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**What is Biodiesel?**

Biodiesel refers to a non-petroleum-based diesel fuel consisting of short chain alkyl (methyl or ethyl) esters, made by transesterification of vegetable oil or animal fat (tallow), which can be used (alone, or blended with conventional petrol diesel) in unmodified diesel-engine vehicles. Biodiesel is distinguished from the straight-vegetable oil (SVO) (sometimes referred to as “waste vegetable oil” “WVO” “used vegetable oil” “UVO” “pure plant oil”, “PPO”) used(alone, or blended) as fuels in some converted diesel vehicles.”Biodiesel” is standardized as mono-alkyl ester and other kinds of diesel-grade fuels of biological origin are not included.

**Uses of biodiesel**

Biodiesel fuel is a renewable energy source that can be made from soy beans grown for fuel, or from cooking oils recycled from restaurants. This means it is a renewable resource unlike petroleum-based diesel.

There is an excess production of soybeans in the United States; therefore biodiesel is an economic way to utilize this surplus.

Biodiesel is less polluting than petroleum diesel. Compared to petroleum diesel, biodiesel produces less soot (particulate matter), carbon monoxide, unburned hydrocarbons, and sulfur dioxide.

The absence of sulfur in 100% biodiesel should extend the life of catalytic converters.

Biodiesel fuel can also be used in combination with heating oil to heat residential and industrial buildings. This can reduce dependence on non-renewable and increasingly expensive heating oil.

Biodiesel burns cleaner & is made of non-toxic chemicals so it does not give out poisonous fumes, unlike the ordinary fuel.

**Instructions to Prepare Bio Diesel****Requirements:**

Vegetable oil

Antifreeze (Methanol)

Lye (NaOH)

Blender

Scales

Plastic containers

Funnels

Plastic bottle with lid

Duct tape

Thermometer

**Steps Involved:**

1. **Step 1:** Measure out 200 ml of antifreeze and put it in one plastic container.
2. **Step 2:** Add in lye so that the antifreeze is absorbed.

3. **Step 3:** Cover container and mix well by shaking it. It is mixed when it starts to feel warm and is foamy. The mixture has now become sodium methoxide.
4. **Step 4:** Blend 1 liter of vegetable oil with the sodium methoxide in a blender for 20 minutes.
5. **Step 5:** Pour mixture into a bottle and wait 8 hours until the byproduct, glycerin, separates from the biodiesel. The glycerin will be on the solid on the bottom.
6. **Step 6:** Separate out the biodiesel by pouring into a glass bottle.
7. **Step 7:** Prepare a wash bottle by poking a small hole in the corner of the bottle and covering it with duct tape.
8. **Step 8:** Wash the biodiesel by pouring it into the wash bottle and adding in  $\frac{1}{2}$  a liter of water. Roll the bottle around to mix it and then remove the duct tape and drain the water.
9. **Step 9:** Repeat the washing process until the biodiesel is clear. This may need to be done numerous times over the course of a week to complete the process. Store the biodiesel in a glass container until ready to use.

### Reactions involved

#### Transesterification:

Animal & plant fats & oils are typically made of triglycerides which are esters of free fatty acids with the trihydric alcohol, glycerol. In the transesterification process, the alcohol is deprotonated with a base to make it a stronger nucleophile. Commonly, ethanol or methanol is used. As can be seen, the reaction has no other inputs than the triglyceride & the alcohol.

Normally, this reaction will precede either exceedingly slowly or not at all. Heat, as well as an acid or base are used to help the reaction more quickly.

#### Biodiesel is a much cleaner fuel than conventional fossil-fuel petroleum diesel

1. Biodiesel burns up to 75% cleaner than petroleum diesel fuel.
2. Biodiesel reduces unburned hydrocarbons (93% less), carbon monoxide (50% less) & particulate matter (30% less) in exhaust fumes, as well as cancer-causing PAH (80% less).
3. Sulphur dioxide emissions are eliminated (biodiesel contains no Sulphur).
4. Biodiesel is a plant-based & using it adds no extra CO<sub>2</sub> greenhouse gas to the atmosphere.
5. The ozone-forming (smog) potential of biodiesel emissions is nearly 50% less than petrol-diesel emissions.
6. Nitrogen oxide emissions may increase or decrease with biodiesel but can be reduced to well below petrol-diesel fuel levels.
7. Biodiesel exhaust is not offensive & doesn't cause eye irritation.
8. Biodiesel can be mixed with petrol-diesel in any proportion, with no need for a mixing additive.
9. With slight variations depending on the vehicle, performance & fuel economy with biodiesel is the same as with petrol-diesel.

#### Biodiesel's fuel features

**Power:** One of the major advantages is the fact that it can be used in existing engines & fuel injection equipment (no modification required) without negative impact to operating performance.

**Fuel availability/economy:** Virtually the same MPG rating as petrol-diesel & the only alternative fuel for heavyweight vehicles requiring no special dispensing & storage equipment.

**Production/Refining:** Can be done at home (wasted veggie oil) & farms (virgin oils from seeds), being the only alternative fuel that can boast of a zero total emissions production facility. By selling the simultaneously produced glycerol, the cost of BD is basically the same cost of the oil used to make it.

**Storage:** Readily blends & stays blended with petrol-diesel so it can be stored & dispensed wherever diesel is stored or sold.

**Combustibility/Safety:** Biodiesel has a very high flash point (300°F) making it one of the safest of all alternative fuels. **Lubricity:** The only alternative fuel that can actually extend engine life because of its superior lubricating & cleaning properties. The present “low sulphur” diesel fuel is badly wearing the injection pumps of not protected diesel engine.

**Usage:** Biodiesel fuel can generally be used in existing oil heating systems and diesel engines without modification, and it can be distributed through existing diesel fuel pumps. This is an advantage over other alternative fuels, which can be expensive to use initially due to high cost of equipment modifications or new purchases. Biodiesel provides almost the same energy per gallon as petroleum diesel.

**Environment Impact:** The only renewable alternative diesel fuel that actually reduces major greenhouse gas components in the atmosphere. The use of biodiesel will also reduce the following emissions: carbon monoxide, ozone-forming-hydrocarbons, hazardous diesel particulate, acid rain-causing sulphur dioxide, lifecycle carbon dioxide.

### Disadvantages of Biodiesel

1. Biodiesel is currently about one and a half times more expensive than petroleum diesel fuel. Part of this cost is because the most common source of oil is the soybean, which only is only 20% oil. However, the costs of biodiesel can be reduced by making biodiesel from recycled cooking oils rather than from new soy beans, or by making it from plant matter with higher oil content.
2. It takes energy to produce biodiesel fuel from soy crops, including the energy of sowing, fertilizing and harvesting.
3. Biodiesel fuel can damage rubber hoses in some engines, particularly in cars built before 1994. You should check with the manufacturer before using biodiesel to see if you need to replace any hoses or rubber seals.
4. Biodiesel cleans the dirt from the engine. This dirt then collects in the fuel filter, which can clog it. Clogging occurs most often when biodiesel is first used after a period of operation with petroleum diesel, so filters should be changed after the first several hours of biodiesel use.

### **Bibliography**

All the information in the project has been gathered from [www.thechemistryguru.com](http://www.thechemistryguru.com).