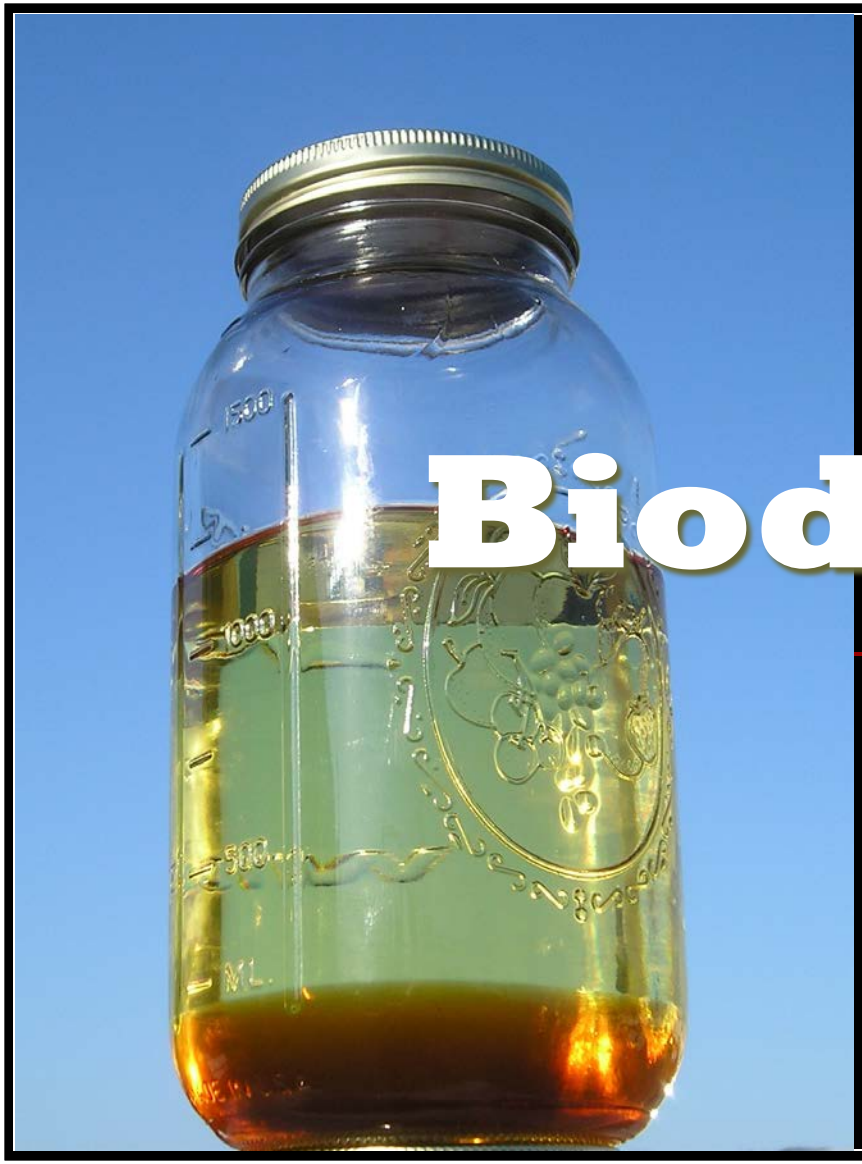


Biodiesel

A Renewable Fuel

What is Biodiesel?

- Biodiesel consists of alkyl-esters derived from a biological source.
- Biodiesel can be used as a diesel fuel in any existing diesel engine.
- Can be blended with petroleum diesel in any ratio.

What is Biodiesel?

- Vegetable oils, such as soy, rapeseed, and palm, are the most commonly transesterified commercial oils.
- Almost any oil can be converted; hydrogenated oils and animal fats do not work efficiently in cold weather.
- Oil from algae grown on waste water is a highly sustainable possibility.

Why Biodiesel?

- IT'S RENEWABLE!

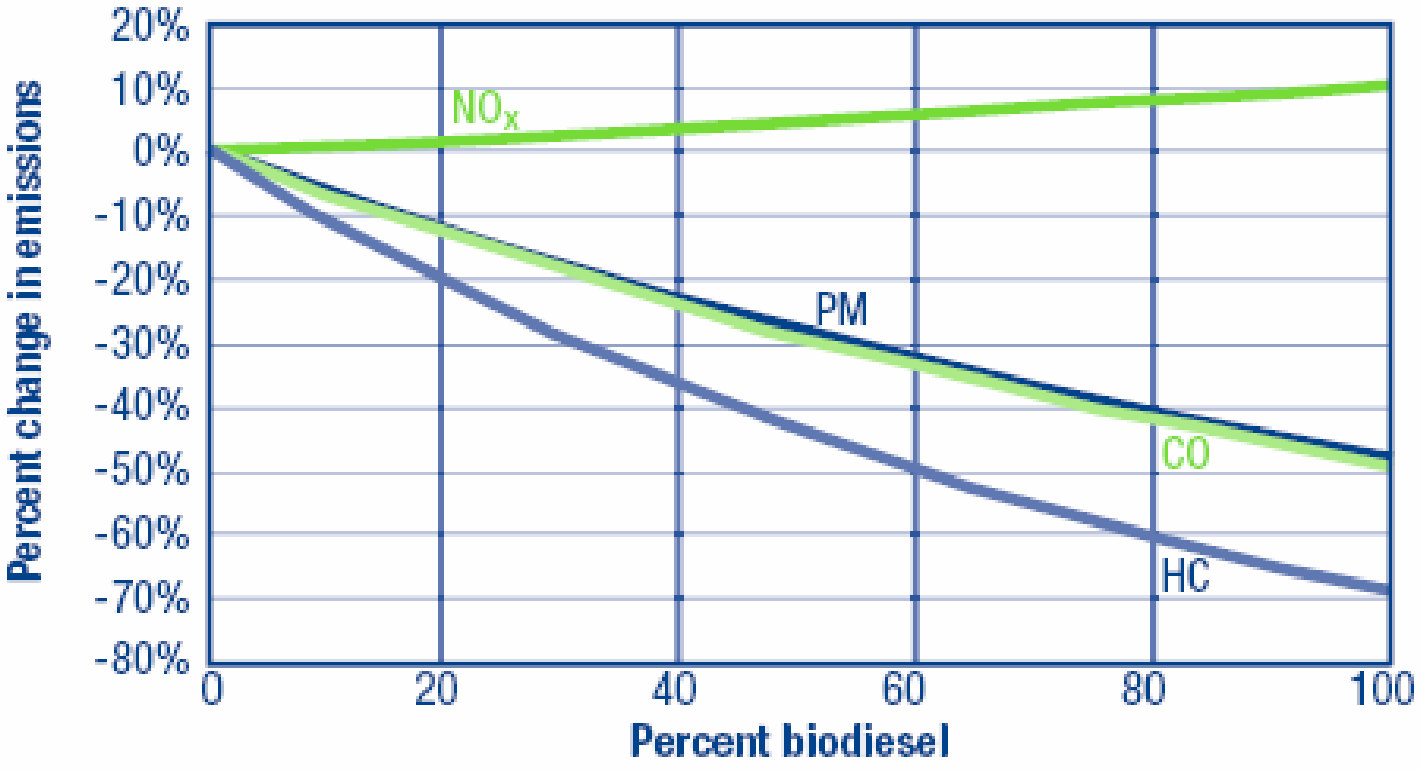
Why Biodiesel?

- Reduced air pollution
  - Sulfur emissions are essentially eliminated
  - EPA Criteria pollutants are reduced (unburned hydrocarbons, carbon monoxide, and particulate matter)
  - The Nitrogen oxides (NOx) issue

Effects on Air Quality

- Reduces health risks associated with petroleum diesel: 75-85% reduction of polycyclic aromatic hydrocarbons (PAH) and 90% reduction of nitrated polycyclic aromatic hydrocarbons (nPAH).
- These have been identified as potential carcinogens

Biodiesel Vs Petroleum



Basic Emission Correlation. Average emission impacts of biodiesel for heavy-duty highway engines. Source: U.S. EPA[2].

Source : EPA Emissions Evaluation for the National Biodiesel Board

AVERAGE BIODIESEL EMISSIONS COMPARED TO CONVENTIONAL DIESEL, ACCORDING TO EPA

Emission Type	B100	B20
Regulated		
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
Nox	+10%	+2% to -2%
Non-Regulated		
Sulfates	-100%	-20%*
PAH (Polycyclic Aromatic Hydrocarbons)**	-80%	-13%
nPAH (nitrated PAH's)**	-90%	-50%***
Ozone potential of speciated HC	-50%	-10%

*** Estimated from B100 result**
**** Average reduction across all compounds measured**
***** 2-nitroflourine results were within test method variability**

Source: EPA Emissions Evaluation for the National Biodiesel Board

Why Biodiesel?

- Non-toxic
  - LD50 of 17.4 g/kg
    - ten times less toxic than table salt
  - Less skin irritation than a 4% soap solution
    - very mild irritation
  - Insignificant aquatic toxicity
    - 1000mg/L is lethal to bluegill

The Methanol Issue

- Methanol is required in the production of BD.
- Methanol is a **flammable neurotoxin**
- However, so is gasoline (a quite common fuel)

-similar precautions **must** be used when handling, transporting, or producing methanol:
  - no sparks
  - no smoking
  - proper ventilation
  - proper safety equipment: gloves, goggles, etc.

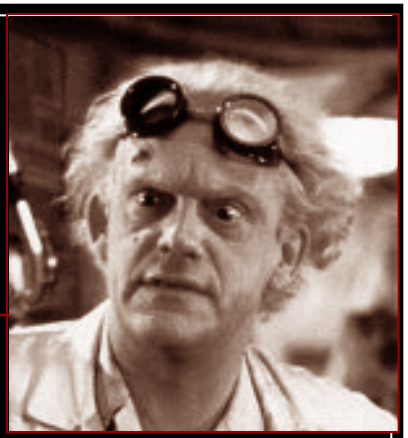
Environmental Benefits

- Biodegradable
  - In fact, Biodiesel degrades at the same rate as Dextrose, a sugar molecule
- Homegrown
  - Can be grown from local high oil yielding crops, lots of botanical potential
    - A chance to get creative in oil crops
  - Possibly even grown on native high oil algae

Some other important considerations

- Fits existing fuel infrastructure
  - Runs in current diesel engines
  - Can be stored at existing petrol stations
  - Can be transported like petroleum diesel
- Higher flashpoint than petroleum diesel
  - Classified as non-flammable by OSHA (150 °C)
  - Safer to handle and transport, safer in accidents
- Provides lubricating properties
  - Reduces engine wear
  - Extends engine life

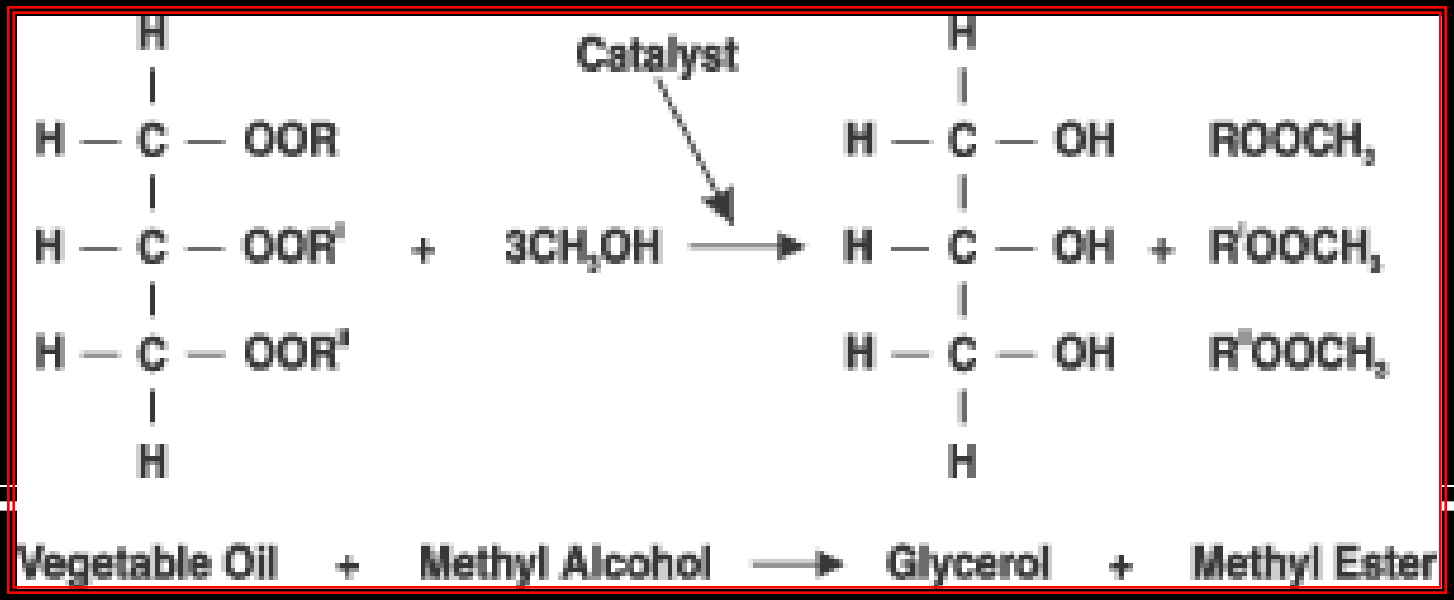
How is Biodiesel Made?



- It is produced by a **TRANSESTERIFICATION** or **ESTERIFICATION** reaction of vegetable (or animal) oils with a low molecular weight alcohol such as methanol or ethanol.
- This reaction is catalyzed by a base, Sodium Hydroxide (NaOH) or Potassium Hydroxide (KOH)

What the Heck is Transesterification?!

- So, Basically you have the reaction:
- Oil + Alcohol = glycerol + Alkyl esters (Biodiesel)
- (It must be catalyzed with a base and heat)
- This is the process of transesterification: **replacing the glycerol portion of the oil with methanol / ethanol**



Making Biodiesel