



## Used Cooking Oil The Easy Way...How to Use Used Cooking Oil in a PlantDrive System...What It's Designed For, What to Expect.

A "six step" approach, starting with selecting the oil, is what is outlined below. It is what we and many of our customers have done for several years:

1. Get non-hydrogenated oil \*from the kitchen.\* (not the dumpster. Give the restaurant our Funnel and Stand to make it easy for them to put the oil back into the jugs it came in.)
2. Let it settle. 2 weeks, room temperature.
3. Take the jugs out of the boxes and check for color, amount of settled crud and water.
4. Do the Hot Pan Test – see below.
5. Use the 70 micron Wand (see our Pump and Wand Deal in the Shop Online section of the catalog: <http://www.plantdrive.com/shop/product.php?productid=16140&cat=255&page=1>) which doesn't reach to the bottom of the jug.
6. Install our Vormax on-board filter (a Vormax, with it's two stages of water separation including 10 micron spin-on Racor Aquabloc filter, will handle well-settled and hot-pan tested oil without the need for further prefiltering.) (Our new VegMax, with a 5 micron filter, may require further prefiltering than settling and the Wand – see below for our One Drum and Two Drum filtering systems.)

**So, what follows, then, is what we recommend.....**

### **Used Cooking Oil The Easy Way...How to Use Used Cooking Oil in a PlantDrive System...What It's Designed For, What to Expect.**

(originally written by Craig Reece of PlantDrive, and Jennifer Radtke, of Biofuels Oasis, Berkeley, California). Additional comments by Edward Beggs of PlantDrive)

Golden Rule #1: Gravity and Time are your Friends, when it Comes to Filtering. A few weeks of settling at room temperature makes a HUGE difference in how long the spin-on filter element will last on your Vormax onboard filter. Contaminants and free water settle out. You then use our Wand and Pump to move the material into the SVO fuel tank.

**Many of our customers never do any more than this – the Vormax two-stage prefilter/filter is that good.**

Golden Rule #2: GET GOOD, LIQUID OIL. WE DON'T DESIGN FOR "GREASE". WE NEVER HAVE. WHY? IT ENCOURAGES THE USE OF HIGHLY VARIABLE, CONTAMINATED, OXIDIZED, THICK, HIGH FREE FATTY ACID (ACIDS ETCH METALS!) OILS THAT ARE DIFFICULT TO HANDLE, GO SOLID IN STORAGE CONTAINERS TOO EASILY, ARE GENERALLY NOT A GOOD FUEL, AND SHOULD BE CONVERTED TO BIODIESEL AS OPPOSED TO BEING USED AS STRAIGHT VEGETABLE OIL.

WE ALSO ADVISE AGAINST TAKING ANY OIL FROM RESTAURANT "BACK-ALLEY" DRUMS OR DUMPSTERS. IT'S THEFT, IF IT'S IN A DRUM OR A DUMPSTER - IT BELONGS TO THE RENDERER/CONTRACTOR NOT THE RESTAURANT. IT ALSO IS MUCH MORE LIKELY TO CONTAIN WATER AND OTHER CONTAMINANTS. WE'VE SEEN EVERYTHING FROM DISPOSABLE DIAPERS TO MOTOR OIL AND OIL FILTERS IN THOSE THINGS! THE LONGER IT SITS IN A DUMPSTER, THE MORE THE FFA'S BECOME ELEVATED, THE MORE OXIDIZED THE OIL BECOMES, ETC., ETC. READ ON FOR MORE DETAILS OF WHAT WE \*DO\* AND DON'T RECOMMEND.

This was posted on the Frybrid Forum - guy with a less than 6000 miles on a conversion of his 2006 Ford Powerstroke 6.0 had an injector meltdown, ended up with 12 quarts of WVO in his engine oil, finally got the verdict on why the injectors failed:

"If any of you are still following the saga of my injector replacement, here is where the story gets a lot more interesting. Jonathon at Swamps diesel emailed

me and basically said it was indeed fuel related and not just poor injectors. He said the inside where the fuel contacts the metal was pitted and corroded from something very caustic, NOT from vegi oil though....from something that was in my vegi oil.

I collected twice from the dumpster and the rest of the time i collected straight from the fryer to the 5 gallon cubies. So it had to be the dumpster oil that i picked up that had something in it besides just oil. Now we are going to find out what it was that contaminated that oil. Jonathon suspects a cleaning agent maybe used to clean the grills and fryers. Those agents are very caustic and may have been dumped into the grease dumpster. A sample of the oil that was in my tank is being tested as I type this and they are looking specifically for chemicals like sodium hydroxide (lye), tri-sodium phosphate, chlorine or ammonia compounds - all chemicals that can be found in cleaning agents. Once we see what exactly is in the oil, I can check with the place I collect oil from and find out what they use to clean fryers and grills with and ask if they have ever dumped these cleaning agents in there dumpster. If this all pans out the mystery will be solved as to why this all happened.

I was sure it was related to poor injectors by design or the added power mod but the proofs in the puddin. I will abandon my quest to make Ford pay for my repairs....there injectors weren't the culprit, bad oil was...what can I say. So let this be a lesson to anyone that collects oil from a dumpster. I'll never get mine that way again, I promise you that. That 300 gallons i got from there dumpster cost me \$3,000.00 and now i have 200 gallons of it in the garage i have to take and dispose of and start a fresh collection."

The above illustrates why we urge you to talk the restaurant into putting the oil back into the jugs it came in, using our Funnel and Stand – you won't run the risk of getting foreign substances or water in your fuel.

### **The Hot Pan Test for Water in Oil**

Here is an excerpt and a link from a good article on water in oil, and a basic test method for determining presence and approximate amount of water in a sample. Wear proper safety gear, water in oil can cause hot oil to "spit" at you! So, safety glasses or face shield, gloves, splash apron, etc.

PRE-heat a CAST IRON frying pan in an OVEN, or use an ELECTRIC FRYING PAN. ENSURE PAN IS NO HOTTER THAN INDICATED BELOW. One thing that you can also do, "for the road" or where you don't have power, is get one of our 12V DC pad heaters, and an old aluminum camping pot or pan, stick the pad heater to the bottom, and use your car battery as the power source. Handy!

Smear an oil dampened finger of used cooking oil ("WVO") across a cool cast iron fry pan. This will serve to indicate when the pan is reaching test temperature.

Keep the sample of WVO to be tested handy. Enough for 1/4"-3/8" thickness covering the bottom works best. Heat the pan on medium high temp until the smear begins to produce smoke then slowly and carefully pour in the sample.

Observe the sample where the oil contacts the pan surface. Very small bubbles forming on the pan/oil interface indicate suspended water in the sample.

The density of bubbles indicates how much water is present. Obviously this is a somewhat subjective test.

Many large bubbles indicate the sample contains at least 1000 ppm of water in the sample.

Many small bubbles indicate the sample contains 500-1000 ppm of water in the sample.

3-4 bubbles per square inch indicate 200-300 ppm of water in the sample.

1-2 bubbles per square inch indicate under 100 ppm of water in the sample.

If crackling or popping is heard..over 1000ppm of water is present in the sample.

Optimally you want to use VO fuel that contains less than 750 ppm of water for maximum injector pump and injector life. (The German DIN fuel standard new rapeseed oil (Canola) is 750 ppm, the US for ASTM-spec biodiesel is 500 ppm.)

#### NOTES:

Do not pour in a sample with any visible water.

If water droplets are visible no testing is needed. There is water present in your sample.

Visible droplets of water will spatter hot oil out of the pan and may cause burns or fire.

Do not average bubble count. The visibility of bubbles is dependent on the temp of the underlying pan and this may be regionalized depending on your heat source.

If the pan has been washed or not used previously it must be "seasoned" to make certain that no moisture is trapped in the pores on the surface of cast iron.

False positive results (bubbles) can be obtained if the pan is WAY too hot..or if solvents are mixed in the WVO.

False negative results (no bubbles) are possible if the suspended water has high concentrations of salt/sugar/acids.

#### What is Good Oil?

Many people who have run on WVO (Waste Vegetable Oil) have gotten bad oil at one time and clogged their fuel filter or had to pump it out of their fuel tank. Getting good oil isn't hard and it's worth it to be picky and get the best oil you can. Good oil is free of water and food chunks and is liquid at outside temperatures (Canola oil is good for winters). Good oil is also not overused, so it's not so rancid/acidic. Restaurants that either 1) change their oil every day or 2) change it weekly but don't use it much are good candidates. Fast food restaurants generally have horrible oil.

1. DO NOT use oil that's solid (or nearly solid) at outside temperatures (for example, don't use oil containing large amounts of animal fats. If your donor restaurant grills meat, try to talk them into giving you just the oil from the fryer, and doing something else with the grill grease.)
2. Avoid hydrogenated or partially hydrogenated oil (check the small print on the boxes the restaurant gets the oil in to be sure it's not partially hydrogenated.) Partially hydrogenated oil can be used in the warmer months, but in the winter months in colder climates will take longer to become liquid in your tank, filter and lines, and you'll end up driving on purchased fuel longer before switchover to WVO. It's worth it to try to find a restaurant with non-hydrogenated oil.
3. DO NOT use oil that has water in it. Alert your restaurant that you can't have water in the oil as well. If the oil looks milky and/or not clear, it could have water.
4. Try not to use oil with LOTS of food chunks, tempura batter, or other foreign material. (The 70 micron filter in The Wand will filter out this stuff, but it will need cleaning more often.)
5. DO NOT Pump the bottom 6 inches from a 55 gallon drum or dumpster behind a restaurant or the bottom inch in a 5 gallon jug. This is where the water and food chunks will settle: leave it there and out of your fuel tank.
6. DO NOT EVER Pump/pour oil directly into your fuel tank without filtering.

## **Approaching Restaurants for Oil**

Restaurants pay to have their waste oil taken away, so they are usually quite happy to have you take it for free. They also think it's cool that you are using it to fuel your vehicle. First of all, I persuade the restaurants who give me their oil to pour it back into the 5 gallon plastic jugs-inside-a-cardboard box it comes in. I currently get oil from 4 restaurants and they all get it delivered in such packaging - rice bran, cottonseed oil, peanut oil, and corn oil. Getting it in the jugs also means you'll be aware if they change what kind of oil they buy and you can decline it if they change to partially hydrogenated. (You could attempt to effect a little social engineering by guilt-trippingly pointing out to them that their oil isn't good for the coronary arterial health of their customers - I look forward to a day when restaurants using lard, Crisco or partially-hydrogenated oil will be at a competitive disadvantage since they'll be the only ones still paying to have their oil hauled away.)

## **Providing Your Restaurants with our Funnel and Stand**

I make their life a little easier by giving them a big (3 gallon) galvanized funnel and a sturdy aluminum stand for it (and we sell it on the website) - they've been pouring their fryer oil into a 55 gallon drum with a removable drum end/cover or a large grease dumpster, a much larger target than the neck of a cardboard-boxed plastic jug, and a large target is nice to have when pouring from a fryer full to the brim that weighs about 40 pounds, full in this case with 5 gallons of warm fryer oil. The aluminum stand supports the funnel, eliminating the need for the kitchen staff to carefully position the funnel on the box and eliminating the risk that the funnel will slip out of the jug mid-pour.

If the restaurants normally pour their oil in hot into the drum/dumpster from the fryer without letting it cool, the hot oil will melt the plastic jugs

If you can't convince them to let it cool (by pointing out that you are saving them money by picking up their oil for free) provide them with metal fuel cans that won't melt.

Providing them with a funnel and stand also lets them know you're serious - you've invested in some infrastructure, and this will help convince them that you'll pick up their oil on the regular basis that you both agree to. I'd suggest bringing a photo of the funnel and stand arriving at the restaurant to first approach them about picking up their oil.

## **Advantages of the Vormax Filter**

If you have our Vormax coolant two-stage fuel prefilter/filter installed on your vehicle, lucky you, you can use our PipeLine 12V Pump and filtering Wand to just pump settled oil right into your tank - no bag filtering needed. (We sell the PipeLine Pump and the Wand, with its cleanable 70 micron stainless mesh filter, on the website.

The Vormax was developed for big diesel rigs. Downtime for a big rig is costly - just taking one in for a fuel filter change is costly in downtime. The designers of the Vormax incorporated a prefilter that gets rid of most of the dirt and water - if any - in the fuel before it gets to the (huge) spin-on cartridge. The dirt (or food chunks, in our application) and free water in the fuel fall to the bottom of the clear Lexan prefilter bowl, where they are visible and can be drained via the drainvalve. And the huge spin-on canister filters are available from us or locally. Truck service shops that maintain large highway trucks are usually going to offer the best prices.

## **Settling of Oil**

The longer you let your oil settle before transferring to your fuel tank, the better, within reason - i.e. you want to use the oil within a few months of collecting it. A few weeks of settling is the norm. The PipeLine Pump and cleanable filtering Wand will also work for "dumpster diving", but if you're dumpster-diving for WVO, it's even more important to let the oil settle - the longer the better - before pumping into your tank. And, see above....we DO NOT ADVOCATE DUMPSTER (DUMBSTER) DIVING. Get oil that smells good, looks good (amber to light brown, transparent or translucent), pours easily at room temperature, and get the restaurant to put it back in the jugs they bought it in, and CLEARLY LABEL IT with a SHARPIE PEN (Marker) or etc. as being "USED COOKING OIL - INEDIBLE"....and DATE IT. On the cap is best. Advise the restaurant to do this, is even better. At least have them write "WVO" or "UCO" on the caps.

I bring the oil home, and let it settle for a day or two, minimum...the longer the better - a few weeks is ideal. Then I pump it into my vehicle using the PipeLine Pump and filtering Wand with 70 micron filter right from the 4.5 gallon restaurant jugs, or alternatively into a settling drum or tote in the shed, into my tank. I then consolidate all the last bits of oil into one jug until it's full, let it settle again for a few weeks, and carefully pump from the top of it. If you don't have the Vormax filter in your vehicle, you'll need to bag filter down to at least 5 micron.

We also sell two 120V pumps on the website, one of which has a replaceable 10 micron filter.

I tell people to leave the cardboard on the boxed jugs until they're close to being ready to pump from them - they're easier to stack

with the cardboard on - but to strip the cardboard off the jugs before you pump from them and take a look at the oil - you'll see how much crud is floating, how much has settled, and if there's any water (which will settle at the bottom, eventually, as will the crud.)

Once you've got the cardboard stripped off the jugs, you may find that more settling is needed, and you can monitor the settling process - unless there's almost nothing in the way of food scraps or water to start with. (And I've never seen any water in any of the over 5000 gallons of oil I've collected - generally, the heat of the fryer will get rid of any small amount of water from frozen food, or water from rinsing fresh food. But at least when you first start collecting from a restaurant, subjecting a sample of settled oil that you've drawn from the jugs with the Wand (which, once again, does not reach all the way to the bottom of the jugs, by design, leaving most water on the bottom) to the Hot Pan test is a good idea.)

As the food scraps or batter chunks settle, you'll see it accumulate on the bottom, and the oil above it will become progressively more clear. And since our filtering Wand doesn't reach all the way to the bottom of jugs, but stops about 2-1/2" to 3" short of the bottom, the settled crud will stay there.

## **Using the PipeLine Pump**

The PipeLine Pump is much more heavy duty than cheaper pumps, and less apt to burn out pumping oil in the winter. I routinely pump over 100 gallons of oil continuously and my pump doesn't even get hot to the touch. Cheaper pumps will burn out easily even in the summer from the thickness of the vegetable oil. I use the pump, connected to a portable jump-start battery, available at auto parts stores everywhere, or Northern Tool, or Graingers. Using this little battery allows me to pump and filter in my shop, but you could also pump and filter near your vehicle using the pump's alligator clips connected to your car's battery.

## **The Wand**

We sell a prefiltering wand that has a stainless mesh suction filter installed inside a PVC tube. The filter is 70 microns, with a pleated stainless screen over a stainless support tube.

## **Cleaning the Filter Inside the Wand**

The suction filter is cleanable, so you never need to buy another one. I use Castrol Superclean, Purple Power, or Greased Lighting!, available at most auto parts stores. I buy Castrol Superclean by the gallon, and I don't buy the quart spray bottles of either brand because the spray function takes a dump after a couple of refills - I go to any local lumberyard or hardware store and buy their best quart spray bottle. The best sprayer out there is made by ZEP. To clean the filter, spray it thoroughly with one of the above, then spray it off with high pressure water from a trigger nozzle or similar on a garden hose. I've done it in the kitchen sink, but not while my wife was home :-). Then shake it out well, and let dry in the sun.

I also occasionally need to use a toothbrush to dislodge small chunks of food (cumin seeds from my Indian restaurant most typically) out of the stainless pleats.

The Wand does not reach all the way to the bottom of restaurant jugs - it stops short by about 3" - so by default it leaves the settled crud on the bottom.

## **Dumpster-Diving , How to Do It Right (if you're going to do it at all)**

Dumpster-diving oil means taking oil from a drum or oil dumpster behind a restaurant .One problem is that an outside drum/dumpster can have rainwater in it, leaves/debris, and even motor oil/etc. that other people have dumped there. This is why it's much better to be getting your oil directly from a restaurant in jugs.

First, smell the oil. It's best if it smells like food (and not like vinegar/rancid.) It shouldn't smell like motor oil. Using the Pipeline Pump and Wand, hold the wand so you are just pumping from the very top of the oil (the top inch or two), and pump into containers. Don't let the wand drop to the bottom. The wand will filter out food chunks and debris. It's good to have an extra filter for the wand, so when it clogs, you can just switch the filter out at the dumpster w/o having to clean it. Leave at least 6 inches of oil at the bottom of the drum/dumpster; don't chance it, especially if you don't regularly dumpster dive at this restaurant, because it could very well have lots of water in it. Take the oil home, let it settle, then use the Crackle Test to check for water before using the Pipeline Pump and Wand to pump into your tank.

## **MAKING A "TWO-DRUM" PREFILTER / STORAGE SYSTEM**

**This is a neat way to do some more prefiltering and really get maximum time between cleanings of the Wand, and to get maximum life out of your filter elements on the Vormax.**

Buy two used 55 gallon drums, one steel open-headed (removable top with a ring that holds the lid on) and one white translucent poly closed-head drum.

If you can't find them used, to buy them new, click: [US Plastic 55 gallon drums](#). Steel drums are almost always available locally, if you can't find them in the yellow pages, try the web.

To buy a 200 micron "drum screen" click: [US Plastic drum screen](#).

(If the link doesn't work, it's their item # 10875, just type that into the search field on their website: <http://www.usplastic.com> or call them at 800-537-9724.)

Buy some 7" x 16-1/2" Two-in-One High Capacity Felt Filter Bags from us - they're on the website under "All Other Products. They are a 25/10 micron rating (the inner bag is 25 microns, the outer bag is 10 microns, so the 10 micron's life is extended by the coarser inner bag).

Use a jigsaw or a 7" holesaw to cut 2 or 3 - 7" diameter holes in the poly top of the poly drum. Drop 2 or 3 filterbags into the holes.

Install the 200 micron drum screen onto the 55 gallon steel open-head drum. Pour your jugs of WVO carefully through the drum screen, slowly, and stop pouring when the "yucky stuff" on the bottom of the jugs starts to flow. Those last few inches can be consolidated into one jug, and "resettled", and re-poured later. To get even less crud in the drumscreen and into the steel drum, use the PipeLine Pump and our Wand to pump from jugs into the drum screen.

Use your PipeLine Pump and PlantDrive Wand to draw from that drum, but never all the way to the bottom - let the sub-100-micron yuck settle there, where you can occasionally clean it out. You can also get some really great things called "drum liners" to put in there before you ever use the drum. Basically very heavy duty bags. then once a year or so, just drain the the drums as low as you dare, to make it possible lift out what will be a fairly heavy bag of a few inches of semi-solid material. That material can then be composted or disposed of and a new bag inserted.

Pump through the wand into the 2 or 3 filterbags in the poly drum. When one filterbag fills up, start filling the 2nd one, and repeat this process until the level of WVO in the poly drum is just below the bottom of the bags or until you've pumped all but the bottom 6" or so of the steel drum.

Remove one of the bags when you want to fill your car - insert the wand, and pump into your tank.

You can buy 120V band heaters that clamp around the bottom of a steel drum, and set the thermostat to give you temps in the 100-110F range, and keep it heated to those temps for 24 hours, which will speed settling of crud and water. Test the finished product for water via the Hot Pan Test.

All the above assumes it's fairly warm out. You cannot get oil to pass a filter bag if you are working in a cold garden shed in winter, for example. A heated workspace is easiest, to be sure. If that is impossible, and you only have a very small storage space available, just bring a few jugs at a time into a warm spot in the house, let them settle, and pump out of them with the Wand and Pipeline Pump. You'll still get decent time between Wand cleanings, and decent Vormax filter life just not as long as using the Two-Drum setup. Or buy one of our 120V pumps, which will pump cold oil faster.

## **The One-Drum Filtering Setup**

If you've tested your restaurant's oil repeatedly for water and it's consistently tested negative, and you're always getting it from inside the kitchen - that is, if they're putting it back into jugs using our funnel and stand, so that it's not getting rainwater due to sitting outside in a dumpster or drum, you might be able to prefilter using just a single drum.

### **Single Drum Prefiltering System**

You'd get a 55-gallon closed head poly drum used locally, or from US Plastics: [US Plastic 55 gallon drums](#) and then follow the procedure outlined in the Two Drum Filtering System to install 2-3 of our two-layer bag filters, and never pump off the very bottom of the drum. Occasionally you'll need to dispose of the settle crud on the bottom.

## **Recycling the jugs and cardboard**

After awhile, you'll find you have some empty jugs, and a pile of flattened cardboard boxes the jugs were packaged in. What to do with them follows.

(And please remember our tip, above, that you want to \*not\* remove the cardboard until you're ready to process the oil in the jugs, because they stack nicely only if the cardboard is still on them, and remember that you \*do\* want to remove the cardboard just prior to starting to process the oil, so that you can see how much settled crud - and water, if any - is on the bottom.

And if you pour the contents of the jugs into a drum with a drum screen, you'll be able to stop pouring before the crud and water exit the jug. If you're using our Pump and Wand to pump from the jugs, you'll leave the stuff on the bottom by default, since the Wand does not reach all the way to the bottom.)

So, back to the pile of cardboard and empty jugs:

Try and recycle it - you will be doing society, and the restaurant a service, by the way in all of this, since a restaurant very often just tosses the whole jug and cardboard sleeve into a solid waste dumpster. If they do, there is no recycling of these, and it also takes up considerable space in a dumpster and in a landfill.

Often the cardboard is clean enough to be recycled (some places won't take it if it's oily and dirty, so encourage the restaurant to use our funnel and stand - which you can give to them, if you wish, and put cooled oil (under 100F, say) NEATLY into the jugs. It's a good idea for them to put an "X" on the caps with a Sharpie pen when they are done, to ensure they will not accidentally mix them up with new jugs.

Do the **JUG STOMP**.....

So, what about that plastic? Well, we sure don't want it going into a landfill for the next thousand years if we can help it, right? Have the cap handy, but removed. Grasp the handle, then stand on it with one foot, flatten it, and quickly reinstall the cap, so air cannot reenter. That'll keep it quite flat. How flat you try for is up to you. Don't overdo it to the point you might split the plastic and have a mess. Then take them to a place that accepts milk jug plastic for recycling. This stuff gets made into plastic lumber, etc., it won't be used for anything to do with food again. Check with the operator if they're acceptable as is, or not. If not, you might have to clean them out more, or give up, flatten and landfill as they likely would have been in the first place. Up to you. But at least they'll be flattened, and you'll have recycled the cardboard.