Plant oil as fuel

Plant oil, which includes pure plant oil (PPO) and waste plant oil (WPO), can be used as a (bio)fuel. PPO is new plant oil whereas WPO is pure plant oil that has already been used for frying food. Plant oil is a very useful fuel as it uses plants as the source material. Plants are able to gather a huge amount of solar energy at a relatively low cost (due to the numbers in which they occur and the amount of space they can occupy). Note that PPO can be further divided in the First-generation and Second-generation fuel type. WPO is always a second-generation fuel.

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Applications

Plant oil can be used as a heating or cooking fuel, and for use in piston steam engines, internal combustion engines (diesel), Stirling engines, steam and fuel-powered turbines. By using them in an engine, mechanical work can be provided (ie for transportation purposes, milling of grain, ...), or electricity generation (by adding a alternator or dynamo; the device is then called a "generator-set" or gen-set, they are often used for stationary application). Finally, the vegetable oils can be used in generator-sets to generate not only electricity but also heat. Typically, these too are general gensets, and the heat generated is just waste heat from the engine, regardless, due to the smart use of the gensets, the efficiency goes up and these gensets are then called CHP systems.

Use in internal combustion engines

At present, few IC engines are standardly equipped to operate on plant oil, requiring modification of the engine.

Direct-injection equipped Diesel engines can be modified to run on pure plant oil or waste plant oil (used cooking oil). Problems can however occur with some engine types when operated for extended periods at idle or low load as vegetable oil does not burn well in these conditions. Problems can also occur when running the engine in cold weather. Even regular diesel vehicles have trouble starting when it is very cold, and vegetable oil is thicker than diesel. Vehicles employ various methods to
heat up the oil, and vehicles used in cold climates can add extra heaters. One type of heater is called a "hot fox" which can be installed for example in the trunk; it heats up the oil before it gets to the front of the vehicle, where there is another heater that finishes the job before the fuel reaches the fuel injectors.

Suitable engine modifications along with attention to fuel quality, ambient temperatures and operating regime generally avoids these issues.

Gasoline engines can only be made to run on ethanol. However, biodiesel may also be used in gasoline engines, if mixed with alcohols (ethanol or methanol)[1] [verification needed] Some engines, oil types, and ambient conditions though can cause problems.

Conversion of diesel engines

Main articles: PPO single tank system and PPO two tank system

As stated above, pure plant oil can only be used in combination with a diesel engine, and even then, modifications may still need to be done for running on this oil. This is a result of the current use of direct injection systems (as opposed to indirect injection systems which can run on plant oils without modification).[2] If the engine used is a gasoline engine, it can only be converted to run on either (very lean/good quality) biodiesel, or alternatively pure ethanol.

Vegetable oil is too thick to burn well in the engine unless it is hot. To deal with this problem, some vehicles use a two-tank system: one tank for petrodiesel -or another starting fuel, ie ethanol- and one tank for vegetable oil. The engine is started on petrodiesel (or another starting fuel) and run until it heats up, then the driver switches to the vegetable oil tank. When done driving, the vehicle must be switched back to the petrodiesel tank in order to get the vegetable oil out of the fuel lines. If this is not done, the lines will still be full of vegetable oil when the car is started, and it will be difficult to start. A single tank system can also be used, this system has the advantage that no petrodiesel (or another starting fuel -ie ethanol) needs to be carried in the vehicle, saving weight and thus fuel consumption. Another advantage is the lower complexity (one less tank and a lot of extra lines being eliminated). A downside though is that the engine isn't heated up as well (only the fuel is heated suitably, due to the electric heater in or near the PPO fuel line). Another downside is that the electric heater can not be powered directly from the alternator (a car battery must always be present in the system).

Oil that is not hot enough when it enters the engine will not burn properly and will cause buildup that will damage the engine.

Waste plant oil can also be used in a diesel engine. It must be filtered and water must be removed before it can be used as fuel, or it will damage the engine.

Plant oil extraction and conversion

Main articles: Decentralised pure plant oil fuel production and Plant fats and oils

The process of oil extraction is carried out the same way as for extraction of edible oil from plants. There are many crops grown in rural areas of the developing world which are suitable for oil production. Most of these have high energy contents; sunflower oil, for example, has an energy content of about 85% of that of diesel fuel.

There are two well-established technologies for oil extraction:
The simple screw press, which is a device for physically extracting the oil from the plant - this technology is well suited to small-scale production of oil as fuel or as foodstuff in rural areas. The press can be motorised or hand-operated. Solvent extraction is a chemical process which requires large, sophisticated equipment. This method is more efficient - that is, it extracts a greater percentage of the oil from the plant - but is less suited to rural applications.

The oil, as well as being used for lighting and heating, can be used as a fuel in internal combustion engines.

Advantages and disadvantages

Biofuel is relatively easy and cheap fuel. This, as the extraction of the fuel from the plants is easy and the fuel can also be stored for a long time[3] without requiring complex or expensive storage methods.

Since waste plant oil (both WPO and PPO from crops intended for human consumption) is not produced in respond to an economic demand for fuel, using it is carbon neutral. Plant oils that are produced especially for use as a fuel (PPO from crops also useful for human consumption) are less ecological, yet are still closed-end recycled since the CO2 that is emitted is sucked up by the next year's oil crops. In addition, crops that produce this PPO may still be more beneficial for the environment than were it not grown, depending on the location where the crop is grown and the vegetation that existed on this location.

The pollution from PPO is not as well studied as that of biodiesel, but it is thought to be similar to biodiesel - and much less than petrodiesel pollution-. The Danish Center for Plant Oil Technology[9] has some interesting figures comparing rapeseed (Canola) oil and diesel fuel: 42% lower carbon monoxide, 63% lower unburned hydrocarbons, 19% lower nitrogen oxides, and 42% lower particulates. Cleaned WVO should have the same pollution characteristics as PPO coming from the same crops.

Depending on the source of the oil, PPO and WPO it has more or less the same energy content as petrodiesel and more energy than biodiesel. This can be noticeable on under-powered vehicles.[4]

See also

- Pure plant oil as fuel

References

1. Gasoline engines able to run on ethanol
2. Both 4-stroke and 2-stroke engines with indirect injection allow this, 2-stroke (uniflow) crosshead engines can even run on very low-quality oils
3. How long?
4. Portions (cc) S.E.E.D.S. under Creative Commons
- Collection of fossil to biofuel conversion projects by BuilditSolar
External links

- DIY Diesel to veggie oil conversion e-books
- Several plans and info on vegoil conversions, site made by Dana Linscott
- Biogas and liquid biofuels (original)
- Making Biodiesel
- Wikipedia: Straight vegetable oil
- Pure plant oil fuel technology at the Open Biofuel Engine Development (OBED)wiki - Information about running vegetable oils in Diesel engines
- 10 steps to converting to wvo...the basic process
- [1]