Making Your Own Biodiesel

Zhiyou Wen[1], Christopher Bachmann[2], Robert Grisso[1], Jactone Arogo[1], David Vaughan[1]

[1.] Extension specialist, Biological System Engineering, Virginia Tech, Blacksburg, VA.
[2.] Assistant Professor, Center for Energy and Environmental Sustainability, James Madison University, Harrisonburg, VA

Biodiesel is an excellent alternative fuel for diesel engines. It is made from agricultural products grown within the Commonwealth and can be used by Virginia farmers. It is most commonly made from oil extracted from soybeans, one of the top agricultural products in Virginia, and there is a lot of interest in biodiesel production across Virginia. In general, biodiesel can be produced from any of the following: pure vegetable oil (soybean, canola, sunflowers); rendered animal fats; or waste cooking oil. The oil is converted to biodiesel through a chemical process called transesterification. Glycerin is removed as a byproduct of the reaction, and the resulting fuel can be blended with petroleum diesel, or used directly as a neat fuel. Biodiesel should be evaluated according to the protocols outlined in the Biodiesel Standard ASTM (American Society for Testing and Materials) D6751 before use. In Virginia Cooperative Extension (VCE) publication 442-880 (Wen et al., 2006), the basics of biodiesel fuel are discussed as well as the myths and questions about biodiesel usage. This new publication presents the procedures for producing biodiesel, with particular emphasis on small-scale production.

Caveats:

Many readers will not want to invest the time for produce your own biodiesel. These readers will still find this publication of value, because it explains the relatively simple procedures to make the products. In that sense, it takes some of the "mystery" out of an important fuel that we used directly, or indirectly, every day.

Keep in mind that chemicals discussed in this report can cause injury. Do not attempt any of the described procedures until you are confident you understand the safety procedures.

It is relatively easy to produce a product that is suitable for use in industrial burners or older diesel engines. However, it is more challenging to produce fuel that meets or exceeds the ASTM D6751 standards. Use of biodiesel that does not meet the ASTM criteria could result in engine damage and will undoubtedly void all manufacturers' warranties. If you are planning to use the fuel you produce in a modern diesel engine equipped with a high-pressure fuel injection system, you must pay particular attention to the amount of residual glycerin that is present as well as the water content of the fuel. If you are unable to evaluate your fuel sample according to the protocols described in ASTM D6751, or cannot afford to submit a sample for professional analysis (approximate cost $1500/sample), then you should not attempt to use the fuel you produce in modern agricultural machinery or industrial equipment. Also, if you are planning to use your home-made biodiesel for on-road applications, you MUST be fully aware of both State and Federal regulations regarding taxing and permitting procedures required for fuel distributors.

Glossary:

- *Triglyceride:* The major component of fat consists of three molecules of fatty acid combined with a molecule of the alcohol glycerol (Figure 1). Triglycerides make up a large portion of many types of lipids (fats).

- *Transesterification:* A reaction between a triglyceride and an alcohol in which the -$OCHCH_2CH_2$…..CH_2CH_3 of the triglyceride and the CH_3O- of the alcohol (methanol) trade places (Figure 2).

- *Methyl-ester:* A compound formed from an organic acid and a methanol-based alcohol.

- *Titration:* An analytical method used to determine total acidity (i.e., free fatty acids) of waste oil. A strong base (such as sodium hydroxide, NaOH) is added to waste oil in measured amounts. If an indicator chemical (such as phenolphthalein) has been added to a sample of the liquid being tested, then a color change will occur at the point when all available hydrogen ions in the acids have been neutralized by the base.

- *Esterification:* A condensation reaction through which carboxylic acids react with alcohols to form esters.

- *Acid value:* The amount of free acid present in waste oil as measured by the milligrams of potassium hydroxide (KOH) needed to neutralize it per gram of acid (unit: mg KOH/g).

Chemical reaction for biodiesel production - transesterification

Biodiesel is made through transesterification between triglyceride and alcohol (usually in the form of methanol). As shown in Figure 1, the triglyceride molecule is like a capital letter "E", where the three "arms' of the capital "E" represent three long-chain fatty acids. In transesterification, methanol molecules replace the "backbone" and link the "arms" of the capital "E" to form three linear molecules (Figure 2). This new linear molecule is called a "methyl-ester", which is the scientific term for biodiesel (Figure 2).

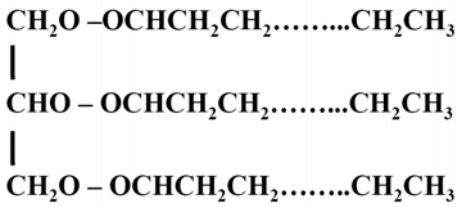

Figure 1. Molecular structure of triglyceride

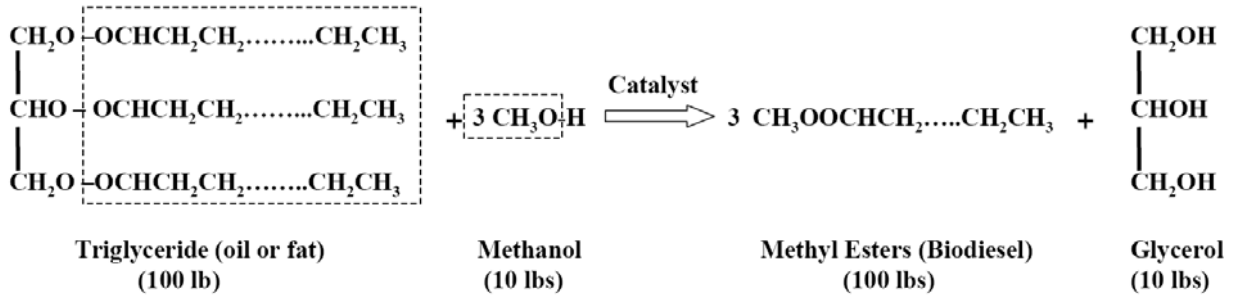

Figure 2. Chemical reaction for biodiesel production - Transesterification

The theoretical ratio of methanol to triglyceride is 3:1; which corresponds to having one methanol molecule for each of the three hydrocarbon chains present in the triglyceride molecule, and is equivalent to approximately 12% methanol by volume. In practice, this ratio needs to be higher in order to drive the reaction towards a maximum biodiesel yield; 25% by volume is recommended. The catalyst can be alkalis, acids, or enzymes (e.g., lipase). The majority of biodiesel produced today is done with the alkalis-catalyzed reaction because this reaction (1) requires only low temperature and pressure, (2) has a high conversion yield (98%) with minimal side reaction and a short reaction time, (3) is a direct conversion to biodiesel with no intermediate compounds, and (4) does not need elaborate construction materials.

Making biodiesel - where do I start?

Following are some tips to remember before making your first batch of biodiesel:

- Always start by making a small-scale test batch in a container using no more than one gallon of fresh vegetable oil. Indeed, small scale test batches are not just something for beginners, it is a basic technique you will always use. Many experienced biodiesel makers do a test with each batch of oil to ensure completeness of their reactions and proper quality of the final fuel.

- Start with new, virgin oil, NOT with waste cooking oil or animal fat. Virgin oil is much easier to process than waste cooking oil or animal fat.

- Focus on the process first, NOT on the processor/equipment. Follow the instructions carefully and familiarize yourself with all the variables. Once you have mastered the methodology, and the ability to trouble-shoot problems, you will have a better idea of the processor you need for your scale of operation and the fuel produced.

- Keep a notebook – make notes and keep records. Use small glass jars to keep samples of all batches. Clearly label all samples with cross references to notes in your notebook.

Small-scale biodiesel production from pure vegetable oil: less than one gallon test batch

A. Recipe

- Use one liter (0.26 gallon) of fresh vegetable cooking oil purchased from a grocery store.

- 250 milliliter (ml) (0.25 quart or 48 teaspoons) of pure methanol (>99%) – This amount is twice the methanol required for the reaction, so you are guaranteed to have at least 125 ml (0.125 quart) of excess methanol in your final product. This excess is needed to drive the reaction forward, but should also be recovered after the reaction is complete. Methanol can be obtained from bulk liquid fuel distributors, particularly from race tracks. Several methanol suppliers are also listed in http://journeytoforever.org/biofuel_supply.html#meths.

- Alkaline catalyst - either sodium hydroxide (NaOH) or potassium hydroxide (KOH). Both NaOH and KOH can be obtained from soap maker supply companies or from chemical stores. NaOH, commonly referred to as lye, must be pure (at least 96% purity). KOH has been shown to be more effective in promoting the reaction and strength of 85% of purity or greater is adequate. But, if you use KOH rather than NaOH as your catalyst, approximately 1.5 times more KOH will be needed compared to using NaOH.

- Mini-processor - The mini-processor is used to familiarize you with the transesterification reaction. The processor is a kit containing all the followings

  - A one-gallon translucent heavy duty HDPE (#2 plastic) container with a stopper and a screw-on cap.
  - A funnel to fit the HDPE container.
  - A cooker.
  - An electric drill.
  - A plastic grip for the drill.
  - A stand for the drill.
  - A sparkplug wrench.
  - A stirrer
  - A portable gas cooker or electric hot-plate
  - Several one-gallon PET (polyethylene terephthalate) bottles for settling and washing.
  - A scale to accurately weigh to 0.01 ounce
  - A heatproof glass bottle with a narrow neck for the mixing of the lye and methanol.
  - Measuring beakers or cylinders used for the methanol and oil
  - A roll of duct tape for sealing holes made in the plastic bottles
  - A thermometer for measuring the temperature of the reaction

Figure 3. Mini-processor kit

In addition to the above items, personal protection equipment such as goggles, gloves, and an apron are also needed. See "Safety issues during processing" at the end of this publication for details. All of materials needed can be obtained from local supermarkets and hardware stores. A detailed description can be found at http://journeytoforever.org/biodiesel_processor7.html

B. Procedures

An outline of the steps for producing biodiesel from pure vegetable oil is presented in Figure 4, and each step is discussed in enough detail for the practitioner to produce biodiesel. In summary, the catalyst and methanol are measured and mixed together until the catalyst is fully dissolved. The resulting methoxide is then mixed with oil, and the reaction forms methyl esters (biodiesel) and crude glycerol (Figure 2). After the reaction, the mixture is separated; the glycerol settles to the bottom while the biodiesel floats on top and is siphoned off. The crude biodiesel is washed with water to remove any residual glycerin and to produce fuel-grade biodiesel. Excessive methanol is usually recovered from the glycerol phase for reuse. An explanation on how to recover the methanol will be given later.

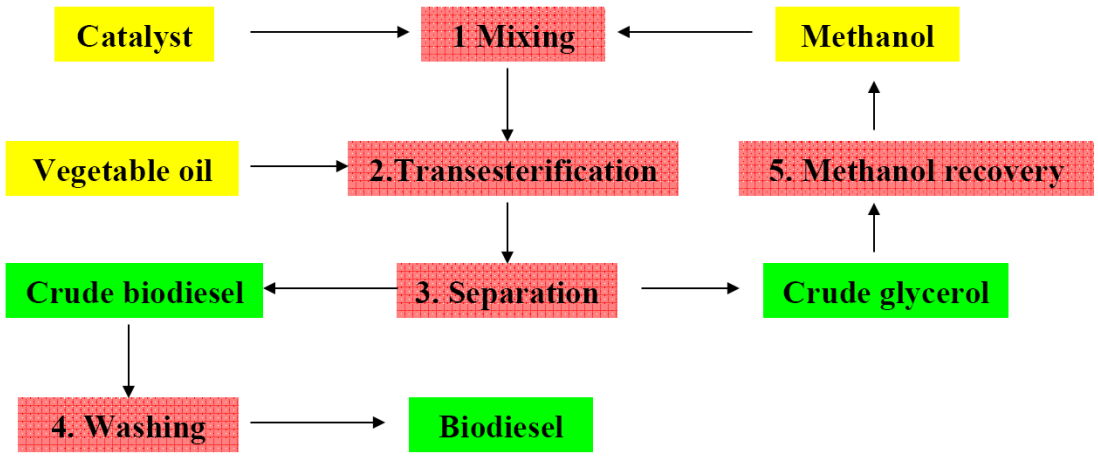

Figure 4. Procedures of producing biodiesel from fresh vegetable oil

1. Mixing methanol and lye

Measure 3.5 gram (0.12 ounce) of NaOH or 5 gram (0.18 ounce) of KOH. Measure quickly since the catalyst absorbs water from the atmosphere rapidly and this water can interfere with the transesterification reaction. Measure the catalyst on the scales using a small lightweight plastic bag, and then close the lid of the lye container firmly and close the plastic bag so air contact with the lye is minimized. Then, mix the lye with 200 ml (0.21 quart or 40 teaspoons) of methanol in a sturdy, heat proof glass (Pyrex is preferred) bottle with a narrow neck to prevent splashing. Constantly mix or stir the solution to quickly dissipate the heat given off by the reaction. The mixing process takes about 15 minutes.

Figure 5. Assembly kit for transesterification

2. Transesterification

When mixing the methanol and lye as described before, pour 1 liter (0.26 gallon) of vegetable oil in the HDPE container, and heat the container to about 50°C-60°C (120-140 °F). Keep the temperature below 60°C (140°F) since methanol will boil at 65°C (148.5°F) and will be lost. Be careful to avoid sparks or open flames near your reactor; methanol vapors are explosive. Stir the heated oil well, and carefully add the methanol-catalyst mixture to the oil. The reaction starts immediately, the mixture rapidly transforms into a clear, golden liquid. Keep stirring for an hour, while keeping the temperature at ~ 60°C (~140 °F). Then allow the mixture to settle overnight. The system should be closed to the atmosphere to prevent loss of methanol during the reaction. The reaction will take about 12 hours to complete. A detailed description of this procedure can be found at http://journeytoforever.org/biodiesel_processor7.html

3. Separation:

As soon as the reaction is completed, pour the mixture from the mini-processor into a glass or PET bottle for settling and screw on the lid tightly. Allow the mixture to settle 12-24 hours. After settling, there will be two phases in the bottle with a clear interface. Dark-colored glycerol byproduct will collect at the bottom, with crude biodiesel on top. The biodiesel varies in color depending on the oil used, but is usually pale yellow. Carefully decant the top layer of biodiesel into a clean jar or PET bottle. Be sure to not inadvertently mix up the glycerol layer with the biodiesel. However, if you do disturb the glycerol, simply allow the mixture to resettle and decant again.

Figure 6. Biodiesel and glycerol after transesterification

4. Crude biodiesel washing

The crude biodiesel still contains contaminants such as soaps, excess methanol, residual catalyst, and glycerol. It can be purified by washing with warm water to remove residual catalyst or soaps. The washing procedure is effective because the residues are more readily dissolved in water. When the two types of liquid are mixed into a homogenous emulsion, the residues will transfer from a biodiesel-phase into a water phase. The two liquids will eventually separate into two phases; thus, the residues can be "washed" from crude biodiesel with water. After washing, you will get a clear amber-yellow liquid with a viscosity similar to petroleum diesel. This product is fuel-grade biodiesel, but only if it meets the specifications outlined in ASTM D6751.

The washing procedure involves using two one-gallon PET bottles in succession as follows: pierce a small hole in the bottom corner of each bottle and cover the hole securely with duct tape; pour the biodiesel into one of the wash bottles; add the half-gallon of fresh water; then use one of the following two methods of washing. Details of the two washing procedures, described below, can be found at: http://journeytoforever.org/biodiesel_bubblewash.html#bubble.

a. Bubble-washing. Use a small aquarium air-pump and an air-bubbler stone. After washing and settling, drain off the water from the bottom of the bottle by removing the duct tape from the hole. Block the flow of water with your finger when the biodiesel begins to flow out the hole.

Transfer the biodiesel to the second washing bottle, add fresh water and wash again. Clean the first bottle and replace the duct tape. Repeat this procedure 3-4 times.

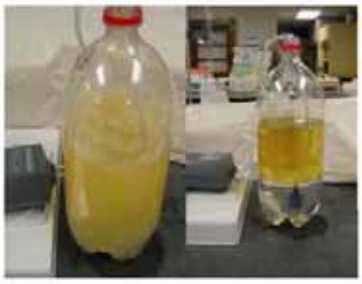

Figure 7 A quarium air-pump and an air-bubbler stone for bubble washing

b. Stir-washing. Cut the lids off the bottles as described above to accommodate the stirrer. The stirrer is simply a small paint stirrer powered by a variable speed drill. Stir until oil and water are well mixed and appear homogenous. Allow the mixture to settle for two hours or more, drain as described above for the bubble-washing procedure, and repeat this procedure 3-4 times.

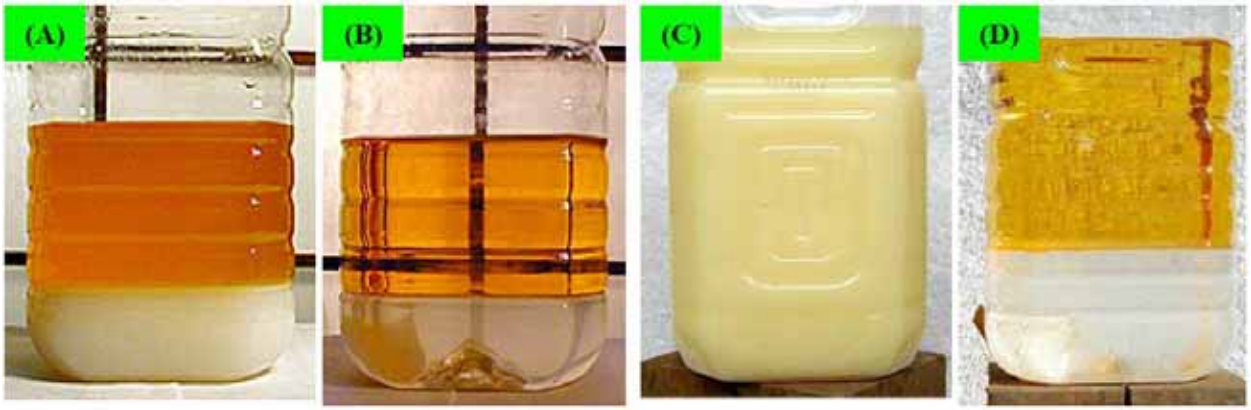

Figure 8. (A) Bubble washing: milky water and biodiesel after first washing; (B) Bubble washing: clear water and clear biodiesel after 3rd washing; (C) Stir-washing: homogenized biodiesel and water immediately after a thorough mix with a paint stirrer; (D) Stir-washing; clear water and clear biodiesel on top after 3rd washing.

It should be noted that some mono, di, and tri-glyceride molecules will remain in the fuel regardless of which washing procedures is used; presence of these molecules is the most common reason for failure of the ASTM testing protocol. Again, it is essential that the reaction is completed, in order to avoid potentially catastrophic engine damage caused by the use of fuel that does not meet ASTM standard.

5. Methanol recovery (optional)

Depending on the kind of oil used, it takes 110 to 160 ml (~22-32 teaspoons) of methanol to make 1 liter (0.26 gallon) of biodiesel. Excess methanol (20% or more of the theoretical volume) is needed to force the conversion process to completion. Most of the excess methanol exists in the glycerol phase of the biodiesel reaction, and can be recovered by simply boiling it off in a closed container with an outlet leading to a simple condenser. Methanol boils at 65^{o}C (148.5 ^{o}F) but it usually starts vaporizing well before it reaches boiling point. To recover methanol from the glycerol, heat crude glycerol to 65^{o}C-70^{o}C (149-158 ^{o}F). As the methanol evaporates, leaving an even-lower

Figure 9. Methanol recovery device

proportion of methanol in the mixture, the boiling point will increase; thus, you must continue to keep raising the temperature to keep the methanol vaporizing. The liquid starts to froth when going up to 100 ^{o}C (212 ^{o}F); stop heating or you will get a frothy brown by-product in the methanol condensate. Most of the methanol should have been recovered by this time. Be sure to use a sealed container for all methanol recovery efforts. **Methanol vapors are toxic**, and pose substantial health risks if inhaled. Refer to the "Safety issues during processing" the end of this publication to ensure you use correct procedures. For details of methanol recovery, visit the website http://journeytoforever.org/biodiesel_processor5.html#methcondens

Small-scale biodiesel production from waste oil: less than one gallon test batch

A. Free fatty acid concern

Waste oil includes rendered animal fats and used cooking oil. In addition to triglycerides, waste oil also contains free fatty acids (FFAs). Waste oil is defined as yellow grease when the FFA content is less than 15%; if the FFA level exceeds 15%, it is defined as brown grease. For either case, those FFAs must be treated before making biodiesel from the triglycerides, otherwise, the FFAs will interfere with the alkali in the transesterification reaction.

B. How to deal with FFAs

Method 1. Using extra lye to turn FFAs into soap

The first method for dealing with FFAs is to turn the FFAs into soap using extra lye. The soap will drop out of the transesterification reaction along with the glycerol byproduct. The procedure for this method is shown in Figure 10. The chemical reaction between the extra lye and FFAs is shown in Figure 11.

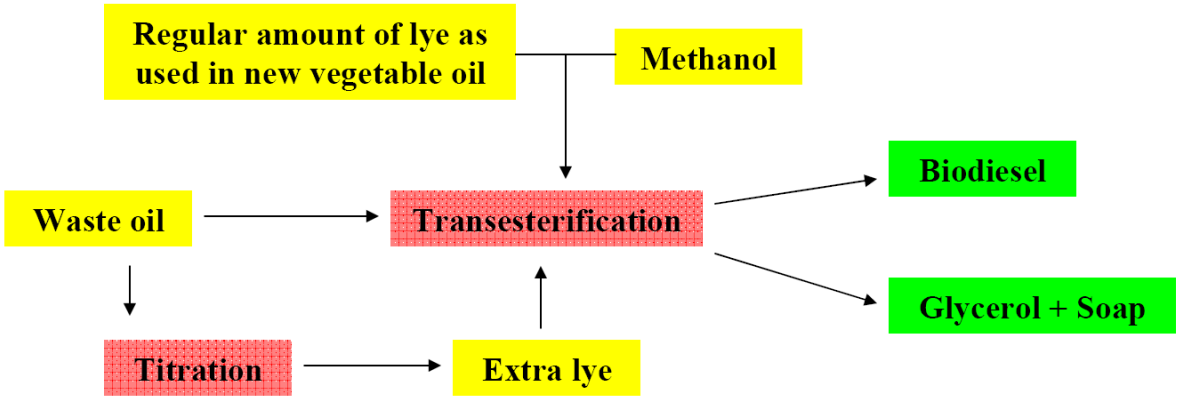

Figure 10. Producing biodiesel from waste oil by extra lye to neutralize the free fatty acids into soap

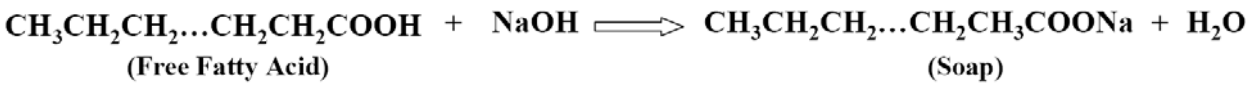

Figure 11. Chemical reaction between FFAs and the extra lye in the production of biodiesel from waste oil by using "extra-lye" method

As shown in the Figure 10, a titration procedure is required in order to determine how much extra lye will be needed to "neutralize" the FFA content in the oil. Thus, the pH of the oil must be determined. Two chemicals are needed to perform a titration: isopropanol and phenolphthalein.

Isopropanol serves as the solvent to dissolve the waste oil so that a homogeneous oil-isopropanol solution can be easily titrated. Always purchase 99% pure isopropanol from a chemical supplier, and store phenolphthalein in a cool, dark place because it is sensitive to light. Phenolphthalein is used as the indicator to monitor the pH change during the titration process. Phenolphthalein is colorless then turns pink (magenta) at pH 8.3, and red at pH 10.4. The titration starts with low pH, in which the phenolphthalein is colorless. When phenolphthalein is just starting to turn pink the pH reading will be 8.5, which is the measure you want. As an alternative, you can also use an electronic pH meter or pH test strips to monitor pH level to around 8.

The titration procedures to determine how much extra lye needed:

- Dissolve 1 gram (0.035 ounce) of lye (either NaOH or KOH) in 1 liter (2.1 pint) of distilled water.
- In a small beaker, dissolve 1 milliliter (0.2 teaspoon) of the oil in 10 milliliters (2 teaspoons) of pure isopropanol. Warm the beaker gently by placing it in a container of hot water, stir until all the oil dissolves in the alcohol and turns clear.
- Add 2 drops of phenolphthalein solution to the oil-isopropanol solution.
- Using a graduated syringe or a pipette (with milliliter as the unit), add the lye solution drop by drop to the oil-alcohol-phenolphthalein mixture, stirring continuously. Although it might turn a bit cloudy, keep stirring.
- Keep adding the lye solution until the mixture starts to turn pink (magenta) and stays that color for 15 seconds.
- Lastly, record the number of milliliters of lye solution you added (from the syringe or pipette reading). This amount is the EXTRA grams of lye you need per liter of the oil titrated. To convert to ounces, multiply the number of milliliters by 0.133. This amount is the EXTRA ounces of lye you need to add for each gallon of waste oil.

Method 2. Convert FFAs into esters by acid-catalyzed pretreatment

Another method for converting FFAs is to use acid-methanol to convert FFAs into esters so that the level of FFAs in the feedstock of transesterification can be significantly reduced (Figure 12). The reaction between FFAs and acid-methanol is called "acid-catalyzed esterification" (Figure 13).

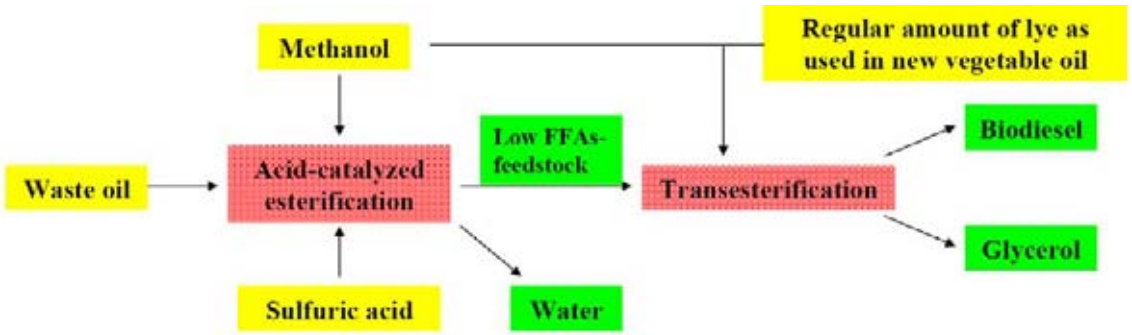

Figure 12. Producing biodiesel from waste oil by acid-catalyzed esterification pretreatment

$$\underset{\text{(Free Fatty Acid)}}{CH_3CH_2CH_2\ldots CH_2CH_2COOH} + CH_3OH \xrightarrow{\text{Acid}} \underset{\text{(Methyl Ester)}}{CH_3CH_2CH_2\ldots CH_2CH_3COOCH_3} + H_2O$$

Figure 13. Chemical reaction between FFAs and acid-methanol mixture in the production of biodiesel from waste oil by using "acid pretreatment" method.

This method is much more complicated than the extra lye-addition method. The catalyst can be sulfuric acid, sulphonic acid, or hydrochloric acid, all of which are dangerous chemicals and dangerous to handle. In addition, the water formed during the esterification process will inhibit the reaction; to avoid this problem, a multiple-step process is used including the removal of the water from the reaction mixture and adding new catalyst and methanol to the system, which further complicates the process. All of these factors make the acid-catalyzed pretreatment method too complicated to be adopted by small producers. Therefore, this method is not recommended for homebrewed biodiesel production. If you are interested in this method, refer to the papers published by Canakci and Van Gerpen (1991, 2001).

Scale-up of biodiesel production and selection of processors

When you are confident that you can get good results every time from small-scale tests, even by using oil from different sources, it's time to scale up the process to provide your fuel needs. When considering scale-up operations, it is important to evaluate your specific fuel needs. If you are planning to distribute the fuel to family and friends, or if your intention is to use it in expensive machinery, you must ensure that the processor is capable of producing quality fuel. The cheaper solutions often yield a product with inferior quality, and are often incapable of producing fuel that meets the ASTM standard.

Ready-made biodiesel processing kits can be purchased from many vendors; a variety of processors are available. Following are some websites with examples of the processors currently sold for "homebrewers" production: www.homebiodieselkits.com/hobikit.html; www.circlebio.com; www.biodieselwarehouse.com; www.nrgrev.com/biodiesel.html; www.biodieselathome.com/product.htm; and www.utahbiodieselsupply.com/biodieseldemos.php. In addition, eBay is also a good place to purchase either the whole kit or individual components at a less expensive price.

(A) $1,995 (B) $2,495 (C) $1,995 (D) less than $2,000

Figure 14. Examples of commercial processes for homebrew biodiesel production. (A) and (B): BioEquipment, Inc (www.homebiodieselkits.com/homeprocessors.html); (C): Biodiesel Warehouse, LLC. (www.biodieselwarehouse.com); and (D): James Madison University; (www.cisat.jmu.edu/biodiesel/presentations06/How%20to%20Make%20BioDiesel.ppt#315,12,Slide 12). The prices listed are as of November 2006.

You can also build your own processor. Components for the processor can be purchased from various vendors. On the website of "Journey to Forever", a Non-Government Organization involved in environment and rural development work, a variety of biodiesel supplies and suppliers are listed based on the recommendation of independent users (www.journeytoforever.org/biofuel_supply.html#pumps).

Figure 15. Biodiesel notebook

Four major factors should be considered when scaling up from small test-batches to a full-sized processor. The first factor is agitation. Short and "fat" (large diameter) reactor tanks need more and better agitation than tall and "thin" (small diameter) reactors. Agitation is usually achieved via liquid recirculation through a pump or a mechanical stirrer. Using a pump for agitation might not provide the same quality of solution agitation as using a stirrer. With stirrers, you can vary the speed, the shape and configuration of the paddles, and use baffle plates in the tank. The second factor to consider in scaling up is temperature control. Once the oil is warmed up it doesn't need much reheating during the processing. Tanks with insulation maintain better temperature control. A thermostat is recommended to control the product quality and prevent the system from overheating. With a thermostat, you can set it to the required temperature, switch it on and leave it until the processing is finished. The third factor for larger batches is the use of large-scale measuring equipment; you will need to measure several hundred gallons of methanol and oil. Also, lye needs to be measured in the scale of pounds. Lastly, remember the various processing methods all use averages and approximations because processors vary so widely, thus, keep a notebook and records of each batch production, including the date, equipment, raw materials used, reaction conditions (i.e., reaction time, temperature, and

agitation speed), and observations after the reaction. You may also keep samples of all of your batches with references recorded in your notebook.

Again, it must be emphasized that the quality of your processor will have a profound effect on the quality of the fuel you produce. It is challenging to produce fuel that will meet the stringent requirements outlined in ASTM D6751, but it is essential to produce quality fuel to avoid potentially serious engine damage. As with most things, the quality of inputs determines the quality of outputs. If at all possible, consider using stainless steel components, precision pumps, thermostatically controlled heating elements, and industrial grade mixing devices to ensure the completeness of the reaction and consistent quality fuel production.

Blending and storage of biodiesel

The biodiesel produced can be stored in its pure form or mixed with petroleum diesel. The mixing can be done by splash blending, injection blending or simply pouring the two products together and agitating. The standard storage procedures used for petroleum diesel can be used for biodiesel blends up to B20 (B20 is defined as 20% biodiesel and 80% petroleum diesel by volume). B100 or blended biodiesel higher than B20 should not be stored for more than 6 months, and it is recommended that all fuel be used within 90 days. The possible sources of contamination during storage include water, dust, microbes, spores, bacteria, algae, in addition to simple oxidation of the fuel. Therefore, the acid value should be monitored, and fuel-enhancing additives may need to be added. For details about fuel storage, refer to VCE publication 442-880.

Safety issues during processing

Methanol is a poisonous chemical that can cause blindness. The catalyst can cause severe chemical burns if it comes in contact with bare skin. Methanol and lye react to form sodium methoxide (CH_3NaO) which is a very caustic chemical. Therefore, always wear proper protective gloves, apron, and eye protection and do not inhale any vapors. Gloves should be chemical-proof with cuffs, it is unsafe to wear shorts or sandals during the handling of any chemicals such as are used for biodiesel production. Always have running water handy when working. The workspace must be thoroughly ventilated. No children or pets should be allowed in the work area.

Figure 16. Safety operation

Avoid exposure to fumes. The greatest danger for fumes is when the methanol is hot. When it's cold or at "room temperature" it fumes very little, if at all, and is easily avoided. Keep methanol at arm's length whenever you open the container. Don't use "open" reactors - biodiesel processors should be closed to the atmosphere, with no fumes escaping. All methanol containers should be kept tightly closed to prevent water absorption from the air.

Transfer methanol by pumping it, with no exposure, which can be achieved using an explosion-proof induction pump. Though the mixture gets quite hot at first, no fumes will escape if the container is kept closed. If the methoxide is pumped into a closed biodiesel processor with an

explosion-proof induction pump and is added slowly, which is optimal for the process and also for safety, exposure to fumes will be prevented.

Once again, making biodiesel is safe if you are careful and sensible. "Sensible" also means not overreacting. All chemicals used are common household materials. Lye is sold in supermarkets and hardware stores as a drain-cleaner. Methanol is commonly used in laboratories, and is the main ingredient in the fuel used in racecars. Be careful with these chemicals, but there is no need to be panic regarding the safety.

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