	-80%	-13%

### Disadvantages

Biodiesel has a few drawbacks. One problem is the increase in Nox in biodiesel emissions. Often, in diesel fuel manufacturing, when you decrease the amount of particulate matter in the emissions there is a corresponding increase in nitrogen oxides, which contribute to smog formation. Currently, there are technologies being researched to reduce this problem. Some older diesel vehicles may experience clogging with higher concentrations of biodiesel. Since biodiesel has the ability to loosen deposits built up in the engine, it is a good idea to replace the fuel pump and also the fuel lines when using biodiesel for the first time. Though many manufacturers have included biodiesel in their warranties, the potential for problems could still exist. Most biodiesels are manufactured at B<sub>5</sub> and B<sub>20</sub>, which are low concentrations of biofuel to diesel. Most automobile manufacturers guarantee this mixture will work with no modification to the engine whatsoever.

### Costs

According to the EPA, pure biodiesel (B<sub>100</sub>) can cost anywhere from \$1.95 to \$3.00 per gallon, while B<sub>20</sub> blends average about 30 to 40 cents more per gallon than standard diesel. However, if one was to buy a biodiesel kit and convert used cooking grease into biodiesel, it could cost as low as \$0.71 per

gallon. Public awareness in biodiesel is growing fast, as well as government involvement. In the wake of legislation such as the 1998 EPACT amendment, alternative fuel sources will be a necessity in the not-so-distant future<sup>[4]</sup>.

### Case Study

If you feel a bit skeptical about making your own biodiesel, take a moment to understand just how big the savings would be. If you spend \$2,000 on a kit which makes 100 gallons of biodiesel per batch, you would make the \$2,000 back after just 16 batches made. If you used 1,200 gallons of diesel in one year, it would cost you \$2,400, whereas making your own biodiesel will cost you \$840; a savings of \$1,560! The results are incredible and with a little bit of elbow grease (along with free grease from a restaurant) you could be the one who benefits. This biodiesel could have a variety of uses such as fuel for tractors, heating, running other machinery and could also be used in combination with regular diesel fuel in older motors which would not be able to run off of 100 % biodiesel.

### References

#### End Notes

- [1] National Biodiesel Board (2006) [www.biodiesel.org](http://www.biodiesel.org)
- [2] U.S. DOE Office of Transportation Technology (2006) [www.eere.energy.gov/vehiclesandfuels/](http://www.eere.energy.gov/vehiclesandfuels/)
- [3] The Biodiesel Standard (2006) [http://www.biodiesel.org/resources/fuelfactsheets/standards\\_and\\_warranties.shtml](http://www.biodiesel.org/resources/fuelfactsheets/standards_and_warranties.shtml)
- [4] USDOE Office of Renewable Resources & Alternate Energy <http://www.eere.energy.gov/afdc/altfuel/biodiesel.html>

### Additional Information

Farmer Biodiesel Use:

[http://www.biodiesel.org/pdf\\_files/farmer\\_use.pdf](http://www.biodiesel.org/pdf_files/farmer_use.pdf)

Government's Biomass Program:

<http://www1.eere.energy.gov/biomass/>

Make Your Own Biodiesel (Links to Processors):

[http://journeytoforever.org/biodiesel\\_make.html](http://journeytoforever.org/biodiesel_make.html)