

# Biodiesel



An outline on Bio-diesel  
production and the  
fundamentals of Handling and  
car conversion.



**Bio Integrated Organics**

For all you contract design and management

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# Introduction to Bio-Diesel.

1. History
2. Production
3. Car Conversion

**History Of Bio-Diesel**

Outlines To Producing

Engine Conversion



# History of Biodiesel.

- Dr. Rudolf Diesel actually invented the diesel engine to run on a myriad of fuels including coal dust suspended in water, heavy mineral oil, and, you guessed it, vegetable oil. Dr. Diesel's first engine experiments were catastrophic failures. But by the time he showed his engine at the World Exhibition in Paris in 1900, his engine was running on 100% peanut oil. Dr. Diesel was visionary. In **1911** he stated "The diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture of the countries which use it." In 1912, Diesel said, **"The use of vegetable oils for engine fuels may seem insignificant today. But such oils may become in course of time as important as petroleum and the coal tar products of the present time."** Since Dr. Diesel's untimely death in 1913, his engine has been modified to run on the polluting petroleum fuel we now know as "diesel." Nevertheless, his ideas on agriculture and his invention provide the foundation for a society fuelled with clean, renewable, locally grown fuel. Today throughout the world country's are returning to using this form of fuel due to its renewable source and reduction in pollution.



*Bio diesel was used before  
Diesel was even thought of*



# Why Use BioDiesel

- **Biodiesel** runs in any conventional, unmodified diesel engine. No engine modifications are necessary to use biodiesel and there is no “engine conversion.” In other words, “you just pour it into the fuel tank.”
- **Biodiesel** can be stored anywhere that petroleum diesel fuel is stored. All diesel fuelling infrastructure including pumps, tanks and transport trucks can use biodiesel without modifications.
- **Biodiesel** reduces Carbon Dioxide emissions, the primary cause of the Greenhouse Effect, by up to 100%. Since biodiesel comes from plants and plants breathe carbon dioxide, there is no net gain in carbon dioxide from using biodiesel.
- **Biodiesel** can be used alone or mixed in any amount with petroleum diesel fuel. A 20% blend of biodiesel with diesel fuel is called “B20,” a 5% blend is called “B5”.
- **Biodiesel** is more lubricating than diesel fuel, it increases the engine life and it can be used to replace sulfur, a lubricating agent that, when burned, produces sulfur dioxide - the primary component in acid rain. Instead of sulfur, all diesel fuel sold in France contains 5% biodiesel.
- **Biodiesel** is safe to handle because it is biodegradable and non-toxic. According to the National Biodiesel Board, “neat biodiesel is as biodegradable as sugar and less toxic than salt.”
- **Biodiesel** is safe to transport. Biodiesel has a high flash point, or ignition temperature, of about 300 deg. F compared to petroleum diesel fuel, which has a flash point of 125 deg. F.
- Engines running on biodiesel run normally and have similar fuel mileage to engines running on diesel fuel. Auto ignition, fuel consumption, power output, and engine torque are relatively unaffected by biodiesel.

**Biodiesel** has a pleasant aroma similar to popcorn popping in comparison to the all-too-familiar stench of petroleum diesel fuel.



# [ What Is Biodiesel ]

- A clean burning alternative fuel, produced from domestic, renewable resources
- Contains no petroleum, but can be blended at any level with petroleum diesel to create a biodiesel blend
- Can be used in compression-ignition engines with little or no modifications
- Simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics



# [ Why Process ]

- **Raw or refined vegetable oil, or recycled greases that have not been processed into biodiesel, are not biodiesel and should be avoided.** Research shows that vegetable oil or greases used in CI engines at levels as low as 10% to 20%, can cause long-term engine deposits, ring sticking, lube oil gelling, and other maintenance problems and can reduce engine life. These problems are caused mostly by the greater viscosity, or thickness, of the raw oils (around 40 mm<sup>2</sup>/s) compared to that of the diesel fuel for which the engines and injectors were designed (between 1.3 and 4.1 mm<sup>2</sup>/s). To avoid viscosity-related problems, vegetable oils and other feedstocks are converted into biodiesel. Through the process of converting vegetable oil or greases to biodiesel, we reduce viscosity of the fuel to values similar to conventional diesel fuel ( biodiesel values are typically between 4 and 5 mm<sup>2</sup>/s).



# [ Benefits ]

## ***Biodiesel and Human Health***

- Some PM and HC emissions from diesel fuel combustion are toxic or are suspected of causing cancer and other life threatening illnesses. Using B100 can eliminate as much as 90% of these “air toxics.” B20 reduces air toxics by 20% to 40%. The effects of biodiesel on air toxics are supported by numerous studies, starting with the former Bureau of Mines Center for Diesel Research at the University of Minnesota. The Department of Energy (DOE) conducted similar research through the University of Idaho, Southwest Research Institute, and the Montana Department of Environmental Quality. The National Biodiesel Board conducted Tier I and Tier II Health Effects Studies that also support these claims.
- Recently, the Department of Labor’s Mining Safety Health Administration (MSHA) tested and approved the use of biodiesel in underground mining equipment where workers are exposed to high levels of diesel exhaust.<sup>5</sup> Switching to biodiesel blends is believed to reduce the risk of illness and life-threatening diseases in miners.



# [ Benefit 2 ]

## ***Biodiesel Improves Lubricity***

- By 2006, all U.S. highway diesel will contain less than 15 ppm sulfur—ultra low sulfur diesel fuel (ULSD). Currently highway diesel contains 500 ppm sulfur (or less). Biodiesel typically contains less than 15 parts per million (ppm) sulfur (sometimes as low as zero). Some biodiesel produced today may exceed 15 ppm sulfur, and those producers will be required to reduce those levels by 2006 if the biodiesel is sold into on-road markets.
- In the on-road market, low-level blends of biodiesel such as 1% or 2% can improve lubricity of diesel fuels and this may be particularly important for ULSD as these fuels can have poor lubricating properties. Engine manufacturers depend on lubricity to keep moving parts, especially fuel pumps, from wearing prematurely. Even 2% biodiesel can restore adequate lubricity to dry fuels such as kerosene or Fischer-Tropsch diesel.





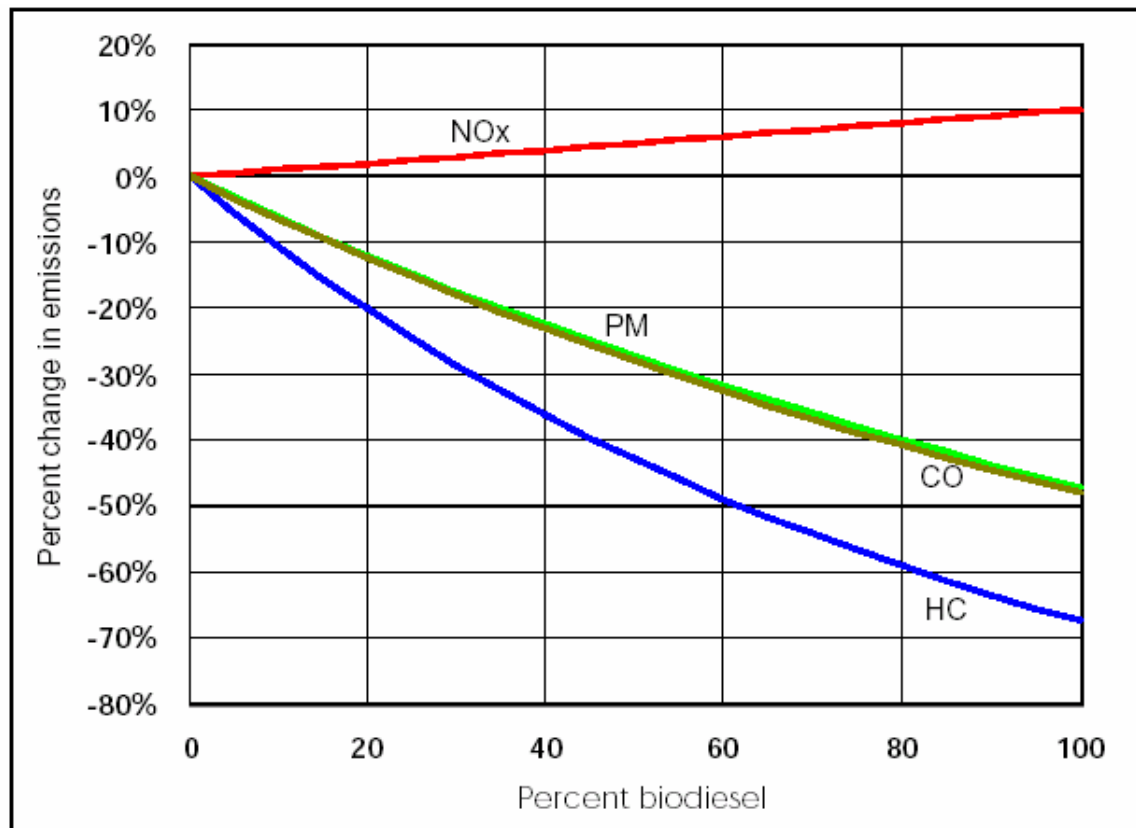
# [ Benefit 3 ]

## ***Biodiesel Reduces Emissions***

- When biodiesel displaces petroleum, it reduces global warming gas emissions such as carbon dioxide (CO<sub>2</sub>). When plants like soybeans grow they take CO<sub>2</sub> from the air to make the stems, roots, leaves, and seeds (soybeans). After the oil is extracted from the soybeans, it is converted into biodiesel and when burned produces CO<sub>2</sub> and other emissions, which return to the atmosphere. This cycle does not add to the net CO<sub>2</sub> concentration in the air because the next soybean crop will reuse the CO<sub>2</sub> in order to grow.
- When fossil fuels are burned, however, 100% of the CO<sub>2</sub> released adds to the CO<sub>2</sub> concentration levels in the air. Because fossil fuels are used to produce biodiesel, the recycling of CO<sub>2</sub> with biodiesel is not 100%, but substituting biodiesel for petroleum diesel reduces life-cycle CO<sub>2</sub> emissions by 78%. B20 reduces CO<sub>2</sub> by 15.66%.<sup>3</sup>
- Biodiesel reduces tailpipe particulate matter (PM), hydrocarbon (HC), and carbon monoxide (CO) emissions from most modern four-stroke CI engines. These benefits occur because the fuel (B100) contains 11% oxygen by weight. The presence of fuel oxygen allows the fuel to burn more completely, so fewer unburned fuel emissions result. This same phenomenon reduces air toxics, because the air toxics are associated with the unburned or partially burned HC and PM emissions. Testing has shown that PM, HC, and CO reductions are independent of the feedstock used to make biodiesel. The EPA reviewed 80 biodiesel emission tests on CI engines and has concluded that the benefits are real and predictable over a wide range of biodiesel blends



# Figure 1. Average emission impacts of biodiesel fuels



# Drawbacks of Bio-diesel?

## Drawbacks of Biodiesel Use

- Biodiesel contains 8% less energy per gallon than typical No. 2 diesel in the United States; 12.5% less energy per pound. The difference between these two measurements is caused by the fact that biodiesel is slightly more dense than diesel fuel, so there are slightly more pounds in a gallon of fuel. All biodiesel, regardless of its feedstock, provides about the same amount of energy.
- The difference in energy content can be noticeable if you are using B100. If you are using B20, the difference in power, torque, and fuel economy should be between 1% and 2%, depending on the diesel with which you are blending. Most users report little difference between B20 and No. 2 diesel fuel. As the biodiesel blend level is lowered, any differences in energy content become diminished and blends of B5 or less do not cause noticeable differences in performance compared to diesel. A further drawback to biodiesel use is its less favorable cold flow properties compared to conventional diesel. The cold flow properties of biodiesel and conventional petrodiesel are extremely important. Unlike gasoline, petrodiesel and biodiesel can both start to freeze or gel as the temperature gets colder. If the fuel begins to gel, it can clog filters or eventually it can become thick enough that it cannot even be pumped from the fuel tank to the engine.





History Of Bio-Diesel

**Outlines To Producing**

Engine Conversion



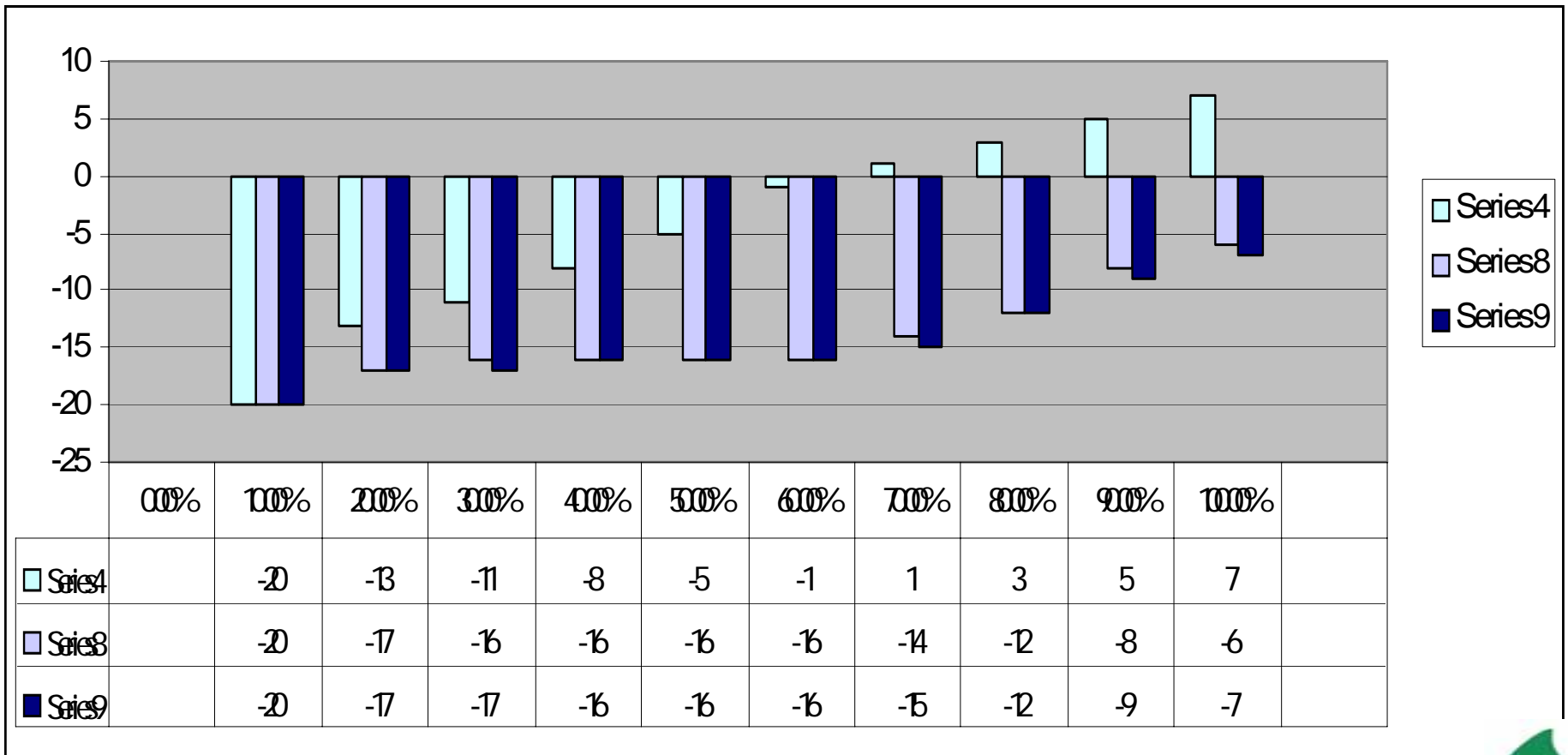
# What is Biodiesel Made From

Feedstock's	Source of biodiesel fuel from plants or animals
Oil Palm	<ul style="list-style-type: none"> <li>■ African palm</li> <li>• Palm oil and palm kernel oil</li> <li>• Extracted from fleshy outside</li> </ul>
Coconut	<ul style="list-style-type: none"> <li>■ South America and tropical areas</li> <li>• Coconut meat is peeled from the husk, dried in the sun, and pressed</li> </ul>
Jatropha	<ul style="list-style-type: none"> <li>■ Americas</li> <li>• A bush that produces a seed</li> <li>• Seed is crushed for oil</li> </ul>
Rapeseed/ Canola	<ul style="list-style-type: none"> <li>■ Canada, Germany, Russia – colder regions</li> <li>• Yellow flowering oil crop</li> </ul>
Peanut	<ul style="list-style-type: none"> <li>■ South America – warm</li> <li>• Sandy soil</li> </ul>
Sunflower	<ul style="list-style-type: none"> <li>■ North America</li> <li>• Squeezed from seeds</li> </ul>
Safflower	<ul style="list-style-type: none"> <li>■ India, Egypt, and Persia</li> <li>• Thistle-like plant</li> <li>• Yellow/orange flower</li> </ul>
Soybean	<ul style="list-style-type: none"> <li>■ East Asia and USA</li> <li>• High protein bean</li> </ul>
Hemp	<ul style="list-style-type: none"> <li>■ Russia, China, and Asia</li> <li>• Illegal to grow in USA</li> </ul>
Corn	<ul style="list-style-type: none"> <li>■ Americas</li> <li>• Use the oil and grain for food</li> </ul>
Algae	<ul style="list-style-type: none"> <li>■ NREL have cultivated algae to produce oil</li> <li>• Could provide enough oil to meet all of the diesel fuel needs of the US</li> </ul>





# What Product works best



# [ Common Oils ]

■ Test Method	Cloud Point		Pour Point		Cold Filter Plug Point	
	oF	oC	oF	oC	oF	oC
■ B100 Fuel						
■ Soy Methyl Ester	38	3	25	-4	28	-2
■ Canola Methyl Ester	26	-3	25	-6	24	-6
■ Lard Methyl Ester	56	13	55	13	52	11
■ Edible Tallow	66	19	60	16	58	14
■ Inedible Tallow	61	16	59	15	50	10
■ Yellow Grease 1	--	48	9	52	11	
■ Yellow Grease 2	46	8	43	6	34	1



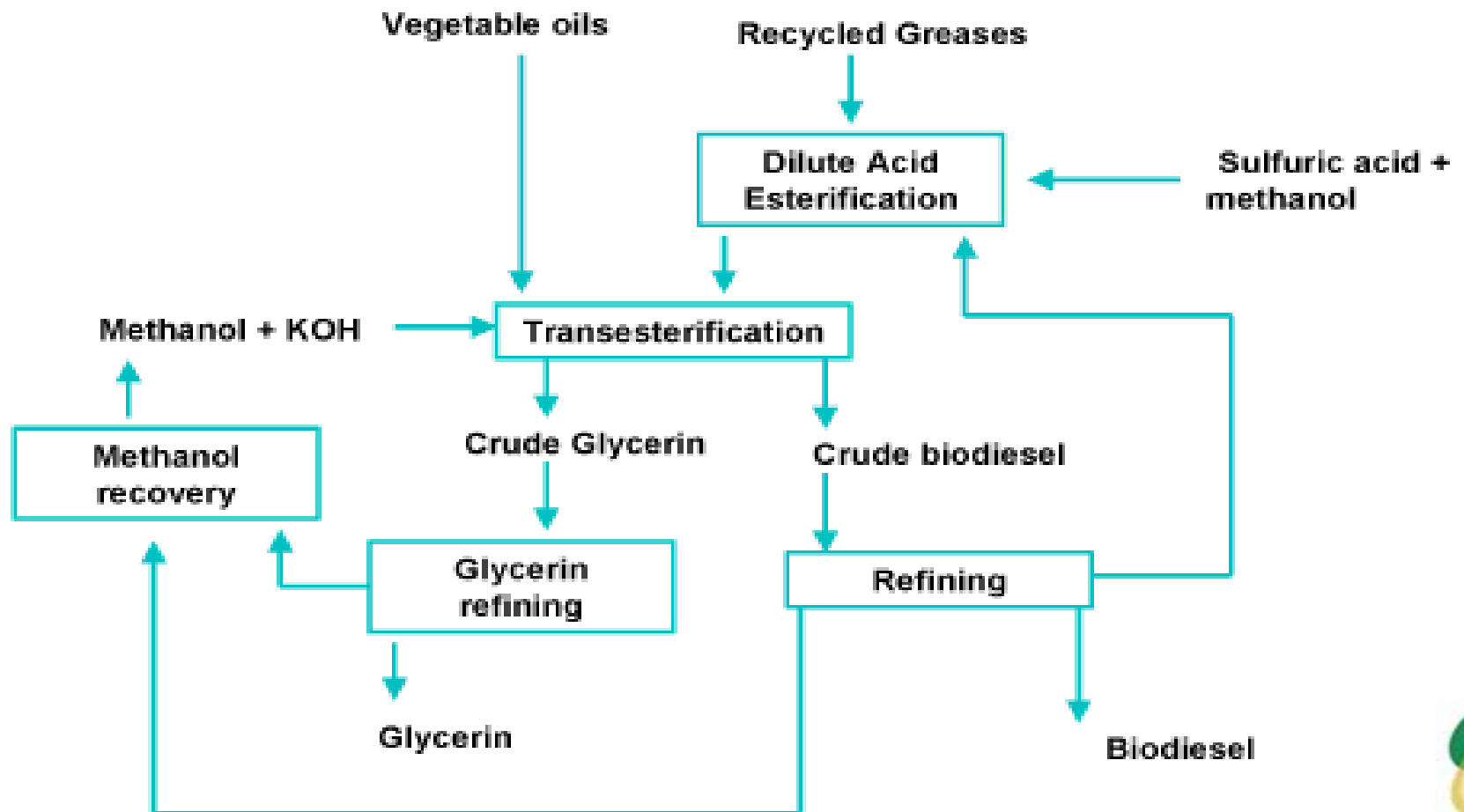
# [ How is Biodiesel Made? ]

- The process of Biodiesel in principle is very simple, however the biggest issue with Bio production is the quality.





# Basic Technology

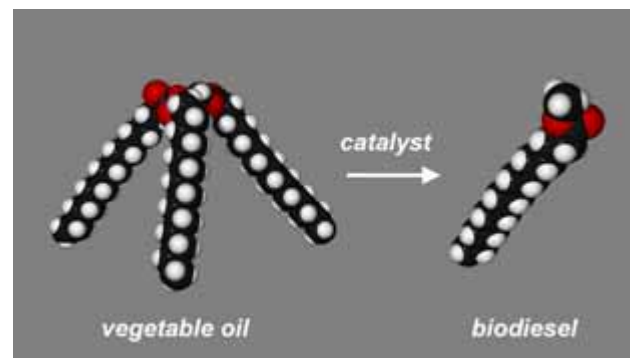


# [Transformation]



- Triglyceride
- 3 Fatty acids (methyl esters)
- 1 Glycerol

- Transformation of one ester into another type of ester
- In vegetable oil, we remove the glycerin and replace it with an alcohol group from methanol
- Requires a catalyst to start the reaction



# [ Equipment Can be Simple ]

Recent Installation in Southwold

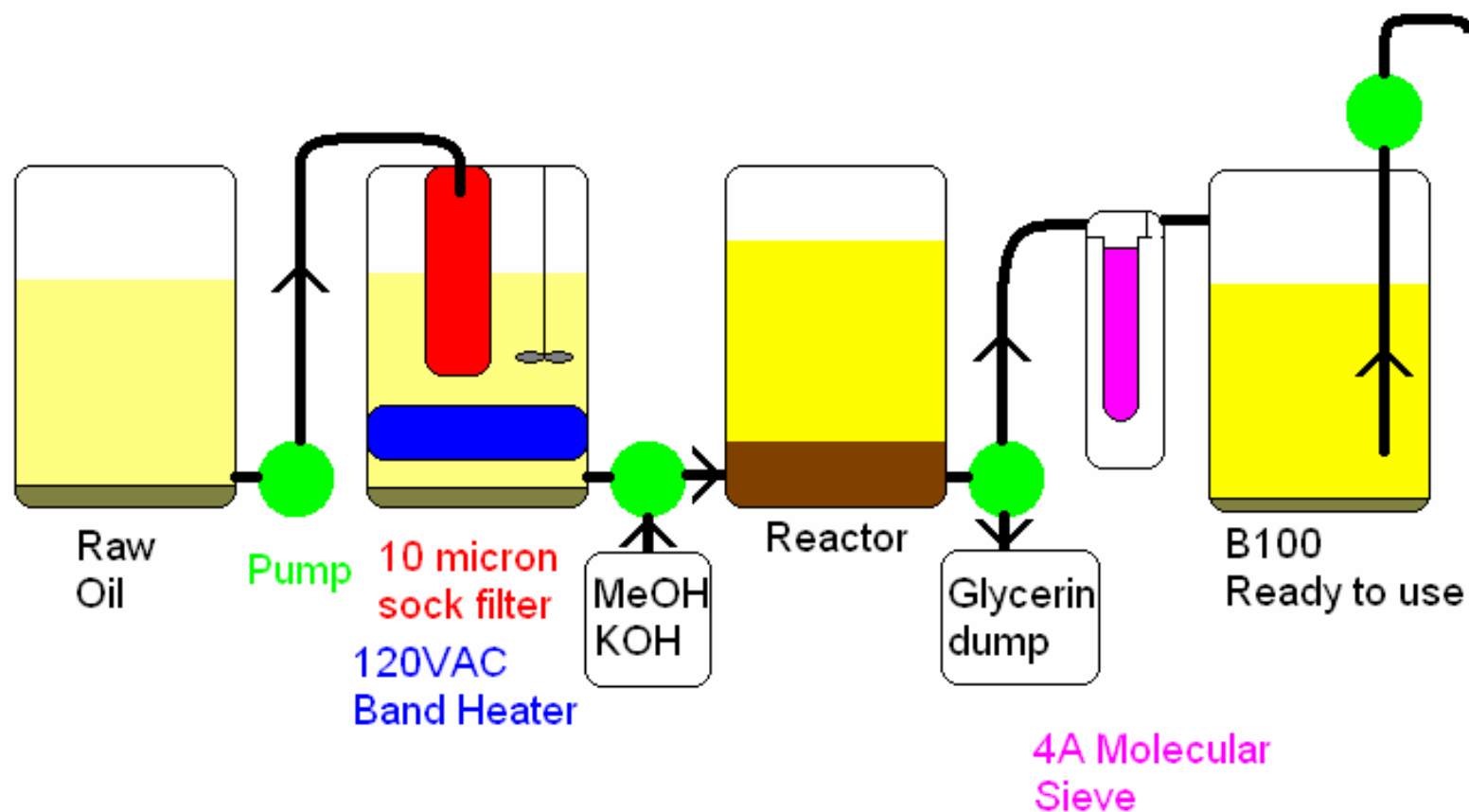


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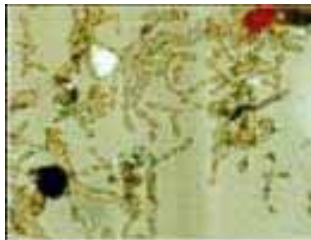
Domestic Hot water Cylinder



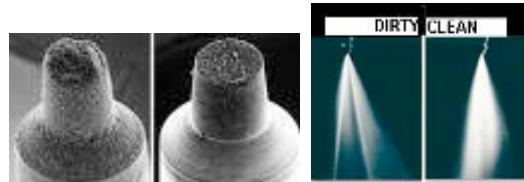
# [ Simple Process ]



# If you don't clean and dry bio-diesel what can happen?



**Bacteria Growth**



**Clogged Injectors**



**Oil degradation/leakages**



**Failed Seals**



**Damaged  
Fuel Pumps**



**Blocked Filters**



# [ What Damage Can Be Done!! ]

**Methyl esters are not classified as bio-diesel until the proper specifications are met.**

- **If you don't clean and dry bio-diesel what can happen?**
- • Corrosion of fuel injectors (water, catalyst)
- • Elastomeric seal failures (methanol)
- • Fuel injector blockages (glycerine, soaps etc)
- • Increased degradation of engine oil
- • Pump seizures due to high viscosity at low temperatures
- • Corrosion of fuel tanks (excess water, catalyst)
- • Bacterial growths and clogging of fuel lines/filters

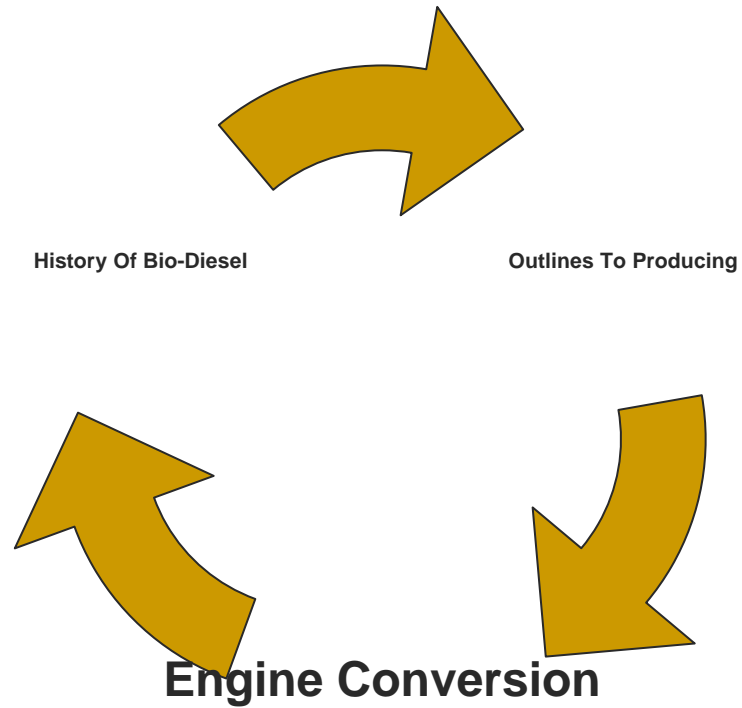


# [ Stages Of Production ]



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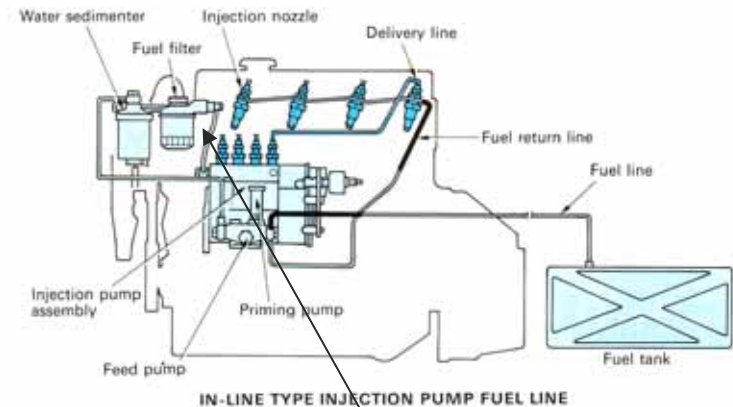
## ■ **User Guides for Blends of B6 through B20:**

- Check your engine oil level daily.
- Use B6 through B20 only if the outside temperature is greater than 16 degrees F (-9 degrees C).
- Clean up biodiesel spills immediately to avoid paint damage.
- Avoid storing equipment more than three months with biodiesel in the fuel system, due to potential stability problems with biodiesel.
- If necessary, run the engine on pure diesel fuel for 20 to 30 minutes to flush the biodiesel out of the system.
- Avoid storing biodiesel in on-site fuel tanks for longer than 3 months.
- The oil and filter change interval for electronic NEF and Cursor engines using a high pressure common rail fuel system is reduced to 300 hours.



# [ 20% blends. ]

- Bio-diesel is a good solvent, It may dissolve sediments in the fuel tank and lines.
- Tank and fuel lines should be cleaned. At worst an inline filter should be fitted in an
- area that is easy to get access to.



# Can We Run On higher Blends?

- So What Happens when the Temperature Drops?
- National Parks in America Use 100% during winter months.
- Two factors have to be taken in to account. 1) Fuel Quality 2) Engine Conversion.



# [

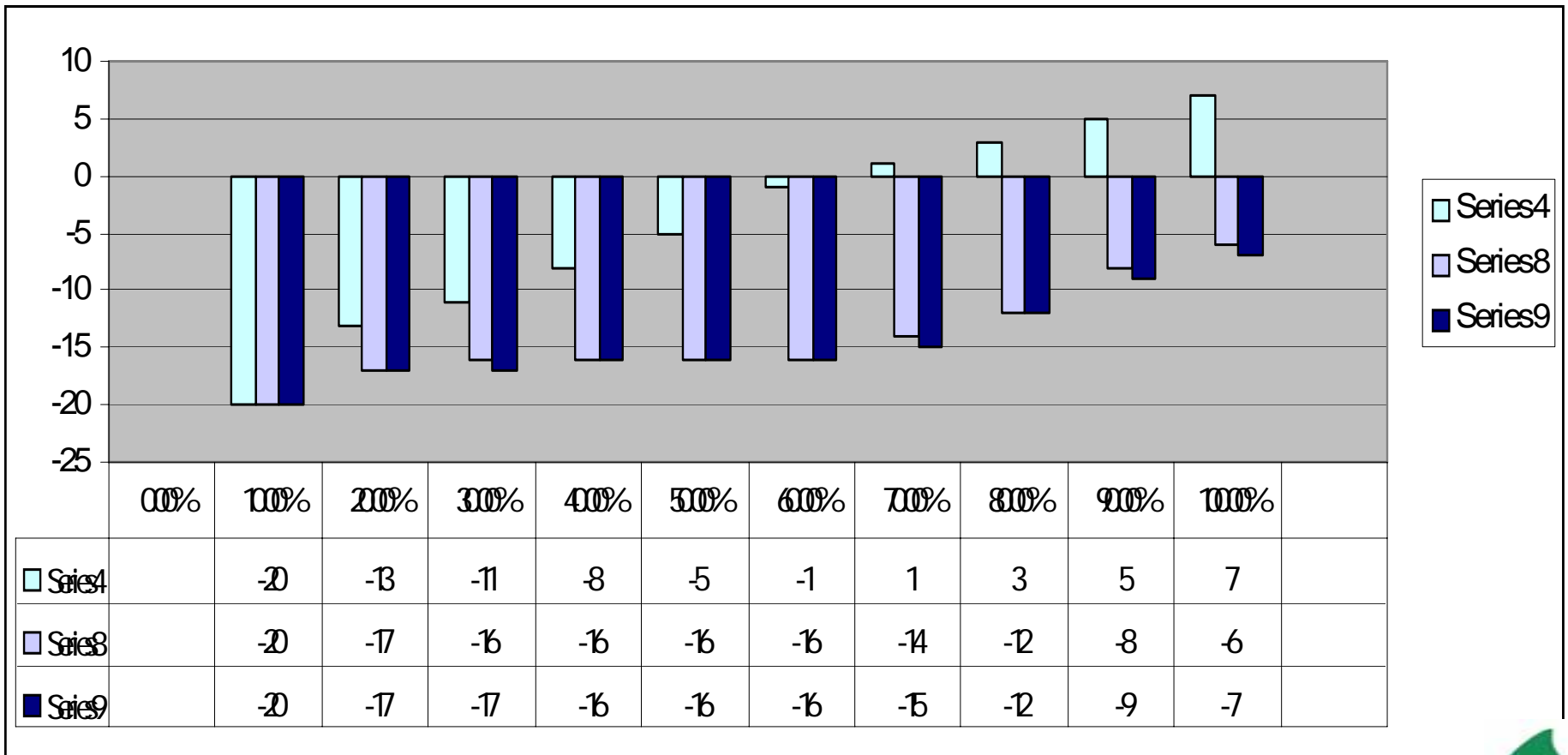
## User Guides for Biodiesel Blends Greater than B20:

- Use greater than B20 blends only if the outside temperature is greater than 41 degrees F (5 degrees C).
- Keep biodiesel storage tanks protected from direct sunlight or frost.
- The use of blends of 20% biodiesel (B20) or more requires greater attention to fuel quality and handling, additional vehicle maintenance and service, and in some cases an update kit is necessary to make your machine greater than B20 compatible.
- **Engine Performance and Durability of B100 and High Biodiesel Blends**
- Low temperature viscosity of biodiesel is higher than viscosity of diesel fuel and some flow impairment may occur in fuel filter and lines.
- Elastomers and various seal materials may harden or swell. Sealing materials must be monitored when using biodiesel blends, especially in older engines.
- with higher biodiesel blends is inferior to that of conventional diesel fuel. This may lead to corrosion of engine fuel supply and fuel injection hardware. Furthermore, water may combine with biodiesel Fatty Acid Methyl Esters (FAME) to create acids that greatly accelerate corrosion.
- The use of higher biodiesel blends may reduce the engine oil service life and drain interval. Oil sampling and analysis may be used to determine the effect on engine oil service life.





# What Product works best

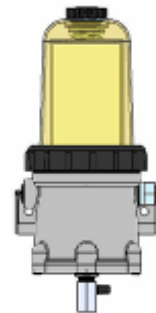


# Vehicle conversion for 30%+blends

Running during winter with blends over 30%

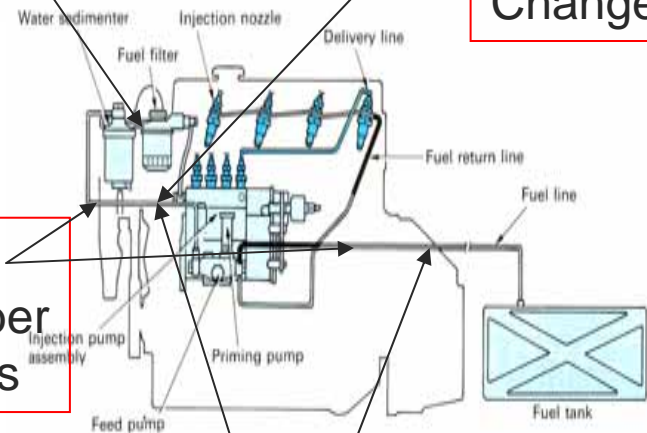
- Replace any rubber fuel lines
- Replace Fuel pump if it has rubber seals
- Replace Fuel filter for a heated one
- Install a heated fuel line
- Don't forget the standard inline filter

Heated Fuel Filter



Inline quick Change filter

Replace Any rubber Fuel lines



Fuel line Heaters

