

DAEAC Bulletin #2

USING VEGETABLE OIL AS FUEL

The use of vegetable oils for engine fuels may seem insignificant today, but such oils may become in the course of time as important as petroleum and the coal tar products of the present time.

Rudolf Diesel, Patent application, 1912

Many people today have begun using vegetable oil as fuel. This can be done with any diesel engine. The German engineer for whom this type of engine is named originally developed this engine to be powered by vegetable oil with the idea in mind that this would be a readily available, economical fuel which would also enhance European agricultural development.

Today, worldwide, as well as in the US, diesel engines are found in a wide spectrum of uses from private automobiles to ships and trains to electricity generation. Because the petroleum industry, at one time in the past, was able to produce an abundant and inexpensive, petroleum based fuel, the vast majority of diesel engines still run on petroleum diesel. But any of these engines can run on vegetable-based alternatives, either straight vegetable oil or biodiesel. Increasingly, particularly in Europe, this is the case. With petrodiesel becoming more expensive and supplies reaching their limits, it makes sense to begin the change over to renewable, carbon neutral fuel sources.

Many people are concerned about the use of agricultural products, particularly corn, for the production of fuel. This is a valid concern. The use of corn to produce ethanol, a gasoline substitute, has already driven up the price of corn, inflating the price of any food products connected with it. But corn is one of the poorer sources of oil for the production of biofuel. Properly managed, oil production from vegetable products would have little affect on food production. In Europe today, significant amounts of biodiesel are being produced from rapeseed or canola oil. This is a product that has an oil yield many times higher than corn. Ultimately, by far the most efficient plant product that could be used is algae, the production of which could also aid in sewage treatment and has no competitive influence on food products. To jump start biodiesel production, however, the most readily available source of a feedstock is waste vegetable oil (WVO) from restaurants. It has

been estimated that WVO could replace 5% of the country's diesel fuel currently being used.

Producing a diesel substitute fuel from vegetable oil, either new oil or WVO, is much easier and less energy intensive than the production of ethanol as a gasoline substitute. Diesel engines and fuel have other advantages as well. Diesel is much safer. Biodiesel has a much higher flash point and thus has a much lower risk of fire or explosion than petro diesel. But even conventional diesel fuel is much safer than gasoline, which must be one of the most dangerous, and volatile substances in common use today. Biodiesel is much less of a polluter than petro diesel producing fewer particulates, hydrocarbons and most other pollutants. In a recent, peer-reviewed study in *Science*, it was estimated that an additional 60,000 annual deaths from heart disease and lung ailments occur nationwide due to air pollution. This likely is due, in large part, to a group of chemicals in petroleum called polycyclic aromatic hydrocarbons, substances not found in biodiesel.

Biodiesel is also much less of a concern with regard to spills both because it can be produced by smaller, local plants eliminating the need for high volume, long distance shipping and because it is a vegetable product and is much more easily degraded. Biodiesel is also a better lubricant than petro diesel. Lubricity is important in diesel fuel because injection pumps require this lubrication. And diesel engines, in general, are more efficient than gasoline engines. Though testing varies, the highest mileage cars on the road today are probably **not** gasoline hybrids but modern, high efficiency, direct injection diesels which are also warranted by the manufacturers to run on biodiesel.

There are two ways that vegetable oil can be used in a diesel engine. Either the oil can be used as straight vegetable oil or it can be modified to be made into biodiesel. Either method can be undertaken by private individuals for personal, home use.

RUNNING A CAR ON STRAIGHT VEGETABLE OIL

Once again, any diesel engine can run on vegetable oil but straight vegetable oil is more viscous than diesel fuel (either petro diesel or biodiesel) so something must be done to make the oil flow more easily. Regarding the use of WVO, recent changes in public awareness of the health benefits of eliminating trans fats have made this easier. The oil used by most restaurants

today is pure vegetable oil with no trans fats and does not solidify even at fairly low temperatures. This makes the product easier to handle and, many engines will run on this fuel with very limited modifications.

Generally the approach is to install a duplicate fuel system in the car that provides for heating the fuel. This would include a duplicate tank with a heating element, duplicate fuel lines that are also heated and valves to switch from diesel fuel to vegetable oil. The operating procedure is to start the engine on conventional fuel (either petro or biodiesel) and run the engine until it and the vegetable oil are warmed enough to switch over to straight vegetable oil. Before the engine is shut down (unless only for a short time) the fuel must be switched back to diesel to avoid leaving straight vegetable oil in the lines when the fuel cools down. How long the warm up is will vary depending on ambient temperature, quality of oil and the ability of the engine type to accept a more viscous fuel. In warmer weather, some engines can be started, run and shut down without ever shifting over to conventional diesel fuel.

Another important consideration with the use of WVO is making sure that the oil is clean. Diesel engines are generally susceptible to breakdowns due to impurities in the fuel. This usually results only in filter clogging but if particles are allowed to get past filters into injection pumps, very expensive breakdowns can result. For this reason careful pre-filtering of WVO is required and WVO fuel systems usually include an in line pre-filter in addition to the usual manufacturers filters already in the car.

Vegetable oil fuel systems can be installed either by purchasing all-inclusive kits or by fabricating a self designed system usually from off the shelf components. Prices can go up to two or three thousand dollars depending on ease of operation and how “idiot proof” the system is. It is now possible to install kits that include small computers that do the fuel switching automatically and all the other thinking to use the system correctly. For those who are more concerned about costs it is possible to do it yourself with the aid of popular manuals and keep the cost down to as little as a couple of hundred dollars.

MAKING BIODIESEL FROM VEGETABLE OIL

Vegetable oil can also be used by modifying it to make biodiesel that can be used in most diesel engines with no modifications to the engine. Although,

for the most part, there are many advantages to biodiesel as noted above, there are two possible drawbacks. Depending on the quality of the biodiesel, it is possible that it will begin to gel at a higher temperature than petro diesel. In very cold conditions this can be a problem with any diesel fuel. Petro diesel for winter use usually has a gel inhibitor added and the same can be done with biodiesel. Moreover, with better quality feedstock such as pure vegetable oil with no trans fats, the resulting biodiesel will be less problematic. Biodiesel is also a solvent and can create problems with rubber hoses and seals. This is mostly a problem with older engines and, in the case of hoses, can be remedied by replacing hoses with Viton or a similar synthetic. Engines produced in the last ten years are likely to already have this type of material in use and thus do not present a problem.

Biodiesel is slowly becoming more widely available and it is possible to find a local source to purchase and use this fuel like any other, but it is also possible to produce biodiesel in a home shop by a fairly simple chemical process. Again, new oil can be used or WVO which can be obtained, usually without cost, from most restaurants.

In producing biodiesel there are some important safety precautions to consider. The process requires the use of methanol which is an extremely volatile and flammable substance. (Ethanol can also be used but does not work as well.) Methanol is an alcohol fuel used in racing. Extreme caution must be exercised when handling and storing methanol. Also, a small amount of lye, either sodium hydroxide or potassium hydroxide, is needed. Some people are familiar with lye for soap making or as a drain cleaner and know that, it too, should be handled with extreme caution.

The actual process is not complicated but requires a dedicated space and some bulky equipment. The processor can either be self-made from simple components that may cost a few hundred dollars or it can be a self-contained, unitized processor purchased for a few thousand dollars. These units can be found on the Internet or even through mail order tool catalogs.

The unitized processors require only adding the required ingredients – oil, methanol and lye and pushing a button to start the process. With self made processors, there will first be mixing of the methanol and lye to make methoxide and then adding that to the oil. After sufficient mixing the whole is allowed to settle for some hours and glycerin will collect at the bottom. This is a biodegradable byproduct that can be drained off leaving the

biodiesel. When using WVO, it should be possible to produce this fuel for about a quarter of the price of diesel fuel.

This is just a brief overview of this process. Actually doing it will require more detailed instructions that can be found in any number of widely available manuals. There are several of these available at local libraries or information can be found on line.

National Biodiesel Board <http://www.biodiesel.org/>
Northeast Sustainable Energy Association <http://www.nesea.org/>
Greasecar Vegetable Fuel Systems <http://www.greasecar.com/>
Cape Cod Grease Fuel Collaborative
<http://capecodgreasefuelcollaborative.com/default.aspx>

From the Fryer to the Fuel Tank by Joshua Tickell. Joshua Tickel Media Productions, New Orleans, Louisiana

Biodiesel is available on Cape Cod at two locations: Cape Cod Oil Citgo, 435 Route 6, Truro and Loud Fuel 552 Thomas B. Landers Road, East Falmouth.

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