

Your Reliable Guide for Power Solutions

To fulfill our commitment to be the leading supplier in the power generation industry, the Total Energy Systems, LLC. team ensures they are always up-to-date with the current power industry standards as well as industry trends. As a service, our **Information Sheets** are circulated on a regular basis to existing and potential power customers to maintain their awareness of changes and developments in standards, codes and technology within the power industry.

Biodiesel for Diesel Generators Sets

1.0 Introduction

Biodiesel has been considered as an alternative fuel to petroleum-based diesel for several years. World biodiesel production has increased rapidly with an average annual growth rate of 40%. Increases in the price of crude oil are forecast to accelerate production.

This information sheet discusses the use of biodiesel for diesel generator systems and details what biodiesel is, availability, blends and the advantages and disadvantages as an alternative to traditional diesel.

2.0 Definition of Biodiesel

Biodiesel is a non-petroleum-based diesel fuel consisting of short chain esters (methyl or ethyl) which are made by the transesterification of vegetable oil or animal fat. This can be used either alone, or blended with conventional petroleum diesel in most unmodified diesel engines. Therefore it is a domestically produced, renewable fuel. *(See diagrams one and two below detailing transesterification)*

Biodiesel use and consumption has been increasing in the USA since the passage of the 2005 Energy Policy Act. The additional cost over regular No. 2 diesel, it is expected to diminish as increased production results in economies of scale.

3.0 Sources

A variety of oils can be used to produce biodiesel. All of the sources detailed below are available domestically and will reduce our dependence of imported oil. In addition to lowering imports, biofuels are a renewable energy source. Oil sources for biodiesel are:

Virgin feedstock - rapeseed and soy bean oils are most common (soybean oil accounts for some 80 to 90% of fuel stocks in the USA), while it can also be obtained from crops such as mustard, flax, sunflower, palm oil and hemp

Waste vegetable oils - Such as canola oil (limited availability)

Animal fats - including tallow, lard, yellow grease, chicken fat and the by-products of Omega-3 fatty acids fish oil production. Availability is limited without large scale recycling and collection of this oil source.

Algae - can be grown using waste materials such as sewage without displacing land currently used for food production. Scientists believe that while algae fuel yields have not yet been determined, the Department of Energy has reported that it has potential to produce 30 times more energy per acre than land crops such as soy beans. The future looks bright with further development in this process.

4.0 Standard for biodiesel

Any biodiesel fuel must comply with the American Society for Testing and Materials (ASTM) D-6751 standard, applicable for blends up to B20. Most diesel engine manufacturers will not void their standard warranty for engines using B20 fuel. *(See chart three)*

5.0 Advantages

While the main advantage for adopting biodiesel has been promoted as energy security by switching to a domestically produced renewable energy source, there are other reasons a generator set user should consider using biodiesel as detailed below:

Lower exhaust emissions - Biodiesel due to their chemical composition produce lower exhaust emissions than diesel distilled from petroleum. Exhaust emissions and subsequent pollution fall due to a reduction in the sulfur levels.

Regulations are already in place through 2010 to adopt ultra-low sulfur in traditional petroleum based diesel.

In addition to lower sulfur, diesels running on biodiesel (B100) have substantially lower unburned hydrocarbons, and carbon monoxide. Particulate matter is reduced for engines running on a 20/80 mixture (B20).

Generator systems users in areas where there are very strict emission controls may wish to consider the adoption of biodiesel. Petroleum based diesel has received a close look by bodies responsible for regulating emissions levels due to higher levels of particulates in the exhaust. *(See chart four for emission data)*

Improved lubrication ability - With the introduction of ultra-low sulfur fuel in 2010 some older engine fuel injection systems may be subject to increased wear due to the lower lubricating properties of ultra-low fuel distilled out of petroleum. The increased lubricating properties of biodiesel (even with small amounts of blending) will reduce wear of fuel injection equipment and extend the life of the engine. *(continued over)*

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Highest BTU - Biodiesel fuel has the highest BTU value of any alternative fuel, falling between the range of No. 1 and No. 2 diesel fuel. There is no noticeable reduction in performance with the use of B20.

6.0 Disadvantages

The disadvantages of biodiesel, as detailed below, largely parallel those of petroleum diesel:

Cold weather - B20 biodiesel will tend to gel in very cold temperatures, as does No. 2 diesel fuel. This can be countered by using the same management treatment as #2. Lower fuel blends like B2 and B5 have virtually no impact.

Operation on older diesel models - Biodiesel is not entirely suitable for older diesel engines, if using blends higher than B20, impacting fuel system components. Primarily the issue is biodiesel over B20 (20% biodiesel blend) degrading natural rubber compounds (fuel hoses) and fuel pump seals.

Long term storage - Currently it is recommended be used within six months. After that period, it should be reanalyzed to ensure it still meets ASTM D-6751 specifications. There are additives available that can extend storage life.

Fuel Filters - Biodiesel can have a cleansing effect on glazed surfaces. When using biodiesel for the first time, the fuel filter should be checked for particles that the biodiesel as cleansed from fuel injection surfaces.

7.0 Useful source of information

The National Biodiesel Board (NBB) - which represents the biodiesel industry in the United States can be viewed on the following site:

www.biodiesel.org

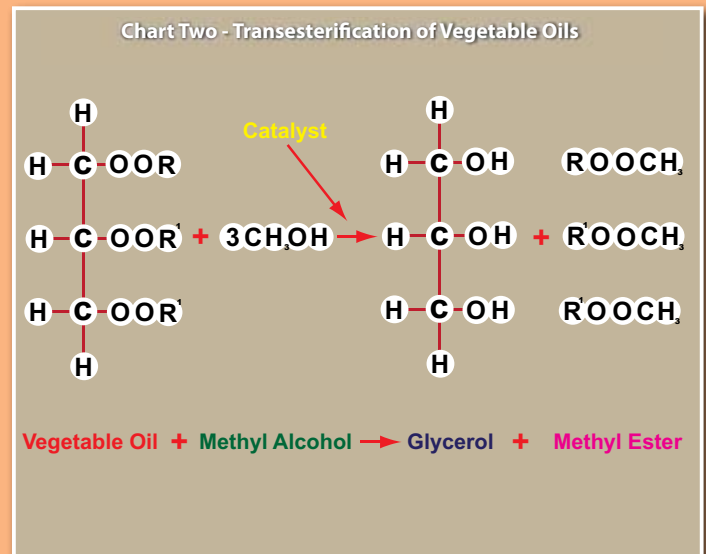
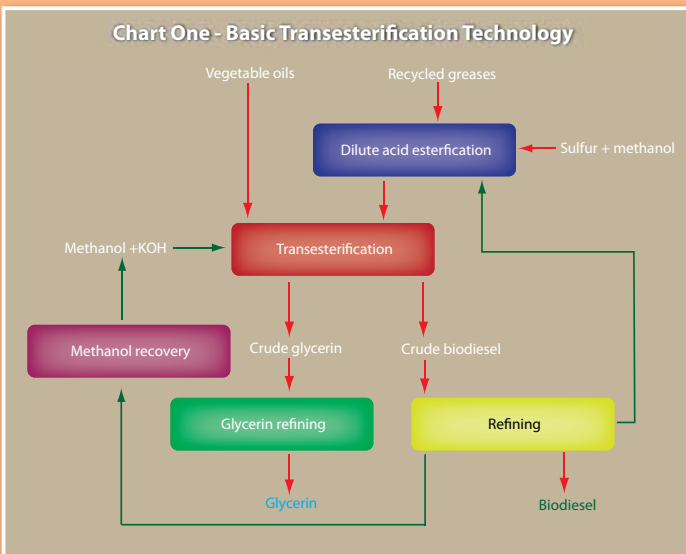


Chart Three - BIODIESEL FUEL PROPERTIES

Fuel Type	Fuel Weight lbs/gal	Heat of Combustion BTU/gal	Cetane Number	Viscosity Centistokes
Number 2 Diesel	7.05	140,000	48	3.0
100% Biodiesel (B100) Methyl or ethyl ester	7.3	130,000	55	5.7
B20 mix (20/80)	7.1	138,000	50	3.3
Raw Vegetable Oil	7.5	130,000	35 to 45	40 to 50

Chart Four - ENGINE EMISSION RESULTS from the UNIVERSITY of IDAHO

Emission Component	100% Ester Fuel (B100)	20/80 Mix (B20)
Hydrocarbons	- 52.4%	-19.0%
Carbon Monoxide	- 47.6%	- 26.1%
Nitrous Oxides	- 10.0%	- 3.7%
Carbon Dioxide	+ 0.9%	+ 0.7%
Particulates	+ 9.9%	- 2.8%

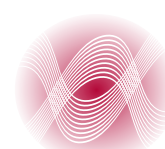


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