

CASE STUDY

Richard Wiswall, Cate Farm, Plainfield Vermont

On-farm Biodiesel Production from Waste Vegetable Oil

Richard Wiswall and Sally Coleman own Cate Farm in central Vermont. They produce vegetables, herbs and flowers on 25 acres, and bedding plants and greenhouse tomatoes in six 20 by 100 foot greenhouses. Biodiesel made from waste vegetable oil is used to heat the greenhouses as well as power several tractors and one car.

When he decided to switch to an alternative fuel, Richard had the choice of converting vegetable oil to biodiesel that could run in his existing equipment or modifying the existing equipment to use straight vegetable oil. The number of locations where he required the fuel made it simpler and more cost-effective to transform the waste oil so it could be burned in existing equipment rather than changing and maintaining multiple pieces of equipment.

Biodiesel is a simple product to make. There are several different options for the ingredients and procedure (see the references at the end of this section). Richard uses a base of oil (triglyceride) combined with methanol in a reaction catalyzed by lye (sodium hydroxide) and heat. This process yields glycerin (a byproduct) and methyl esters (the biodiesel).



A 55-gallon metal drum is used for mixing his biodiesel batches. In the drum, Richard drilled two holes to draw off its contents: one opening at the bottom (for glycerin) and one midway up the barrel with a small pump (for methyl esters). An electric hot water element and thermostat are used to heat the ingredients inside the barrel (a burner underneath would also work); a paint mixer attached to a washing machine motor mixes them.

Making biodiesel begins with collecting deep-fry oil from area restaurants. Non-hydrogenated oil is best (although largely unavailable as waste cook oil). Oils changed weekly at the restaurant are preferred to often-reused oils. Richard has established reliable weekly or bi-weekly pick up schedules with restaurants throughout the year. It is important to arrive reliably on a fairly regular schedule that fits with the restaurant's routine; otherwise they may return to their more familiar waste haulers.

Once the restaurant oil arrives at Cate Farm, it sits in the sun in plastic jugs while the particulate matter settles out. Once particulates have settled, Richard pours 40 gallons of the oil over a screen into the 55-gallon drum. He then clamps on the top, heats the oil to 120 degrees and mixes slightly. He draws off a sample to take a titration for determining how much lye to add (see *From the Fryer to*



the Fuel Tank for titration instructions). The more free fatty acids in the waste oil, the more lye is required as a catalyst.

Richard mixes lye with eight gallons of methanol in a container separate from the oil drum. He is extremely cautious with the methanol, wears protective clothing and eye protection and measures it in the open or in a well-ventilated shed. The lye dissolves in the methanol for approximately one hour to produce sodium methoxide.

Finally, Richard adds the lye/methanol to the heated oil and mixes it for one hour, then allows the mixture to sit overnight. The next day he can draw biodiesel from the top $\frac{3}{4}$ and glycerin from the bottom $\frac{1}{4}$. The biodiesel might sit to settle once more or, if he wants to use it in his vehicles instead of the furnaces, he will wash it to remove further impurities. The glycerin goes to the compost pile, but could be burned or made into soap as other options.

A rough estimate for Cate Farm's biodiesel costs (not including labor) is about \$0.60 per gallon. The methanol is the most expensive ingredient and it costs \$2.00 per gallon. Richard makes about 2500 gallons of biodiesel per year.

About 95% of the biodiesel is burned in the greenhouses in early spring, the rest in the tractors and car.

Some Biodiesel Resources:

From the Fryer to the Fuel Tank by Joshua Tickell (to start a biodiesel project)
Biodiesel Homebrew Guide by Maria Alovera (a more recent, more detailed reference)
<http://www.biodieselnow.com>
<http://biodiesel.info.pop.cc>
<http://www.journeytoforever.org>
<http://www.vtbiodieselproject.org>

Prepared by:
Vern Grubinger
University of Vermont