Sustainable Energy Solutions: Straight Vegetable Oil

Dual Fuel Systems

Basic Concepts:
1 Tank System

- Vehicle starts on vegetable oil
- Heat exchanger near fuel filter pre-heats vegetable oil
- Heated fuel filter further pre-heats vegetable oil
- Covered in Elsbett presentation
- The remainder of this presentation deals with 2 tank systems

Basic Concepts:
2 Tank System

- Vehicle starts on diesel or biodiesel
- Vegetable oil tank heated
- Vegetable oil fuel line heated from tank to injection pump
- Fuel filter heated
- Switch from diesel fuel tank to vegetable oil tank

Filtration & Temperature

- Filter oil to 1 micron
- 160 deg. F is adequate for vegetable oil to flow through lines, filter, injection pump, injector nozzles, and combust well
- Viscosity is adequate at 20 centistrokes (10 centistrokes is better)
- 175 deg. F reduces viscosity of vegetable oil below 10 centistrokes
- Note: Heated vegetable oil filter faster because waxes are melted. However, those waxes will reform as the oil cools down. Filtering at cooler temperatures takes longer and clogs filters more quickly but it filters out more.

Precautions

- **Injector Coking**

  Problem: straight vegetable oil can cause injector coking which results when carbon deposits build up on the injector nozzle causing irregular spay patterns and reduced fuel flow and efficency

  Solution: Pre-heat veggie to at least 160 def F, Start and stop on diesel or biodiesel; Accelerate hard when climbing hills.

- **Coolant Precautions**

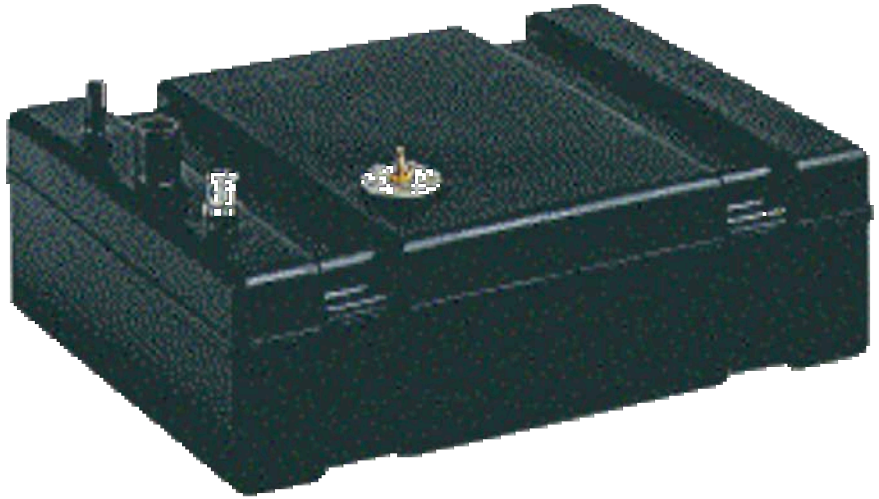
  - Coolant must be cool before working on coolant system
  - Store coolant properly
  - Keep animals away from coolant
  - Try Low-Tox

Conversion: Tank

- Aluminum or stainless make ideal vegetable oil tanks, polyethelene will work too
- In and Out ports should face the engine and, ideally, be located at the bottom of the tank

- Fuel output should go through the top of the tank
- A float can be attched through the top for a fuel gauge on the dash

Conversion: More Tanks



Conversion:
Heat Exchanger

- Coolant Operated

  - A coil or zig-zag made from flexible copper or zinc piping can serve as a heat exchanger inside the tank. Transmission oil coolers or any other type of heat exchanger will also work.

  - The heat exchanger is fed by hot coolant from the engine and returned to the radiator to continue cooling the engine.

- Electric

  - An electric heating element can be place in or on the tank and wired to a dedicated battery, the vehicle's battery, the vehicle's electric system, or external AC power.

Conversion: Fuel Lines

- **Option 1: Hose within a hose**

  - Polyethelene fuel lines work best as supply and return.

  - Hi temperature, oil resistant heater lines work best. (the red ones!)

  - Poly fuel supply line goes inside the larger heater hose

  - Vegetable oil goes through the poly supply line

  - Hot coolant goes through the heater hose

  - The hot coolant around the fuel line heats the vegetable oil on its way from the tank to the injection pump. Note: coolant and fuel should never mix

  - The lines are all attached with brass compression fittings and tees

Conversion: Fuel Lines

- **Option 2: Triple By-Pass**

  - A flexible nylon fuel supply line can be bundled with two larger, nylon coolant lines

  - The heat from the coolant lines transfers to the fuel line and the insulating sheath that wraps all the hoses together helps minimize temperature loss

  - This system doesn't not require multiple brass compression fittings but the nylon hose kinks easily

Conversion: Fuel Routing

- **Return Line**

  Diesel injection pumps take more fuel than they actually inject and use for combustion. Therefore, excess fuel is returned to the tank via a *return line*.

- **Option 1: Looping the Return**

  The return line out of the injection pump is cut, looped around and re-connected to the supply line using a tee connector

- **Option 2: Returning to the Veggie Tank**

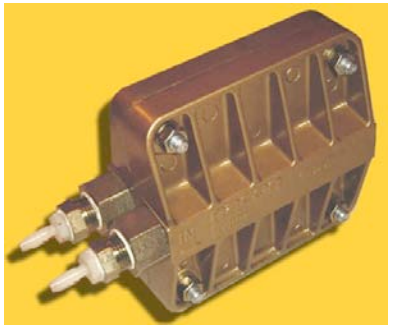
  A six port fuel selector valve can be employed to return excess diesel back to the diesel tank and veggie back to the veggie tank

Conversion: Thermo Switch

- An adjustable thermo switch (thermostat) can be used to sense the temperature of the vegetable oil in the tank or coolant temperature near the tank return
- At speficied temperature (160 – 175 deg. F) it automatically switches the fuel selector valve from the diesel tank to the vegetable oil tank

Fuel Filters

- Injection pumps are designed to operate optimally with a specific resistance that the fuel filter provides
- Changing the type of filter can also change the resistance to the pump
- It is recommended to stick with stock filters when possible or, at least, try to match the micron ratings
- Filter options include: heating, water separation, water present or change monitors, and re-usable elements



Fuel Selector Valves

6 port motor driven valve

3 port solenoid operated valve

Assembly: Tank & Lines

- ❑ Determine location of vegetable oil tank. Measure and mark.
- ❑ Determine where coolant line and fuel line will be routed. Measure and mark.
- ❑ Design tank: where will the coolant in/out be, where will the fuel out be, where will you fill it, where will the fuel float go, where will the temperature sensor go?
- ❑ Assemble the tank

- ❑ Assemble hoses and run them from the engine compartment (near coolant lines and injection pump) to location of vegetable oil tank
- ❑ Mount vegetable oil tank
- ❑ Connect the coolant lines and fuel line to the vegetable oil tank

Assembly: Heater Hoses

- ❑ Determine and mark hot and cold heater hoses
- ❑ Drain and store coolant. Follow proper safety precautions.
- ❑ Cut the hot heater hose where you want to insert the new coolant line that goes into the vegetable oil tank
- ❑ Install a tee-connector and hook connect the new coolant line securing them with hose clamps
- ❑ Repeat for the second coolant line

- ❑ Refill coolant and check for leaks

Assembly: Solenoid Valve

- ❑ Determine the open (default) port, the closed port, and the send port and mark them accordingly
- ❑ Determine where to attach the solenoid to the side of engine compartment and mount it
- ❑ Attach the poly vegetable oil fuel line to the closed port
- ❑ Re-route the fuel line from your existing fuel filter to the open port on the solenoid
- ❑ Install your auxilary vegetable oil fuel fitler into the vegetable oil line direclty before the solenoid
- ❑ Attach the fuel line from the injector pump directly to the send port on the solenoid
- ❑ Re-route the return fuel line off the injector pump back into the send line (coming off the send valve on the solenoid) using a tee-connector and hose clamps

Assembly: Toggle Switch

- ❑ Determine where to mount the toggle switch on the dash board and mount it there
- ❑ Attach the 2 control wires to the solenoid valve and the other two power/ground wire to the batter and ground
- ❑ Install a 10 amp in-line automotive fuse on the positive line
- ❑ Check your work

Assembly: Priming the Injector Pump

- If your injector pump is not self priming you must prime it
- Detach vegetable oil feed line from solenoid and blow everything out of it
- Pull a vaccum on this line until vegetable oil comes out and reattach it to the solenoid
- You could install a brass tee-fitting in-line here to ease with priming

Assembly: Thermoswitch

- Insert probe in vegetable oil tank or in coolant line near tank (this requires running the wire from the engine compartment to the tank)
- Cut the positive wire (dissconntect battery first) between the toggle switch and the solenoid valve and install the thermoswitch

Take a Test Drive