Make Biodiesel!

by **drinkmorecoffee** on May 21, 2008

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Author:drinkmorecoffee author's website
My name is Nathan!
Feel free to ask me any questions you may have about my instructables, or anything related to coffee, BioDiesel, or cooking.

Email: mybiodieseljourney@gmail.com
AIM screen name: nateinboone08

http://twitter.com/Nateinboone

Ask about skype!

-DMC

Intro: Make Biodiesel!

Instructable #2 in my series on biodiesel.

This is my tutorial for using my appleseed processor to make biodiesel. This tutorial will get you through the process of making biodiesel, but not the necessary washing process. I will do my next instructable on dry-washing biodiesel.

Biodiesel is a great way to go green, and cut your carbon footprint quite substantially, not to mention it's cheaper than diesel. Biodiesel will run in a diesel engine, I don't recommend trying it in a gas engine.
The process for making biodiesel uses an oil, a catalyst, and an alcohol. In this case: Waste vegi oil (WVO), NaOH (lye), and methanol.

Please read up on this before you start, and please understand the chemical dangers involved in this process.

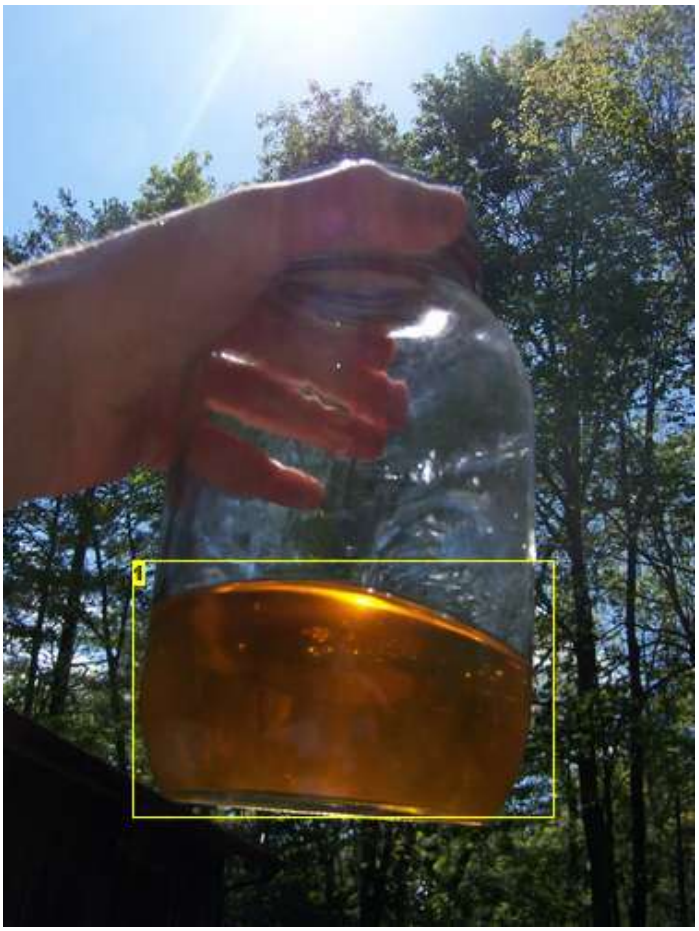

Image Notes
1. The finished product

Step 1: Safety

First off, some disclaimers and safety info.

NaOH (or KOH, depending on your catalyst of choice) is extremely caustic and will cause extreme irritation if it comes into contact with your skin, eyes, or any other part of you. Methanol is a harmful alcohol. It will cause blindness or death if ingested; one way it's absorbed into your body is through your skin, so simply handling the stuff with bare hand is bad for you. Lastly, Methoxide, the substance produced when you mix your catalyst with the methanol, is an extremely toxic nerve agent. It can do some serious bodily damage.

BE CAREFUL

I use a chemical resistant p100 respirator when I do this process, as well as eye protection. I use some heavy-duty chemical-proof gloves from Northern Tool. Long sleeves are recommended.

Step 2: Necessary supplies

Before you make the fuel you need to **filter your oil**. I filter mine down to 50 microns. I know people who don't filter at all and some people who filter as fine as 10 microns. One person I know simply lets it settle for a few days and disposes of the sludge that settles on the bottom.
To filter it I just hung a bag filter above a clean 5 gal. bucket. I used an old sock to get out the large particles before it went through the filter.

For the actual making of the fuel you will need:

- an appleseed processor

-WVO (you'll get as much fuel as the amount of WVO you use)
You can get this from restaurants, but you need their OK before you take it. You will get arrested and get in a pile of trouble if you just take the oil. Avoid burnt oil, as this will not react to make biodiesel. Most fast food places burn their oil.

-A catalyst: NaOH (sodium hydroxide) or KOH (potassium hydroxide)
The difference? well, KOH dissolves better in the methanol and NaOH tends to make the final byproduct (glycerin) more congealed. Also, you use different amounts depending on which you go with. NaOH is cheaper, and that's why I went with it.

-Methanol
Methanol is used for race car fuel, and can be purchases at many chemical supply places. This is the most expensive part of the process. Methanol is at about $5 a gallon. This still ends up being cheaper than regular diesel, since you add 20% methanol for the amount of WVO you use.

Safety equipment you'll need:

-chemical resistant p100 respirators
Got 2 at Lowes for $25-$30 each

-lab goggles

-chemical resistant gloves

What you'll need for the titration:

-Isopropyl alcohol
get this at an auto parts store

-distilled water

-a very tiny bit of your catalyst (NaOH or KOH)

-a sample of your WVO

-3 oral syringes
Get these at the drug store

-Phenol Red indicator (like for testing your pool water)

Step 3: Filter the WVO

I'm going to leave the collection part up to you, I'm just going to tell you what to do with the oil once you have it.

You should get it in Carboys, it's easiest to use this way.

my basic setup is very low tech, just a bag filter hung from a broom stick over a clean bucket. I used a sock this time around to try and get a longer life out of my filters. I have on clean carboy I put some oil in, and put the rest in another bucket.

Some people like to heat their oil before they filter it. Probably not a bad idea, and I may do this in the future.

Do not use any crappy oil that looks like a cloudy mess at the bottom of the oil. You can see it in one of my pictures. It has water in it, and will ruin your reaction, avoid using this at all costs.

Image Notes
1. bad stuff here at the bottom

Image Notes
1. A funnel! I amaze myself sometimes...

Image Notes
1. a sock!

Image Notes
1. water. (this is why you don't use this stuff)

Step 4: Titrate your oil

This is where we test the acidity of the oil, by measuring the free fatty acids, to see how much NaOH is needed for the reaction.

Start by measuring out 1 gram of NaOH and mixing that with one liter of the distilled water. This gives you a 1/1000 solution. Keep this, you won't use it all on one titration.

Next measure out 10 milliliters of the isopropyl and 1 milliliter of your WVO sample. Mix these in the same jar. Now add about 5 drops of Phenol Red indicator to this solution; swirl to get it mixed. Fill the last syringe with your lye/water solution and add 1/4 milliliter at a time while swirling the jar. Once it turns bright pink and stays that way you need to count exactly how many milliliters of lye/water solution you used to neutralize the acidity of the oil.

Now we can use this information to tell us how much NaOH to use in the reaction.
The formula is this:

For NaOH- *# of liters of oil x 4 grams + titration*

For example, say I titrated at 2 milliliters and was using 50 liters of oil. I would do 50 x 6=300. 300 grams of NaOH for that batch.

Image Notes
1. the color you're looking for

Step 5: Prep the oil

Take a carboy filled with oil and connect a section of hose from the carboy to the intake valve on your processor.
Use hose clamps to secure the hose to the carboy lid with the ball valve on it. Be sure to have primed the pump.
Now open the valve on the carboy and the intake valve. Turn on the pump and make sure the glycerin drain and out-take valve are both closed, so oil doesn't come shooting out.
At this point it is very important to have the pressure vent on the processor open, this way you can leave the valve nearest the processor tank closed and let as much oil as you can be sucked though the intake point and get pumped into the tank. Also, be sure to have the vent on the back of the carboy open, or you'll create a vacuum and the carboy will implode.

Once all the oil is in the tank you can turn on the element. If you're using more than 5 gallons of oil you obviously will need to disconnect the hose and repeat more than once.

Heat the oil to 130 degrees F. (you can open the drain valve, get a quick sample, and use a quick-read thermometer to check.)

Image Notes
1. closed
2. closed
3. closed
4. open
5. open
6. open
7. open

Step 6: Methoxide Mixing and Introduction To the WVO

This is the most dangerous part of making the fuel.
Measure out 20% of the total volume of oil worth of methanol into a carboy with a vent. (1 gallon of methanol per 5 gallons of oil and so on.)

Be wearing eye protection, chemical resistant gloves, and a respirator at this point.

Measure out the calculated amount of catalyst and put it in/on a coffee filter or something that you can dump quickly. Dump the catalyst into the carboy and immediately screw on the same lid or same kind of lid as shown in the previous step, the one with a ball valve on it.
Shake vigorously and crack the valve open away from you and other people. It will hiss. Shake it up some more, to be sure you get things dissolved all the way. You may need to vent it once or twice more to release the pressure.

Hook this up the same way you did the carboy with the oil. Make sure it's all very tight and secure, you don't want this stuff leaking. leave the intake valve closed for now.
Open the valve on the carboy and remove the vent cap so there is a slight bit of air coming into the carboy as some of the liquid trickles down the hose.
Open all the valves in the circuit on the processor and start the pump again so the oil is circulating. Leave the element on.
Now very very slowly crack the intake valve so the methoxide is introduced very very slowly. If you introduce it too quickly it will make soap. Not what we're shooting for here. Tilt the carboy to make sure all the methoxide drains out. Close the intake valve.
Double check the pressure vent on the processor. chemical reactions are happening and the pressure needs somewhere to go.

Let this go for about an hour before you consolidate it all in the tank. Let it sit with the element on for the next 12-14 hours.

Step 7: Draining the Glycerin

The main byproduct of biodiesel is glycerin. You put in 20% methanol, and get out 20% glycerin. Glycerin is useful, and can be used to make soap and things. You can also compost it. Just be sure to boil off any leftover methanol before you use it. There may be some unreacted catalyst, too.

After 12-14 hours it should be separated out. Open the valve nearest the tank and make sure the valve on the other side of the drain is closed, then slowly open the drain valve. Drain into a bucket until what's coming out changes color. At this point you've drained the glycerin and have reached the fuel. Drain the fuel into a separate bucket/container.

Image Notes
1. 20% glycerin, roughly.
2. Unwashed fuel, not quite ready to use.
3. unwashed sample

Step 8: What's next?

Now all you need to do is wash your fuel before you can put it in a car. There are several methods to wash fuel, and if you use water you need to be sure to dry it. I'm dry-washing my fuel. Dry-washing uses Magnesol, and it uses no water.

My next instructable will deal with the washing process.

Please don't run unwashed fuel in your car, and please don't forget to dry/filter after you wash.

Now I know some of you are wondering about this, and yes, I am going to add a methanol recovery system. As soon as I add the larger tank I'm adding that and some other upgrade type things.

Cheers!

-DMC

Related Instructables

Make Your Own Biodiesel Processor by drinkmorecoffee

Easy BEGINNERS guide to making a "BIODIESEL" powered car by deth2all

Mer-Chevy Project: Engine Pull Day (video) by bennelson

Automotive fuel hack by plumbhack

Cheapest and best biodiesel (video) by mieszalniapasz

Mer-Chevy Project: Tranny & Flywheel removal (video) by bennelson

Comments

50 comments **Add Comment** **view all 84 comments**

stib says: May 29, 2008. 5:37 PM **REPLY**

If you're making biofuel from waste products good on you, but if you think that biofuel is the 'green' solution to everyones transport needs I have to rain on the parade a bit. Biofuel sounds like a good idea until you start thinking about the consequences of it a little.

Like the way it's pushing up the price of food around the world , and the fact that producing food crops uses about 2.3 times more fossil fuel energy to grow than the energy they provide.

Looks like I can swap destroying the climate with my car for causing global famine with my car. Makes you wonder what would it take to get people to ride bikes instead.

bingo1912 says: Mar 10, 2011. 5:28 PM **REPLY**

Yup, what he said,,,,,

servant74 says: Jul 30, 2008. 5:35 PM **REPLY**

yep, but riding bikes on a 50 mile one way commute in Houston TX or LA kind of sucks. ... such is life for those outside the sweet spot areas where walking, bicycling, or even train commuting is an option.

Pkranger88 says: May 30, 2008. 8:49 AM **REPLY**

So you've made complaint. What's your solution, all wise and knowing?

drinkmorecoffee says: May 29, 2008. 8:08 PM **REPLY**

One word: Algae. Biofuels from food crops- bad idea, biofuels from non-food sources- the way of the future.

stib says: May 30, 2008. 2:38 AM **REPLY**

Well, biofuels from non food crops sounds good, until farmers who were growing food crops realise there's more money in growing fuel crops and give up growing food. It's not rocket surgery, it's market economics 101. If everyone switches to biofuels we can kiss the last of the world's rainforests goodbye. Biofuels from algae does sound promising, but then there will be impacts on marine environments. It just takes a lot of area to power the private car fleet with plant based sources. But you know I use biofuel for most of my transport needs: I eat food and ride a bike.

drinkmorecoffee says: May 30, 2008. 7:05 AM **REPLY**

Yes, but algae can be grown in the middle of nowhere. The fact that soil conditions matter a lot less with algae means it doesn't have to take up food crop land, or rainforest areas. There's still plenty of ground to cover, but algae is very promising.

smithy813 says: May 30, 2008. 3:37 PM **REPLY**

actually, soil conditions don't matter at all to algae, because it grows in the WATER, thats right, not the middle of nowhere, the middle of the OCEAN, its actually a promising idea, I've heard of it before. About the farmers switching to it, most like there land, not the ocean, I'm sure that a new job niche will only do good things for the economy (now, I've tried to make this neutral enough so that I don't spark a huge debate, but, in advance, sorry if i offend anyone)

bingo1912 says: Mar 10, 2011. 5:29 PM **REPLY**

OI VEY! soylyent green!

drinkmorecoffee says: May 30, 2008. 8:28 PM **REPLY**

Well, the most promising way to grow it right now is in tanks, above ground. No harvesting required. This could be done in the middle of nowhere, somewhere where the soil is no good for growing food-crops.

servant74 says: Jul 30, 2008. 5:39 PM **REPLY**

I like the one where they use overgrown plastic baggies hung row after row, with the algae solution pumped into the top and it slowly winds its way to the bottom. Still has big tanks to drain it into, but it does allow for circulation and central harvesting / maintenance / feeding. Some bloke in El Paso TX seems to have come up with it, but they are still working on which is the most profitable strain of algae for them. personally I have seen plenty of swimming pools and ponds that could use to have some cleaning done ... at least there the algae could be used rather than just thrown / flushed away if algae harvesting was easy to do.

T2Pogi says: May 29, 2008. 7:03 PM **REPLY**

There are many sources of veggie oil and tapping into these sources will no greatly impact the food situation. There is jatropa seeds, coconut oil (many countries in asia have a surplus capacity of this oil due to the scare re "unhealthy" oils), and of course, there is the waste oil for small consumers like us. now if you are talking about ethanol from corn, you may be right. that route is apparently not the way to go.

How To Guy says: Sep 28, 2008. 4:23 PM **REPLY**

How is biodiesel worse for the environment? Diesel is a fossil fuel. Biodiesel isn't. Besides, I wish all exhaust smelled like greasy french fries.

bingo1912 says: Mar 10, 2011. 5:24 PM **REPLY**

The main reason they are saying that bio diesel is bad for the environment is not true. what is bad is raising crops and using the oil for fuel instead of human consumption. When this happens the price if food goes up and less land is used for the production of food.. As our population grows so does the amount of land we use to live on, decreasing the amount of farmland. Couple that with the fact that more and more small farmers are leaving the farms. Hug a farmer. they are a dying breed

mr.space says: Dec 28, 2008. 9:48 AM **REPLY**

the fact that its a fossil fuel doesn't make it worse for the environment, only certain fossil fuels are worse for the environment, the good thing about biodiesel is that it can be made out of waste products and wont run out...like fossil fuels

psi3000 says: Jan 7, 2011. 6:17 AM **REPLY**

WARNING!!! You imply that your p100 respirator will protect from Methoxide, when in fact IT WILL NOT!! NO RESPIRATOR WILL. Only fresh air supply will. Just a heads up. The best thing to do is mix the Methoxide and make the bio diesel outside with the wind blowing in the right direction. I wish there was a respirator that could help as this is the only thing holding me up from making my own bio diesel. I have everything to my my processor even and I stopped when I found this out.

phucall-fitz says: Jun 24, 2010. 5:23 AM **REPLY**
hi tufrat look on the journey to forever web site it gives covertion tables for both koh and naoh.Its agood site for allthings earh friendly. regards

dsandds2003 says: Oct 12, 2008. 8:50 PM **REPLY**
is the Methanol the same as they use for the E-85 cars?What is kinda ironic is when they were first building tractors they came with a 3-way valve. These old tractors used gasoline,kerosene and diesel. Now we use entirely different engines. As a matter of fact before gasoline was popular most engines ran on moonshine....Think about it????

drinkmorecoffee says: Oct 13, 2008. 10:04 AM **REPLY**
E-85 is Ethanol. Different stuff. .... And do not, whatever you do, buy an E-85 vehicle. Any car with a gas engine can run E-85. Car manufacturers slap an E-85 sticker on a car and charge a butt-load of money for it.

bmk789 says: Apr 26, 2010. 12:22 PM **REPLY**
Not completely true. While about any gasoline engine CAN run on E85, not all will do it correctly. For example, I've run my 93 Dodge Shadow 3L on E85 for a few months, until I noticed a white coating on my spark plugs when I pulled them out. The ECU doesn't know to add additional fuel, and the engine runs lean, all the time. This burns the pistons/spark plugs/cylinders and can eventually damage your engine. If you're not sure your vehicle can account for ethanol, I suggest running about 60% gasoline 40% E85. This won't run lean enough to do damage and will usually result in more power and fuel economy than straight gasoline or straight E85.

TufRat says: Jan 24, 2010. 4:46 PM **REPLY**
What is the method if you are using KOH instead of NaOH, particularly the mass/ volume KOH used instead of NaOH?

dpacjones says: May 25, 2009. 12:13 PM **REPLY**
If you heat the oil first, 180F is ideal, minimum 140F, and a maximum of 210F, you can evaporate alot of the water and the oil filters alot better. Keep the lid off, and wrap the barrel with insulation to help keep it warm and speed up the process. Also if you do have water in the oil you can heat it, let it settle overnight in a barrel/ bucket with a drain on the bottom, then in the morning the water should be seperated on the bottom of the barrel, open the bottom valve and drain off the water and other particles that have gathered on the bottom. the longer you let it settled the better. good luck!

Derin says: Feb 22, 2009. 6:24 AM **REPLY**
I read in the paper that fast food places use Magnesol to re-use burnt oil.It fixes the color,fixes the smell but does not remove the carcinogenic stuff.

Skor459 says: Aug 17, 2008. 3:27 PM **REPLY**
Step 1) Piss in jar Step 2) Put in car Step 3) ??? Step 4) Profit

pickford78 says: Oct 12, 2008. 9:25 PM **REPLY**
lol. the fuel gnomes tell you that one?

Skor459 says: Oct 13, 2008. 12:17 AM **REPLY**
They tell me to burn things.

Matt D655 says: Oct 12, 2008. 6:09 PM **REPLY**
excuse me, why put a jar of pee in your gastank?

Skor459 says: Oct 12, 2008. 7:44 PM **REPLY**
If it looks like biodiesel, it must be biodiesel.

pickford78 says: Aug 17, 2008. 11:48 PM **REPLY**
Bio Diesel is worse for the environment. don't use it!

drinkmorecoffee says: Aug 18, 2008. 3:22 AM **REPLY**
Do explain, please.

pickford78 says: Aug 18, 2008. 2:09 PM **REPLY**
The vegetable oil is made of more carbon. try burning your mixture and then burn diesel. use the same ammount and see how much carbon comes off.

Ikotoo says: Oct 12, 2008. 8:26 PM **REPLY**
Also, many farmers are cutting down massive amounts of trees and others greenhouse reducing plants to make crops for biodiesel. With less trees there is higher amounts of greenhouse gasses going into the atmosphere. Personally I think biodiesel is a step in the right direction.

drinkmorecoffee says: Aug 18, 2008. 5:03 PM **REPLY**
You're absolutely right, but the diesel just came out of the ground. Where did carbon in the oil come from? -The plant it's made from. Where did the carbon in the plant come from? -The air. It's not necessarily about how much carbon is going into the atmosphere, it's how much you're leaving there. Biodiesel is miles closer to carbon neutral than diesel, just sayin'.

Matt D655 says: Oct 12, 2008. 6:06 PM **REPLY**
I think youre correct but it is much cheaper to make biodiesel

pickford78 says: Aug 18, 2008. 5:28 PM **REPLY**
good point, i think.

Bubbler says: Aug 18, 2008. 5:50 AM **REPLY**
At the beginning, you mention the water factor and how to avoid using the sludgy bottom of the tank contents. In an industrial setup, this is handled by storing re-cycled oil in a high narrow tower. After it has been ther for a good few months, gravity takes care of the solids (metal grindings) and water. It all settles to the bottom of the tank. A tap at the bottom of the tank o s turned on to expel the lower contents until the flow turns from a muddy colour, into the black used engine oils. This system could be utilised by storing veggie oils in a PVC down pipe of six metres length or maybe less, in a vertical position.

Derin says: Aug 17, 2008. 2:19 PM **REPLY**
ok,*drinks more coffee* lol

puffyfluff says: Aug 15, 2008. 5:47 PM **REPLY**
I think I just convinced my parents to get diesel cars after showing them this. Awesome job!

Pkranger88 says: May 22, 2008. 10:19 AM **REPLY**
Awesome. I will definitely stay in tune. I've been doing research on this for a while.
One problem we're running into locally is that home processing is becomming so common that commercial recyclers are taking over at restaurants so obtaining quantities of waste oil is extremely difficult. Whereas 2 years ago I could get the oil for free or even cheap, not it costs about $2/gallon. For that price, making my own is really not that much different cost wise than just buying diesel.
I have 33 acres, so now I'm looking into efficiencies of raising certain crops to get my own oil.
Keep up the good work. If you want any collaboration, my email is brianjherr@yahoo.com. I'm a research associate for the National Institute for Aviation Research.NIAR

socrateez says: May 22, 2008. 11:51 AM **REPLY**
What about Hemp?

Sonoffar says: Jul 25, 2008. 11:35 PM **REPLY**
Illegal in the US as I recall. It would probably make a good oil for bio-D. The problem of course would be all those folk running along behind your car trying to inhale your exhaust. Visualize a Los Angeles freeway at 5:00PM. 70,000 cars running on Hempolene.192,000 stoners running in and out of traffic seeking the least efficient operating engine. Just bring tears to my eyes.

servant74 says: Jul 30, 2008. 5:24 PM **REPLY**
Not all hemp, but the authorities keep a CLOSE eye on you so I am told. Some varieties are better at production of THC than others. The high producers are not the best for rope/celulose, but trying to explain that to some county mounty in the middle of nowhere doesn't work well. So keep it simple and don't is the best common answer.

Pkranger88 says: Jul 31, 2008. 6:19 AM **REPLY**
THC producing Hemp is illegal to grow while the non-THC Hemp is perfectly fine. The issue comes in that you will likely have random checks and testing on your crops from law enforcement. This destroys the plant, by the way. Hemp does make rope, paper and even clothing. I wasn't looking at using Hemp but rather Soy, sunflowers or switchgrass, etc.

Sonoffar says: Aug 1, 2008. 2:12 AM **REPLY**
I'm not a grower of any sort of plants, except the weeds that have replaced my lawn.
Pkranger88 What are the characteristics of the plants and oil you hope to produce? How much bio-diesel do you hope to make per month? What quantities will be required to satisfy your needs?
If anyone reading has an interest in commercial hemp production, as opposed to DEA attraction, this site has some good basic information.

http://www.hemp-sisters.com/Information/factsheet.htm
Hemp might be a good alternative to fossil fuels, and the smoke and mirrors of wind, solar, and manure.

socrateez says: Jul 26, 2008. 9:35 AM **REPLY**
LOL, I know it's illegal but wondering if it is viable compared to other biomass.

drinkmorecoffee says: May 22, 2008. 10:57 AM **REPLY**
Oh neat. With the way diesel prices are going right now $2 a gallon for oil may still be cheaper pretty quick here. I'm interested to hear what you do on your land if you end up growing anything. I wish we had enough land to grow anything, but sadly all the land we do have is too shady to grow any crops. Thanks for the positive comment! -DMC

nnsg says: Jun 6, 2008. 12:03 PM **REPLY**
SOMEONE TOLD ME THEY JUST STUCK VEGGIE OIL IN THEIR DIESEL AND IT WORKED. IS THIS TRUE?

servant74 says: Jul 30, 2008. 5:31 PM **REPLY**
It does work. Folks that do it regularly use a 'dual fuel' system, starting and ending using 'petro-desil' and running in between on straight veg-oil. Dear ol' Mr. Diesel initially envisioned being able to run on veg oil or just about anything that burns directly. It works, just not in the higher compression engines we like to run today (but they do burn it more efficiently).

drinkmorecoffee says: Jun 7, 2008. 12:09 PM **REPLY**
Well, yes. It probably did work, but it's not the most efficient way to go. SVO (straight vegetable oil) works best if you do some engine modifications first (heated fuel lines, etc.). I wouldn't recommend just pouring it in.

TWMCNANEY says: Jul 29, 2008. 11:58 AM **REPLY**
You are really good at making instructables. I hope that you are going to make another one on how to dry the diesel. Im making a proccesor for Biodiesel with the other instructable that you posted.

view all 84 comments