

## BE Bioenergy

### Biodiesel from Canola Oil

#### In the beginning...



Photo: Steven Hobbs

Steven Hobbs was your typical canola and sheep farmer from Kaniva, Victoria, Australia, who liked to dabble. One afternoon, his wife, Helen, called him in to the lounge room to watch a report on the television. A chef was using vegetable oil to make his own biodiesel to power his delivery van. Steven immediately jumped on the Internet, typed in the search word 'biodiesel' and began a journey of discovery. Steven knew then that biodiesel would become a major part of his life.

Over the last four years, Steven made connections through Internet chat rooms and email with fellow biodiesel producers in Denmark, Sweden, America, Canada and Germany.

In Australia Steven gained assistance from a company called AgSeed, now a part of Monsanto, who provided a large enough batch of fresh vegetable oil to begin testing. Steven has been producing biodiesel for the past two years in his shed. He is so committed to the production and use of biodiesel as a renewable energy source that alongside his normal farming business, he runs his own sustainable energy business, [BE Bioenergy](#).

#### What is biodiesel?

Diesel is a fuel used in a large number of vehicles, such as tractors, trucks, buses & 4 wheel drive vehicles. Diesel fuel is a fraction distilled from fossil crude, which on combustion, produces sulfur and carbon based gas emissions, gases known to contribute to the greenhouse effect.



Biodiesel is produced from biological organisms, such as vegetable oils and animal fats, produces fewer emissions, and provides better lubrication than low sulfur diesel. Funnily enough, when Dr. Rudolph Diesel, inventor of the diesel engine, demonstrated his new invention at the World Exhibition in 1900, he used peanut oil. The diesel engine has been since modified to use the more readily available fossil fuel diesel.

Technically, biodiesel is the name

given to fuels containing methyl or ethyl esters. They are essentially made from tri-glyceride oils found in plant oils, such as canola, mustard, sunflower, cottonseed, safflower, soy, and corn. Used cooking oils, fats and tallows can also be used.

Biodiesel is formed through a chemical process called "transesterification" that occurs when an alcohol (such as methanol or ethanol) is added to the plant oil together with an alkaline reactant such as caustic soda (sodium hydroxide) or potassium hydroxide – this acts as a catalyst. The glyceride molecule is "cracked" and replaced with an alcohol molecule, forming an alkaline ester chain.

## How Steven produces biodiesel on a small scale

At present, there is no extensive large scale production of biodiesel in Australia, although the existing network that supports fossil fuel energy production could support the use of biodiesel.

Steven is especially interested in producing biodiesel on a small scale on his farm to provide fuel for his diesel-powered farm machinery. There are a number of steps involved in making biodiesel from his canola crop:

**STEP 1:** Removing the oil from seed. Steven bought a screw press from Egon Keller KEK in Germany. The press using high pressure "presses" the seed to extract approximately 6 litres of oil per hour. This straight oil then needs to be processed.



**STEP 2:** Processing the oil. On the Internet, Steven saw many different processors, some very professionally built, others put together with scrap materials. Steven's unit is constructed from new and used water pressure units, steel, recycled plastic drums, bearings, washers, shafting, couplings, fittings and hoses. Steven has made two units, the first (called Mk1) being very simple, the second (called Mk2) being more elaborate and producing higher quantities. The different components of the Mk2 include:



- A reaction vessel from a 1200mm cylinder with the ends caps made from a 30 litre pressure unit cut in half.
- The mixer uses a motor from an old water pressure pump with a shaft, bearings and stirrer. Down grade steel used for the legs
- Heat is produced by a new hot water immersion element, with a preserving thermometer to monitor the temperature
- A transfer system on the side of the reaction vessel was made from a 30 litre foam marker tank

*The process:*

1. The canola oil is placed in the mixer with methanol and Potassium Hydroxide (KOH)
2. This is mixed using the agitator.
3. The mixture is transferred to the reaction vessel using the air compressor. Here the mixture is left to chemically react, and the glycerol is removed.
4. A pneumatic diaphragm pump pushes the now-diesel from the reactor vessel to the first washing tank, where it is washed with a fine spray of water. Washing removes the soaps that have formed as a bi-product of the chemical process. This is allowed to settle.
5. The biodiesel moves to the second washing tank to be washed again, settled and transferred to the cooker where the biodiesel is heated to 100 degrees to boil off any excess water.
6. The biodiesel is then filtered into storage containers.



**From canola seed to biodiesel. Steps in the process:**

1. Canola seed
2. Ground meal
3. After transesterification biodeisel separated from the by-product, glycerol (bottom)
4. biodeisel after one wash
5. Biodeisel after a second wash
6. Pure biodiesel – the “golden fuel”

## Benefits of biodiesel

The production of biodiesel on a small scale by primary producers (farmers) has many benefits.

### Environmental benefits

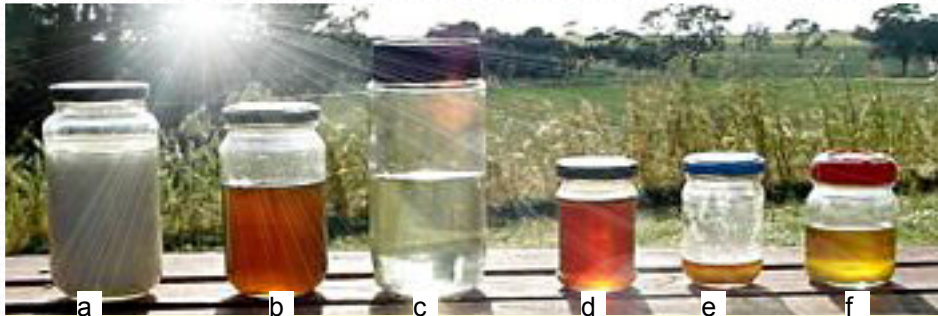
Biodiesel does produce carbon dioxide emissions; however, the carbon being emitted was initially taken from the atmosphere through a process called photosynthesis. The quantities of carbon being emitted are then taken back into the next crop of canola. It is a cycle.

The difference between using biological carbon sources and carbon from fossil fuels (such as coal) is that fossil fuels lock up enormous amounts of carbon. When too much of this carbon is “released” through burning for electricity production, the atmosphere is unbalanced. Wide spread deforestation worldwide compounds the problem.

Biodiesel uses a source of carbon that is “renewable” – what is released when driving the tractor can be captured again in the canola crop.

### Social benefits

Using the crops in this way helps the farmer to get the maximum benefit. For example, the oil seed is crushed and the oil is used to make the biodiesel. Other byproducts are produced during this chemical process that can be used on the farm.



Byproducts of transesterification (process used to turn vegetable oil into biodiesel): (from left) A. Emulsified soaps - used as a lubricant or potential source of potassium. B. Crude glycerol – Degreaser or heavy duty soap. C. Light oil fraction – good light grade lubricant. D. Semi-refined glycerol – can be refined further to be used for cosmetics ,hand cremes,etc. E. Potassium Phosphate – by-product of refining process – valuable fertiliser. F. Recovered fatty acids – can be used as a lubricant or used as a fuel in a straight vegetable oil conversion

The press cake, or meal, is a high protein feed supplement for livestock such as cows, pigs, chooks or sheep.

The use of biodiesel in fuels reduces the amount of “particulate emissions” released by diesel engines. Particulate emissions are the small carbon based particles that contribute to smog. They have been associated with health conditions such as lung and heart disease and breathing disorders. The use of biodiesel can reduce these emissions by up to 70%.



Steven's truck is equipped with a biodiesel kit that allows him to use biodiesel.

No more diesel smell – it smells like fish and chips!

### Economic benefits

In 1<sup>st</sup> January 2003, Low Sulfur Diesel (LSD) replaced normal diesel fuel to reduce the amount of sulphur based gas emissions entering the atmosphere. LSD fuels, however, cause damage to older diesel engines. The farm machinery on Steven's farm has older diesel engines. At present, Steven adds biodiesel to the commercially produced LSD to produce a 4% blend. He has found an increase in both the power of his farm machinery and in the life of the engines in his farm machinery.

*Farmers spend large amounts of money to upgrade farm machinery, so extending the life of machinery has obvious benefits!*

## Difficulty as a farmer producer of biodiesel



See the Energy Grants (Cleaner Fuels) Scheme Act 2004 for more information

By using biodiesel on the farm Steven can use his crop to produce his own supply of fuel, extend machinery life, and receive the benefit of a partly self-sustaining system.

However, Steven is facing a new regulatory framework. As of the 18 September 2003, biodiesel locally manufactured for use in diesel engines became subject to a tax, or excise. Stephen could apply for a cleaner fuels grant to offset this excise. To be eligible for a grant the biodiesel is required to meet the national biodiesel fuel quality standard under the Fuel Quality Standards Act 2000. The biodiesel fuel quality standard ensures consistency in biodiesel quality, allows more effective operation of engines and reduces the level of pollutants and emissions arising from the use of fuel that may cause environmental and health problems. Given Steven's small-scale production, he believes the cost to meet this requirement is unsustainable. Another factor in this new regulation is that the offsetting grants for biodiesel do not apply to off-road use of pure (100%) biodiesel, however biodiesel can be used in blends with petroleum based diesel, for example, B5 (5%), B10 (10%).

## Where to from here?

The future of farmers producing biodiesel to support their small farming operations is unclear. One thing is clear – people like Steven are raising the profile of small scale production of renewable fuels. It is easy to make, support is available, and it has benefits for both the farmer and the environment.



## Useful Resources and Contacts

- Australian Government Department of the Environment and Heritage- *Fuel Quality Standards Act 2000*: <http://www.deh.gov.au/atmosphere/cleaner-fuels/index.html>
- BE Bioenergy: [www.bebioenergy.com](http://www.bebioenergy.com)
- *Energy Grants (Cleaner Fuels) Scheme Act 2004*: [scaleplus.law.gov.au/cgi-bin/download.pl?/scale/data/pasteact/3/3649](http://scaleplus.law.gov.au/cgi-bin/download.pl?/scale/data/pasteact/3/3649)
- Journey to Forever – American Proponent for biodiesel: [journeytoforever.org](http://journeytoforever.org)
- Lemley, B. (2003). Anything into oil. *Discover*, 24 (5).
- Tickell, J. (2000). *From the fryer to the fuel tank: The complete guide to using vegetable oil as an alternative fuel*. Ed. Kaia Roman. Tallahassee, FL: Tickell Energy Consulting.

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- Steven Hobbs and his family, BE Bioenergy, farmer

Photos by Linda Darby unless otherwise indicated

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This case study is available on the Educating for a Sustainable Future website: [www.ballarat.edu.au/projects/ensu](http://www.ballarat.edu.au/projects/ensu)  
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