

The 'No Nonsense' Biodiesel Guide

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This is a guide and nothing else - you operate under your own responsibility.

This is a plan of action that will give you all the information to assess whether or not making D.I.Y Biodiesel is for you. The format is a list of questions and the further away your answers are to mine the more difficulty you will have. If you make it through the questions and still feel positive there is a recipe for Biodiesel that hasn't caused me any problems for well over three years (approximately 40,000 miles) and cuts out the majority of the hassle. To finish is the 205 litre Clap Top Drum HDPE Reactor Vessel materials list and layout diagram, perfect for medium size production. I started the way the big boys on Ebay suggest, *i.e.* buying all their equipment and chemicals, and later realized a lot of it wasn't necessary.

On the subject of **what is necessary**. Before putting any other fuel in your diesel vehicle change any organic rubber 'leak off' tubes to inorganic 'Viton' rubber tubes. The reason for this is that normal rubber is chemically very weak and will crack within a few days of use, covering your engine bay in smelly oil. This type of tubing can be found on the internet, doesn't cost much for a small length and is fitted in minutes. Also change your fuel filter after travelling approximately 500 miles, as Biodiesel actually cleans the fuel tank. These things only need to be done once and then it's back to normal servicing for the vehicle.

Important Questions to Ask Yourself

1. Do you have a ready supply of free waste vegetable oil?

D.I.Y Biodiesel manufacture is only worth while if there is a source of **free** waste oil. Oil can be brought in bulk, but the time taken to make the fuel will make it pointless. Surprisingly getting free waste oil is the hardest thing for most, a lot of pubs and takeaways are supplied by the same firm that removes the waste oil. Therefore it is almost impossible to get their waste, as the owners / tenants have signed an agreement with the oil company.

However the situation may differ in your locality. You need to find establishments that buy their oil direct from the cash 'n' carry and use a separate company to remove it. It's all about setting a good impression, and if you turn up offering to save them money with a more regular free service they may take you on. If you really don't have much luck then one solution may be to approach establishments and offer to deliver oil from the cash 'n' carry in return for the waste.

The best waste oil is produced by pubs, particularly country pubs, as the oil is changed regularly. Next are Italian takeaways, then Chinese Takeaways (watch out for some Chinese oil – full of filter blocking bits!). Fish and Chip Shops are to my experience a no go, as the oil is normally Palm or Tallow, both make poor Biodiesel as are solid at room temperature. Additionally Fish and Chip Shops are normally sown up by a joint supplier / remover. No harm in asking though.

2. Does your waste oil source have any water or 'large' bits in it?

You can't make Biodiesel with oil that has water in it. Some establishments wash out their fryers into the same container as the waste oil. This must be stopped from getting into the reactor as it will combine with the Methanol, and at worst nothing will happen.

A little water can be dealt with easily - as after practise you can hear the difference when pouring the contents of a container and quickly stop. A small amount of water will also evaporate when you heat the oil prior to the reaction, and excessive

water will always sit at the bottom of a volume of hot oil. Best to drain the bottom of the reactor before adding the chemicals.

I ask my clients to purchase brands of oil that come in transparent plastic containers boxed in cardboard. The reason for this is that they can empty the waste oil back into these containers, allowing you to visually inspect the contents prior to using. The dirty empty containers are then put in their bins when I return the following month.

3. What kind of diesel vehicle do you plan on fuelling?

Believe it or not for about 5 months of the year my car runs on filtered waste oil, not Biodiesel, just pure filtered waste. I actually think it runs a bit faster, go job as the smell is worse!

A lot of the important stuff about Biodiesel is related temperature. The main reason for making Biodiesel from oil is that the oil itself is a lot thicker and can damage some fuel pumps. However the Bosch brand of fuel pumps are really strong and will happily pull 1 micron filtered waste oil during the warmer months of the year, about 5 out of 12. These pumps are found on most German vehicles, particularly VW. Lucas pumps have to be avoided even with good Biodiesel, as they have a tendency to burn out. The way to tell is that the fuel inlet is on the opposite side to the fuel outlets on a Bosch.

In addition, my experience is that cars manufactured later than 2002 may have problems getting the oil or even Biodiesel past the numerous sensors *etc.* To be cautious – stick to pre 2002 vehicles, and definitely a Bosch pump even with Biodiesel. In winter my Biodiesel sometimes turns a bit lumpy (because of animal fats) and filling the tank with the occasional lump feels a bit funny! However the lumps in Biodiesel melt really fast, so that by the time they reach the engine they're liquid.

Remember – Bosch fuel pump, no later than 2002, and if you want, 1 micron filtered waste oil from May to September then back on the Biodiesel for the cold months. Simulate outside conditions by safely putting your Biodiesel in the freezer or the microwave, this will give you piece of mind.

4. Where do you plan to mount your reactor?

My set up fits tightly into a normal sized shed. However it does require an outside tap (preferably with hot and cold water) and obviously a drain. A work place where the benefits of gravity are at hand will also prove useful, and save you money as there will be less pumping. One thing to note is that the mess gets everywhere and will affect a much larger area, possibly getting in your house. Oily shoes are not good on the carpet! Also don't wash your Biodiesel work clothes in your normal washing machine, because everything will end up smelling of vegetable oil / Biodiesel.

5. Are you image conscious?

Biodiesel smells like barbeques / candles when combusted and will possibly affect your 'street cred'. If you're the kind of person that likes attention then it will be to your advantage. The smell isn't restricted to outside the car, as at traffic lights the smell comes into the car, making you realize how well adjusted we all are to fossil fuel smoke.

6. Do you have a vehicle to collect oil and another to use normally?

Any medium sized D.I.Y Biodiesel production really needs a van or at least a trailer to collect the oil and chemicals. With only one vehicle, which I had when I started, you will definitely end up with a seriously soiled car. You may not believe it, but the oil gets everywhere! Additionally - your chemicals need to be bought in bulk as otherwise the costs will be more than double, *i.e.* a van or trailer is essential. If operating on your own, you will also need some form of lifting equipment, as the

chemicals in bulk weigh too much to manually handle. To make things even more difficult – any medium sized set up will produce a lot of the by-product Glycerol, you will get approximately the same volume of Glycerol as Methanol used. In these volumes, the Glycerol needs to be disposed of correctly, which actually isn't too bad these days as most Methanol suppliers will take it off you for free, or may even pay you.

7. Do you worry about your health?

A bit of a silly question - but the chemicals needed are flammable, toxic and irritants. If you are careful and follow the directions then it'll be fine, but accidents do happen and **you will** come into contact with these chemicals. Remember to wash your hands **immediately**.

8. Do you have a life?

If you do, then you will have to give a big chunk of it to Biodiesel. If you don't, then it will definitely keep you busy. The thing is the process never stops and you are constantly trying to improve your system. It is an involved hobby to say the least!

The No Frills Biodiesel Recipe

If you're still interested then here is my guide to making quick and easy Biodiesel. Some would say I'm stupid for not titrating my oil, but they are usually trying to sell you a titration kit! All I can say is that my Biodiesel and the 1 micron filtered waste oil (warmer months only) have never caused my vehicles any problems over the course of three years. Once again all are pre 2002 and have Bosch fuel pumps.

Here you go!

For Any Volume of Biodiesel –

1. Heat oil to no more than 60°C (Methoxide / Methanol boils at 65°C = not good) after removing any **excess** water. Note – water settles faster in hot oil so drain the bottom of the vessel after heating to ensure all water is gone.
2. Through agitation, completely dissolve 10 grams of Potassium Hydroxide or 7 grams of Sodium Hydroxide to every 200ml of Methanol in **only** a HDPE container. Giving 200ml of Methoxide (instantly burns – remember rinse affected area with cold water immediately!). I only use Potassium Hydroxide, it costs more but the resulting Glycerol is always liquid. (*Tip of the day* – if you purchase for example a 205 litre drum of Methanol, simply add 10.25 Kg (205 x 5 x 10) of Potassium Hydroxide. Therefore the Methoxide is ready and waiting to be **carefully** pumped out. Please note that adding either Sodium or Potassium Hydroxide to Methanol creates heat and therefore pressure in a closed container).
3. For every 1 litre of oil you will need 200ml of Methoxide.
4. Add the Methoxide (without inhaling any fumes!) into a HDPE container holding your volume of warm oil. Replace the top securely and agitate intermittently (every 2 minutes) over 2 hours.
5. After the reaction is complete the solution settles and you will see two distinct layers. The bottom dark one is the by-product Glycerol, and the top lighter fraction is Biodiesel.
6. Leave over night for best results.
7. Pour off the Biodiesel in to another container for washing.
8. Wash your Biodiesel gently with water for 3 hours. This is done by adding a volume of water equal to 1/5 of the volume of Biodiesel, and using aquarium air stones to bubble the water through the fuel. If you get serious foaming then add a lot of vinegar to decrease the pH or invest in a stronger acid, preferably Acetic acid. Neutralising the pH will stop the foaming. Foaming can take a while to occur so watch out!
9. Leave for two days to settle and separate.
10. The fuel may look cloudy once the water has dropped out, but this is fine.

11. Finally pour out your Biodiesel, but make sure not to pour out any water with the fuel.
12. Fill your tank up, and smell the difference!

The 205 litre Clamp Top Drum HDPE Reactor Vessel

Please refer to the diagram with regards to the following materials list. All materials should cost less than £350 if sourced correctly. Note - the beginner should always start with a small 1 litre HDPE bottle and work their way up to a 25 litre HDPE container, and then finally a 205 litre Clamp Top HDPE drum.

There is a lot of experience gained during this transition. A word of caution – any pump used in this reactor ‘should’ be ATEX approved as it will be pumping Methanol. However my pumps aren’t and I’ve never had any problems, but it’s useful to know that Methanol is extinguished with water, unlike petrol. A brand of **self priming** pumps are the Rover Pompe diesel transfer pumps (internet search), which have a switch to **change the direction of flow**. Using a pump to circulate the reactants and oil is doubly useful as it allows you to agitate in a completely sealed environment and it acts as a macerator to any normal sized bits, leaving fine sediment after the reaction.

As can be seen in diagram, the reactor consists of several valves that isolate particular pipes or combinations of pipes. The flexible pipes are designed to be easily disconnected at one end and used to pump in to and out of the reactor. Once complete this design will allow you to perform all of the requirements to make 175 litres of Biodiesel per batch. This is the cheapest and most reliable design, and it also allows many other applications which become apparent with use. The hardest part of the build is getting a tight seal on the heating element, without breaking the brass body. If you build this design and need some further tips, then drop me an email and I’ll try to help.

Materials List

205 litre clamp top HDPE drums (Ampulla, Cheshire)

Two way self priming electric pump (*e.g.* Rover Pompe) (www.pumpexpress.co.uk)

3 metres of 22mm copper pipe (B&Q)

Immersion heater (Electrical / Plumbing Wholesalers)

Back ring for immersion heater (Plumbing Wholesalers)

5 x brass compression 22mm tank connectors (B&Q)

2 x brass compression 22mm T fitting (B&Q)

2 x 90° brass 22mm compression fitting (B&Q)

7 x 22mm isolators (B&Q)

5 metres of 1" PVC braided hose (goes on easier with hot water)

Platform upon which the reactor and wash tanks will sit

3 metres of 2.5mm² 3 core flexible cable (B&Q)

3 x 25 litre transparent HDPE containers (mixing, precise settlement and storage)
(Ampulla, Cheshire)

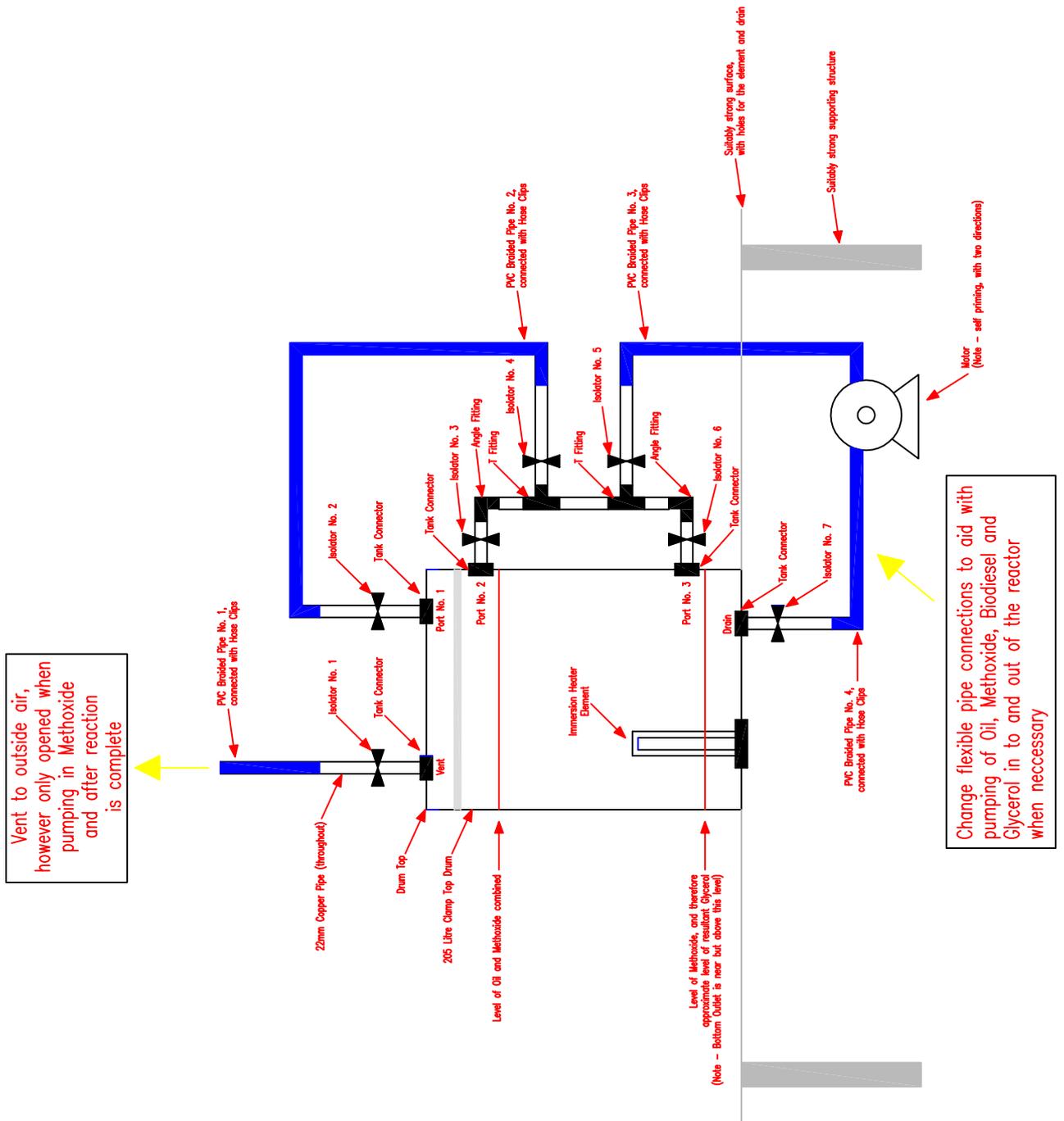
100 micron large sock filter (initial filter) (Ebay)

1 micron large sock filter (final filter) (Ebay)

10 x 30mm Hose Clips (Plumbing Wholesalers)

Reactor Vessel Diagram

By The Chip Pan Man – J. B-C



To conclude – Biodiesel is great fun after the initial learning curve, and you'll righteously drive past service stations knowing that you're doing good for the environment and also saving money. These two things don't normally go hand in hand and in this competitive world it makes a nice change.

Take care and happy brewing!