



Biodiesel Tech

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SAFETY CONSIDERATIONS FOR BIODIESEL

Biodiesel is an alternative diesel fuel that provides many environmental advantages over petroleum-based fuels. Biodiesel is safer than conventional diesel fuel but there are certain safety precautions to take into account during the production of biodiesel. Established guidelines for formulating and implementing a safety plan can be found within two agencies and a federal law; The Occupational Safety and Health Administration (**OSHA**), the National Research Council (**NRC**) and the Emergency Planning and Community Right to Know Act (**EPCRA**).

OSHA's mission is to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health. The agency's hazardous communication standard requires material safety data sheets (**MSDS**) to be provided to employees by the chemical supplier. It is imperative to have these sheets prominently displayed and within easy reach of personnel. These sheets should cover all products used in the plant. They provide the key to treatment in case of an accidental exposure and/or spill as well as some preventative measures (osha.gov).

The NRC is currently administered jointly by the National Academy of Sciences, the National Academy of Engineering and the Institute of Medicine. It has developed a lab safety publication entitled, **Prudent Practices for Handling Hazardous Chemicals in Laboratories**. It recommends that a chemical hygiene plan be instituted in every lab including adequate ventilation and clearly stated guidelines for minimum exposure to hazardous chemicals. The plan should also include an employee training plan, adequate record keeping, signs and labels indicating

potential hazards and safety procedures, and procedures for spills and accidents. It can be purchased or read on-line for free at: nap.edu/catalog/4911.

The EPCRA was passed in response to concerns regarding the environmental and safety hazards posed by the storage and handling of toxic chemicals and has four major provisions: emergency planning, emergency release notification, hazardous chemical storage reporting requirements and toxic chemical release inventory. More information can be found at: epa.gov/epcra.

Biodiesel is a relatively safe product. It is considered non-flammable, biodegradable, and is not DOT regulated. However, the components to make biodiesel can be hazardous in some situations. These components include: alcohols, strong bases and strong acids.

Alcohols such as Methanol and Ethanol

Methanol is the driving force behind the transesterification reaction. It is colorless and tasteless with a mildly sweet odor and is toxic. It can enter the body through respiration, direct skin contact or accidental swallowing. It is slowly eliminated from the body and thus is considered a cumulative poison and repeated exposure can present long-term health hazards. Personnel working with methanol should wear protective clothing and a full face respirator with a cartridge rated for organic volatiles.

Methanol is highly volatile with a flash point of 12°C and it burns with a nearly invisible flame. Its vapors are heavier than air and may travel some distance to a source of ignition, hence it has a fire hazard rating of 3 out of 4 by the National Fire Prevention Association. Methanol should be stored outside in bonded and grounded steel tanks with secondary containment and under a nitrogen blanket. The Methanol Institute (methanol.org) has posted a handbook for safe storage and handling of methanol. If a fire does occur, dry chemical powder, carbon dioxide (CO₂) and alcohol resistant foam will extinguish it by oxygen starvation. Water in the form of a fine mist will absorb vapors, quench heat and provide a curtain shield for upwind advancement. Several disastrous fires and explosions have occurred in the biodiesel industry because workers were cutting or welding on tanks that had held methanol. Proper procedures to expel air and methanol vapor should always be followed before moving or modifying methanol tanks.

Ethanol in its absolute form (anhydrous) can also be used to make biodiesel. It is less toxic than methanol but the same general safety guidelines for handling and storage should be observed.

First Aid for Methanol: Call 911

Inhalation: Move victim to fresh air and keep warm and rested. Monitor breathing. If breathing is difficult do not give mouth to mouth as this may expose rescuer to methanol. Use oxygen if trained to do so.

Ingestion: Give 2 glasses of water and induce vomiting if directed to do so.





Eyes: Flush with water at least 15 minutes.

Skin: Wash with soap and water at least 15 minutes. Remove clothing and shoes. Patient should be seen by a doctor.

Strong Bases such as Sodium and Potassium Hydroxide or Methoxide

Used to catalyze the transesterification reaction, sodium and potassium hydroxide/methoxides are extremely corrosive. The hydroxides are dry flakes or pellets and must be dissolved in methanol whereas the methoxides are supplied as a concentrate in methanol. This liquid will kill nerve cells before the pain can be felt and the dust from the hydroxides will burn unprotected skin and eyes. Dissolving the hydroxides in alcohol is an exothermic reaction and can generate a considerable amount of heat. Stirring the liquid can produce a fine mist of liquid droplets. If this mist is accidentally inhaled breathlessness and severe irritation of the respiratory tract can occur. Accidental swallowing can lead to major damage to the throat lining and digestive system. It is therefore imperative to wear protective equipment such as full-face shields, a respirator and impervious protective clothing when working with these products.

Mix materials in a closed nitrogen-blanketed tank in a well-ventilated area. Empty containers may contain dust or solid residues that can be hazardous. Store the material in a tightly closed container in a cool, dry, well-ventilated area away from sources of heat and moisture. Combustion of methylates will generate toxic fumes. In the case of fire, do not use water or foam. Use dry chemical, soda ash, lime or sand or withdraw from the area and let the fire burn.

First Aid for Strong Bases: Call 911

Inhalation: Move victim to fresh air. If not breathing, give artificial respiration.

Ingestion: Do not induce vomiting, give large quantities of milk or water unless unconscious.

Skin Contact: Flush with plenty of water immediately for at least 15 minutes and remove contaminated clothing.

Eye Contact: Immediately flush with water at least 15 minutes, lifting the eyelids occasionally.

Strong Acids such as Sulfuric and Hydrochloric

Acids are used to treat high free fatty acid feedstocks, neutralize base catalysts, split soaps in the washing process and to treat the crude glycerin by-product. They may be colorless and odorless and extremely corrosive to all body tissues, causing rapid tissue destruction and serious chemical burns. Their vapors can cause eye, nose, throat irritation, shortness of breath, pulmonary edema and a host of other, more serious ailments. Workers should wear acid resistant protective clothing and gloves, a face shield, and a respirator where exposure to hazardous levels of mist or fumes are possible. Store acids in a dry, cool, well-ventilated area away from alkali. Keep in tightly closed glass or plastic containers, which are appropriately labeled. If spilled, acids can be neutralized with alkali such as

sodium carbonate, sodium bicarbonate, soda ash, lime or limestone granules.

Acids can decompose at high temperatures forming toxic gases. They are non-flammable but react violently with water generating large amounts of heat and may spatter. If diluting with water, always add the acid to water; never add water to the acid. Acids can react with combustible materials to generate heat and ignition. They also react with most metals, particularly when diluted with water, to form flammable hydrogen gas, which may create an explosion hazard. If fire does occur, use carbon dioxide or dry chemical extinguishers. Use water spray only if absolutely necessary to cool fire-exposed containers.

First Aid for Acids: Call 911

Eyes: Immediately flush with water for at least 15 minutes. Flush under lids by lifting them or rolling eyes. **See doctor ASAP.**

Skin: Flush with water. Remove clothing and continue flushing.

Inhalation: Remove to fresh air and restore breathing. Get medical help.

Ingestion: Do not induce vomiting. Dilute stomach contents by giving water or milk together with milk of magnesia. Symptoms of overexposure are tissue damage, respiratory tract damage, severe eye damage, and blindness.

The process of producing biodiesel should be made as safe as possible by developing and adhering to a prudent practices safety protocol plan for each facility. Accidents can be avoided with thorough training of personnel and strict adherence to all local, regional, and national safety regulations. If an accident does occur, proper remediation protocol should be in place to effectively deal with any situation to minimize the extent of the loss.

Do's and Don'ts

- Do know your equipment.
- Do wear safety glasses over your eyes, especially when working with chemicals.
- Do know where your first aid supplies are located.
- Do display and know where your MSDS sheets are located.
- Do have an eye wash and chemical shower station readily available.
- Do formulate a safety plan and follow the protocol.
- Do know where all the shut offs are to your equipment.
- Do properly mark your exits with signs and always know when to execute your exit plan.
- Do use nitrogen blanketing on all tanks that hold methanol or mixtures of methanol with other materials.
- Do make sure all electrical equipment used for biodiesel processing are rated for hazardous environments. (Class I, Division I).
- When using a forklift, travel with the forks high enough off the ground to not spark any materials left on the ground.
- Don't allow smoking or smoking materials in/on the biodiesel plant premises.
- Don't allow food or drink in the plant or laboratory areas. Employers should provide an appropriate break room.
- Don't weld, grind, or cut on tanks that contain or have contained combustible liquids

