Biodiesel is a viable and sustainable alternative energy source that has the potential to alleviate U.S. dependence on foreign oil and also improve environmental stewardship. There are several sources from which biodiesel can be produced, including vegetable oil and algae. Because biodiesel is relatively simple to produce, there is interest in producing biodiesel on a small scale. Small batches (usually 50 gallons or less) can be produced using the proper equipment. Though biodiesel itself is nontoxic, biodegradable, and produces far less emissions than petroleum diesel fuel, producing biodiesel on a small scale does have environmental and safety concerns. These issues have to do mainly with the front end of the production process and include safety in handling alcohol and catalysts (e.g., titration solution, methanol, and sodium hydroxide or potassium hydroxide), glycerol handling and disposal, spill response, and storage tank recommendations. Fire safety is also imperative even though biodiesel itself is not as flammable as other petroleum-based fuels.

**Precautionary Measures**

- Always wear safety gear or Personal Protection Equipment (PPE): A) safety glasses or a face shield, B) a respirator, C) an apron, and D) gloves (figure 1).
- Properly label all containers to avoid improper usage or accidental mixing of chemicals.
- Have available eye wash fountains or bottles in the work area.
- Always have sorbent on hand to immediately clean up spilled oil and prevent accidents.
- Have available a fire extinguisher.
- Note that ventilation systems are necessary in confined spaces to keep airborne concentrations of methanol below permissible exposure limits (PEL; 200 ppm or 260 mg/m³).

**Safe Handling of Biodiesel, Methanol, and Lye**

Biodiesel and methanol (methyl alcohol) are 100 percent biodegradable. Biodiesel has a high flashpoint and low volatility, so it does not ignite as easily as petrodiesel. Biodiesel degrades four times faster than conventional diesel. It is nontoxic and is generally safe to handle, transport, and store. Long-term storage of biodiesel should be in an airtight steel vessel that is labeled appropriately. Biodiesel is hygroscopic, meaning it will absorb atmospheric moisture and potentially allow microbial growth.

When producing biodiesel, falling or slipping is the largest cause of accidents and personal injury. Floors can be slippery, so operate with caution, wear appropriate footwear, and keep floors clean.

Methanol (figure 2) is the most dangerous ingredient used in the biodiesel process. Methanol can cause poisoning, systemic acidosis, and optic nerve damage, and it can also impact the central nervous system if a person is exposed to it. Again, wear proper PPE when handling methanol. Exposure to methanol can occur via inhalation, ingestion, or absorption. Inhalation of methanol vapors is the most common type of exposure. Keep methanol containers sealed at all times. This is important because methanol is odorless. If exposed to the eyes or skin, irritation may occur. Flush eyes or the skin area with water for at least 15 minutes, and remove contaminated clothing and shoes. Methanol ingestion can cause gastrointestinal irritation with nausea, vomiting, diarrhea, and/or headache; it can also pose a serious threat to life. Promptly get medical attention for anyone who has ingested methanol.
Potassium hydroxide is a good choice of catalyst for biodiesel production, and it also poses fewer risks to the environment than sodium hydroxide. For this reason, safety recommendations in this section are geared toward sodium hydroxide. Lye, or sodium hydroxide (figure 2), is a substance that dissolves easily in water and absorbs moisture when exposed to the atmosphere. Eventually, it will absorb enough water to form a liquid solution. If skin comes in contact with lye, gently wipe it from the skin and remove any contaminated clothing. Immediately wash the area with water for 15 minutes because lye can cause chemical burns. Always wear a respirator when handling lye to avoid particle ingestion. If lye is ingested, rinse mouth with water and drink one or two glasses of water. Do not induce vomiting! If lye is ingested in adequate amounts, it can be fatal. Lye can cause blindness, so immediately flush eyes with water for at least 20 minutes. Remember to remove contact lenses, if applicable. After handling lye, remove gloves and immediately wash hands.

Remember, if lye is ingested, immediately get medical attention or call your poison control center at (800) 222-1222.

**Biodiesel Waste Product Disposal**

If a wet-wash process is used, glycerol and wet-wash water are the two major waste products from the production of biodiesel. There are several methods of disposing of glycerol (figure 3). Glycerol can be added to an existing compost pile, but it is imperative to drive off any excess methanol by adding heat (160°F) for 1 hour. Excess lye and soap must also be combated. Check the pH as it will probably be alkaline because of unused lye. Reduce the pH by adding acid, such as muriatic acid or even vinegar. When the pH is around 7 (neutral), the glycerol can be composted. Besides composting, glycerol can also be used by water treatment plants or in boilers. Check with your local water treatment plant to see if it has an operating anaerobic digester to which the glycerol can be added. Bacteria in the digester feed off glycerol, providing an increase in biogas. Glycerol can also be burned in boilers for heat, but it will leave a residue that has to be frequently cleaned.

If a wet-wash procedure is performed on the biodiesel, the water must be titrated to determine the pH. When the pH is brought to neutral, the water can be discarded using a brown water drain.

**Recommendations for Storage Tanks**

Methanol coming in contact with most metals at ambient temperatures has no adverse effect on the metal; exceptions include lead, magnesium, and platinum. Select mild steel tanks for storing methanol. Tanks built with copper alloys, zinc (including galvanized steel), aluminum, or plastics are not suitable for methanol storage as they are corroded slowly. Many resins, nylons, and rubbers, particularly nitrile (Buna-N), ethylene propylene rubber (EPDM), teflon, and neoprene, are used acceptably as components of equipment in methanol service. While plastics can be used for short-term methanol storage, they are generally not recommended for long-term storage due to deterioration effects and the risk of contamination. As a general rule, only acquire enough methanol to use in a 2-week period, and always store all components of biodiesel production in a cool, dry place. When grounding a large storage tank, carbide tipped clamps (to ensure good contact through paint) and dip tube filling are generally used to guard against potential ignition from static electricity.

Use a clean and properly labeled general gasoline container to store biodiesel. If your biodiesel storage container is 55 gallons or larger, store the container within a spill control basin using a double-wall tank. A hazardous materials cabinet is also recommended for product storage. Cabinets should be labeled in eye-catching print, “Flammable—Keep Fire Away.”

Lye and caustic soda have much stronger hygroscopic properties than activated carbon or silica gel and will readily absorb water. For this reason, lye and/or caustic soda should be stored in an airtight resealable container and labeled appropriately. A plastic bucket with a sealable lid will suffice. Lye and/or caustic soda may react with magnesium, zinc (galvanized), tin, chromium, brass, and bronze to produce hydrogen gas. This is very dangerous. Do not allow lye or caustic soda to contact these metals.

**Fire Fighting Equipment**

Methanol flames are almost invisible in daylight, producing no soot or smoke. They may only be detected by the heat generated, a heat haze, or burning of materials in the immediate area. A class B fire extinguisher should be used in all stages of biodiesel operation as it is rated for flammable liquid fires as well as oil and grease fires. In addition to methanol vapors, exposure to formaldehyde and carbon monoxide from ignited methanol can generate oxygen deprivation.

**Spill Response**

A spill will be inevitable during the production of biodiesel. As a precautionary measure, spill control pallets or basins should be utilized under all containers, in particular those with a capacity of 55 gallons or more. If a spill of methanol or lye occurs, stop or reduce expulsion of material if this can be done without inherent risk. Eliminate all potential sources of ignition. Do not walk through the spilled product, and stay upwind. Prevent spilled methanol from entering sewers,
confined spaces, drains, or waterways. Maximize methanol recovery for recycling, or reuse. Vapors can be knocked down using a water spray. Whenever possible, contain land spills by forming mechanical or chemical barriers. Remove the spilled product with explosion-proof pumps or vacuum equipment. Treat the surface with sorbent materials, such as cat litter or activated carbon, to remove the remaining methanol. Remove the sorbents after use. Soil contaminated with methanol should be removed and remediated. Spills into natural water bodies (e.g., streams, rivers) should be contained using natural or mechanical barriers. Then, remove the contained material with explosion-proof pumps or vacuum equipment. Large quantities of waste methanol can either be disposed of at a licensed waste solvent company or reclaimed by filtration and distillation.