

The SlugBus

A Biodiesel-Powered Vehicle

Jon Kenneke

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I've always been interested in alternative transportation, such as electric vehicles and methanol-powered engines. In my continuing search for more knowledge, I bumped into a different technology: biodiesel. I read and learned, and as a result I now own a VW diesel, and make my own biodiesel fuel.

What Started This Mess?

One evening, I was surfing the net, looking around at various types of alternative-fuel vehicles. After reviewing several Web sites, I came across www.veggievan.org, a biodiesel-oriented site. I quickly discovered that biodiesel is a product made from vegetable oil that can be used as fuel in an unmodified diesel engine.

Further, biodiesel can be made from used cooking oil. Fast food restaurants are a great source of used oil. That caught my interest.

Studies by major universities say that biodiesel has fewer emissions than fossil diesel. Also, biodiesel does not put more net carbon into the atmosphere, since it uses carbon that plants captured from atmospheric carbon dioxide. It is a "green" fuel.

The creators of the Veggie Van Web site have a new, second edition of their book available—*From the Fryer to the Fuel Tank: The Complete Guide to Using Vegetable Oil as an Alternative Fuel*. This book was written by Joshua and Kaia Tickell. I purchased the book from their Web site, and read it cover to cover when I received it. That was not enough—I had to try it. I had one problem, though; I didn't have a diesel vehicle.

Vehicle Search

Since the authors of the book mentioned a Volkswagen (VW), and since I have had previous experience with

VWs, that was the make for me. Parts are reasonably easy to find, and they are generally inexpensive.

To find a suitable vehicle, I searched the classifieds in the local newspaper, and the Web. That search turned up nothing affordable. I read the classifieds some more, and saw that the paper offered free "wanted" ads. Free is a very good price, so I wrote a quick classified ad: "Wanted: VW diesel."



The classified ad generated several calls, most of them being for diesel Volkswagen Rabbits and Dashers that did not run, had blown head gaskets, or other problems. I wanted a running vehicle. It didn't need to look good, but it needed an operating engine, so I could try out biodiesel.

One of the last calls I got was from a fellow who had a Volkswagen Vanagon that had been stored in a barn for several years. It didn't sound good at first, but the idea of a Vanagon was appealing, so I went out and took a look. Well, that was the vehicle for me: It ran, looked decent, and the price was right. I gave the guy six hundred dollars, and the 1983 Vanagon was mine.

Fuel Tribulations

Keep in mind that biodiesel is not straight vegetable oil. It is filtered and chemically processed. Not to get into a technical discussion, but the basic idea is that something needs to be done to break apart the really long used cooking oil molecules into something smaller



L to R: storage drum, mixing drum, and sodium methoxide mixing drum.

that a standard diesel engine fuel system can deal with. See Josh and Kaia's article in *HP72*, page 84, for the details.

The biodiesel recipe calls for some nasty chemicals: lye and methanol. So I took all the precautions—gloves, a well ventilated area, eye protection, and all that. For my first batch, I used Red Devil lye, new Crisco oil, and SLX paint thinner/stove alcohol, since the back of the alcohol container read "Contains Methanol." More on this mistake later. The mixture of lye and methanol creates a very skin-corrosive compound called sodium methoxide. This is the magic that breaks the cooking oil apart.

As the Tickells suggested, I started with a small batch. The book recommends sacrificing a blender, but I used a glass jar. My method just takes lots and lots of shaking the jar. It's sort of like making butter, I would say. But all I could come up with was sludge. I tried several times, and only got sludge.

So I started suspecting that one or more of my nasty chemicals was not quite right. I checked, and verified that Red Devil lye was the right thing to use. That left one suspect: the alcohol. After some research, I found out that the SLX paint thinner/stove alcohol is mostly ethanol. It is clear in the book that ethanol is difficult or impossible to use.



The trolling motor mounted to a board and held by a concrete block.

OK, so I knew what was wrong. But I couldn't find methanol anywhere, until I was driving around town and saw a gas station that sold racing fuel. Those folks had several types of racing fuel, one of them being methanol. I purchased several gallons for US\$3 a gallon, and went to try a small batch again. This time it worked!

I dumped this approximately one quart of biodiesel into the Vanagon. It continued to run. No anti-matter explosions, and the sun came up the next day. I was pleased.

The Big Batch

After mastering the small batch, I was ready for used cooking oil, and



A solar-charged 12 volt battery powers the mixing process.

a larger batch. I went to the local rancid oil well behind a greasy spoon restaurant and filled several four gallon plastic buckets with foul smelling oil. I first explained to the manager what I was up to, and she was more than happy to help. Away I went, covered with oil, with twelve gallons (45 l) in the trunk.

Back at home, I poured the oil into a 55 gallon drum. I then created the sodium methoxide (from lye and methanol) in a separate container. Once ready, the two were combined in the drum, and an old 12 volt trolling motor mounted on a board was used as a mixer. I did this when the outside temperature was 55°F (13°C). After running the trolling

Like any diesel Vanagon, the SlugBus may be a bit slow, but this one runs on greenery, just like its namesake.



motor for an hour (from a PV-charged deep cycle battery), I let the mixture settle for 24 hours.

I checked the biodiesel the next day, and it was sludge *again!* I was getting tired of this. So I went back to the research. What I found out was that for the chemical reaction to take place, the temperature of the mixture needs to be around 80°F (27°C). No problem—the next day was in the 80s. I simply ran the mixer motor again, and this time—success!

After 24 hours, the fuel was on top, and food chunks and glycerin were on the bottom of the drum. Approximately 15 percent of the volume was not biodiesel.

Getting Rid of the Junk

To get the biodiesel off the top of the glycerin/food chunks, I used a marine oil change pump to transfer the biodiesel into another plastic 55 gallon drum. On the output end of the pump, I put a filter/water separator. According to the book, the waste can be composted, which is what I did. It didn't kill the Jerusalem Artichokes growing in my compost pit, so it seems to be pretty safe.

Some Web resources that I came across in my various research missions suggest spraying water on the top of the separated biodiesel to remove excess alcohol from the fuel. I think it's a good idea, so I did it using a plant sprayer. Some folks spray with vinegar, which supposedly gets rid of more impurities.

Since alcohol mixes readily with water and with vinegar, and the mixture settles to the bottom, it has a cleansing effect. The water and vinegar flow from top to bottom, pulling impurities along with them. Vinegar has the added benefit of being slightly acidic, so it attracts the impurities.

In my first batch of biodiesel, I did not adequately remove the remaining alcohol. The alcohol attacked the van's already old fuel hoses, causing them to leak. Alcohol in diesel fuel will ruin various fuel system seals. On a Volkswagen diesel, bad seals in the injection pump will result in costly repairs. So I would highly recommend getting as much alcohol out of the biodiesel as possible. I got lucky on this one.

I routinely add automatic transmission fluid (ATF) to my fuel. I use half a quart when I think about it. ATF is designed to keep seals from drying in an automatic transmission, and works well for fuel system seals.

The First Test

After creating just over 10 gallons (40 l) of biodiesel, I wanted to see how the van would run on the stuff. Since I had to replace fuel hoses on the van, I drained

all the fossil diesel from the tank. I then pumped all 10+ gallons of biodiesel into the van. This was the test.

I climbed into the van, and it started right up, and kept on running. I went around to the tailpipe, and experienced an interesting smell that I can best describe as a mixture of french fries and burning marshmallows. Then it was time for a drive.

A diesel Volkswagen Vanagon is a slow creature. Running on the biodiesel, it was as slow as normal. Sources say biodiesel has a little less power than fossil diesel, and that might be true. It was hard to tell, but it ran smoothly, and with little smoke.

So I went for a drive. The van performed well with 100 percent biodiesel. The cost per gallon for this batch was 50 cents, not counting my time. Not bad. Fossil diesel was well over US\$1.30 per gallon then. The Vanagon, now named "SlugBus," gets around 30 miles (48 km) to the gallon.

The Big Test

Burning less than a gallon in the test, there was still 270 miles (435 km) of range with the first big batch of straight biodiesel in the tank. So we took a 160 mile (260 km) round-trip excursion on pure biodiesel. Again, we completed this trip without a hitch. Even in the SlugBus, we could attain freeway speeds of 65 mph (105 kph). The remainder of the fuel was consumed around town.

Given this success, the next test was a 500 mile (800 km) round trip, with the outbound leg running on the second batch of biodiesel. On this trip, we were headed to the SolWest Renewable Energy Fair in John Day, Oregon. A full tank gives the SlugBus a range of around 300 miles (480 km). So the drive home was mostly fossil diesel.

The only problem on the John Day trip was a near overheating situation on the long grade heading east out of Mitchell, Oregon. It was a 95 degree day, with a 65 horsepower motor trying to push 3,500 pounds (1,600 kg). A quick stop into a turnout to cool the engine was enough to make the rest of the trip "cool."

Performance SlugBus

The biodiesel works well in the SlugBus. I've done some further improvements to increase the life of the vehicle and reduce the amount of pollutants. Probably the biggest performance improvement came when I switched to synthetic lubricants in the motor and transmission. This subject has been the topic of a recent *Home Power* article (*HP69*, page 50). Synthetics have worked for me.

With synthetics, the vehicle runs noticeably cooler. This means less energy is being wasted as heat, so fewer pollutants are being generated. I use Amsoil, but there are many other great synthetic lubricants on the market.

I also use a magnetic algae reducing system. Believe it or not, algae can live (and thrive) in diesel, and especially in biodiesel. These critters can clog your fuel system, and do other nasty things. There are toxic chemical biocides, but the magnetics seem to work. According to the manufacturer of the system, the magnetic fields disrupt the clumps of micro-organisms. The critters have no chance to form colonies, and will not clog the filter. They are often small enough to pass through the filter, and are safely burned in the engine.

Tire pressures also makes a big difference. Keep those tires inflated to proper pressure for safety and better fuel economy.

Earth-Friendly Fuel

Based on my experiences with biodiesel, I believe it is a low-cost, earth-friendly alternative fuel. Experimenting with biodiesel just takes some careful chemical handling techniques, and very little money. There are commercial sources of biodiesel in some places, but making the fuel yourself really gives you do-it-yourself satisfaction.

Access

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From the Fryer to the Fuel Tank: The Complete Guide to Using Vegetable Oil as an Alternative Fuel, a new second edition by Joshua and Kaia Tickell, US\$29.95 from BookMasters, PO Box 388, Ashland, OH 44805 • 800-266-5564 or 419-281-1802 • biofuel@best.com
www.veggievan.org

Fuel Dynamics, PO Box 523, Cape Canaveral, FL 32920 • 888-825-4239 or 321-784-4227
Fax: 321-784-5663 • fuelmag@fueldyn.com
www.fueldyn.com • Magnetic algae reducing devices for diesel fuel systems

Web biodiesel resources:

www.biodiesel.com • Commercial biodiesel

www.biodiesel.org • National Biodiesel Board

www.webconx.com/biodiesel • The biodiesel resource

A new biodiesel email discussion group has been formed. To join, send a message to biodiesel-discussion-subscribe@topica.com

