Agtech CENTRE

Focus
On Alternative Fuels

Vegetable Oil Fuels

What is Biodiesel?

Biodiesel is made from a chemical reaction that uses alcohol (usually methanol) and a strong base compound (usually lye) to split vegetable oil into components. The ester component of the oil is what is known as biodiesel and the separated byproduct is glycerin. The separated ester has a lower viscosity than the original oil. Either new oil or waste restaurant fryer oil could be converted in a biodiesel process.

What is Straight Vegetable Oil (SVO) Fuel?

SVO is vegetable oil that has been pre-filtered for use in a modified Diesel engine. An engine that has been modified to run on SVO will typically be a two-tank system. A small tank is required to contain biodiesel or regular diesel for vehicle start-up and shut down. Once the engine is up to operating temperature, a solenoid switching valve is opened to draw fuel from the larger vegetable oil tank. The line running from the vegetable oil tank and often the tank itself is heated. This system has shown to be reliable for indirect injection Diesel engines, but is not yet proven with direct injection engines, which may experience injection

Why Vegetable Oil Fuel?

Technical Feasibility

The viscosity of vegetable oil must be reduced to use it as fuel for a Diesel engine. There are two main ways to do this. The most common way is to chemically convert the oil into biodiesel. The second is to modify a Diesel engine so it preheats the oil to produce an acceptable viscosity prior to going through the injectors.

The technical feasibility of biodiesel is well proven. Numerous studies exist in Europe and North America that examine technical performance of biodiesel in engines. Biodiesel-fueled engines deliver mileage, torque and horsepower similar to diesel-fueled. SVO use in modified indirect injection engines is also well developed. Europe and especially Germany is leading development and testing of SVO conversion kits for direct injection Diesels.

Biodiesel, even at low blends, provides a significant benefit as a lubricity additive in diesel fuel. Specially formulated SVO blended additives can also be used for lubricity. The University of Saskatchewan develops and tests biodiesel- and SVO-blended lubricity additives.

Biodiesel and SVO are carbon-neutral, renewable fuel sources. Biodiesel and petroleum diesel have comparable life cycle energy efficiencies – about 80% for biodiesel and 83% for diesel. In terms of fossil energy efficiency, biodiesel yields about 3.2 units of fuel product energy for every unit of fossil energy input and diesel yields 0.83 units. SVO fuel would fare even better, as it does not require further processing of biodiesel.

There are emissions benefits related to vegetable oil fuel use. Carbon dioxide emissions, total particulate matter (TPM), and carbon monoxide emissions are reduced with biodiesel. Nitrogen oxide emissions seem to be increased but can be brought to baseline with timing adjustments. As well, new catalytic converter

technology can be used with biodiesel and SVO as they are sulfur-free. Vegetable oil fuel degrades quickly in the environment, and is nontoxic. It is safer than diesel because it has a high flash point (over 300° F) (150 C).

Cost Effectiveness

The real cost of biodiesel technology is contained in the oil feedstock. Batch processing methods used for biodiesel production are not greatly affected by economies of scale. A small scale producer would see about the same benefit as larger scale production, assuming oil costs were the same. For a complete on-farm production cycle, an oil extruder would be required to press oilseeds to obtain the oil and press meal.

A small 150 L batch processor could be constructed for about $300, and a 450 L batch processor would cost about $1100. A suitably-sized cold press oil extruder would have a capital cost in the range of $18,000 – $20,000. Once the equipment and oil supply are in place, the next biggest cost is the reaction chemicals. Depending on the volumes purchased, the chemicals will contribute $0.20/L (bulk) to $0.40/L to the cost of the finished biodiesel product.

For example, if your equipment and raw oil costs contribute $0.45/L to the finished product, your total cost would be $0.65 to $0.85/L. At current diesel prices, this makes farm biodiesel production uneconomical. However, there may be situations, including where the press meal has value as an animal feed component or organic fertilizer, where small scale biodiesel production may be economically feasible.

Using SVO fuel basically only requires the one time cost of the conversion of the engine to a two-tank system with preheating and the cost of the oil press if extraction is done on farm. The ongoing chemical cost associated with biodiesel would be avoided, as well as the processing time and safety considerations. The press meal byproduct may be used in a value process.

The cost of conversion will depend on the type of vehicle, the particular climate (coastal versa prairies) and the type of SVO used (waste oil versa new cold-pressed oil). For a passenger car, the conversion could range from $500 to $1000. Older model Mercedes are particularly well suited to SVO conversion due to the fuel pump and engine design.

What are Some Problems with Vegetable Oil Fuel?

Biodiesel can be winterized by blending with petroleum diesel, using additives, using standard diesel heating technology, or any combination. In North America, a big issue for some biodiesel users may be warranty on their equipment. Commercial biodiesel is not widely available in Canada. While farm production is possible, if the fuel is not analyzed and documented as meeting certain standards, there would be no warranty fall back. The producer would assume the fuel system liabilities related to non-commercial biodiesel use.

Biodiesel can be stored wherever regular diesel is stored. For long term storage in hot, humid weather a biocide may be required to prevent bacterial growth. Any amount of biodiesel to be used during winter would require additives and/or semi-heated storage.

Biodiesel has natural solvent properties. Fuel filters will initially require frequent changing as deposits left by petroleum diesel are cleaned. Biodiesel degrades rubber, so rubber components will need to be switched to plastic components such as Viton. Biodiesel also degrades paint finishes if left in contact for a period of time.

SVO is used in a preheat system so extra winter modifications are not required. If biodiesel is used as the start-up fuel, it will have to be winterized. SVO would need semi-heated winter storage and may require biocides during summer storage. In North America, lack of warranty on engines modified to run SVO may also be a consideration.

Where Can I Obtain Biodiesel?

In general, biodiesel is not commercially available in Canada. A company in Foam Lake, SK sells biodiesel as a specialized lubricity additive, but the cost would preclude large scale use. A Toronto company has developed a continuous biodiesel process and is sponsoring a trial with Toronto Hydro fleet vehicles. A company out of Westbank, BC, produces biodiesel on a small scale for their own use. They also consult on small scale biodiesel production and SVO conversion kits for Diesel engines.

Biodiesel could be produced by individuals on a small scale by chemical transesterification of oil feedstock in a batch process. Fuel taxes may need to be remitted according to applicable regulations. Biodiesel can be mixed at any rate with petroleum diesel, or used at a 100% rate in any diesel engine.

Straight vegetable oil can be used in a specially modified system on an indirect injection Diesel.

For More Information

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