

# BIODIESEL PLANT SAFETY OVERVIEW



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# BIODIESEL PLANT SAFETY OVERVIEW



## TOPICS

### → BIODIESEL BASICS

- NFPA COMPLIANCE
- EPA COMPLIANCE
- OSHA COMPLIANCE



# BIODIESEL PLANT SAFETY OVERVIEW



## BIODIESEL BASICS

(1) **veg oil** + (3) **methanol**  $\longleftrightarrow$  (3) **biodiesel** + (1) **glycerin**  
sodium methoxide

1 x **mw 884** + 3 x **mw 32**  $\longleftrightarrow$  3 x **mw 296** + 1 x **mw 92**

**99.6 lbs** + **10.8 lbs**  $\longleftrightarrow$  **100.0 lbs** + **10.4 lbs**

- Approximately 100 pounds of vegetable oil and 10 pounds of methanol react to form 100 pounds of biodiesel and 10 pounds of glycerin.

# BIODIESEL PLANT SAFETY OVERVIEW



## BIODIESEL BASICS

- The methanol and sodium methoxide used in the biodiesel process are the primary areas of concern for biodiesel plant safety.
- A typical 30 mmgy biodiesel plant will consume about 65,000 lbs of methanol and 11,000 lbs of 30% sodium methoxide catalyst per day, both flammable liquids.

# BIODIESEL PLANT SAFETY OVERVIEW



## BIODIESEL BASICS

- Both methanol and sodium methoxide are flammable liquids and present a fire and explosion hazard which requires compliance with NFPA regulations.
- Both methanol and sodium methoxide are toxic and can present health hazards which requires compliance with both OSHA and EPA regulations.

# BIODIESEL PLANT SAFETY OVERVIEW



## TOPICS

### ✓ BIODIESEL BASICS

### → NFPA COMPLIANCE

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# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA LIQUID CODES

- **Flammable Class IA:** < 73 F flash point & < 100 F b.p.
- **Flammable Class IB:** < 73 F flash point & > 100 F b.p.
- **Flammable Class IC:** 73 – 100 F flash point
- **Combustible Class II:** 100 -140 F flash point
- **Combustible Class IIIA:** 140 - 200 F flash point
- **Combustible Class IIIB:** > 200 F flash point

# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA LIQUID CODES

- **Vegetable oil** = Combustible Class IIIB Liquid
- **Biodiesel** = Combustible Class IIIB Liquid
- **Glycerin** = Combustible Class IIIB Liquid \*\*
- **Methanol** = Flammable Class IB Liquid
- **Sodium Methoxide** = Flammable Class IB Liquid

\*\* If below 2000 ppm methanol.

# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

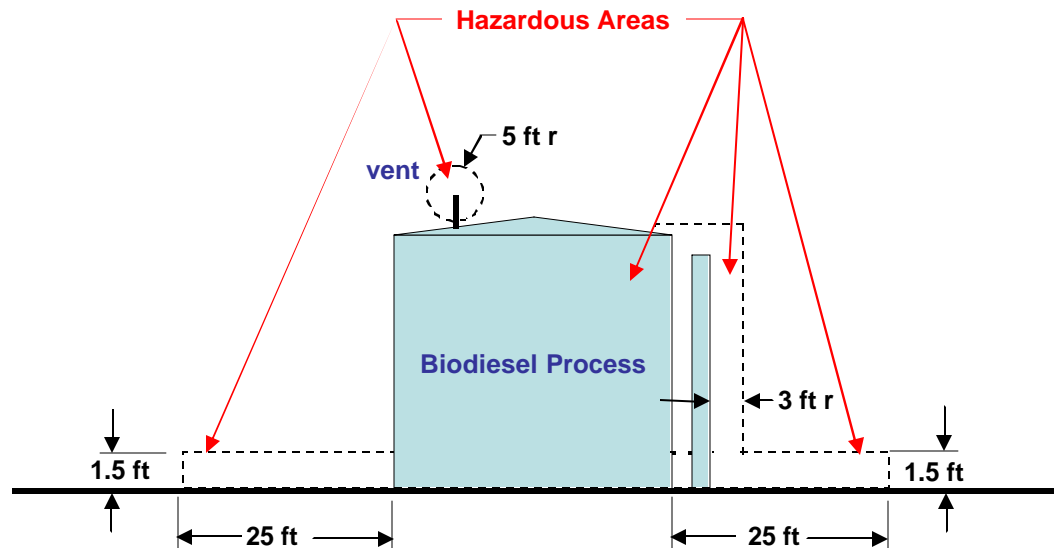
- **NFPA 30 Flammable and Combustible Liquids Code** applies for the process as well as the tank farm, including vegetable oil, biodiesel, glycerin, methanol and sodium methoxide tanks.
- **NFPA 30 chapters 1-6** contains tank design specs, tank farm spacing requirements, emergency pressure relief venting requirements, fire protection requirements, etc.
- **NFPA 30 chapter 7** contains operations requirements, including the biodiesel process building.

# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- NFPA 30 chapter 7 requires a minimum of 25 feet between process equipment and adjoining buildings or property lines.



# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

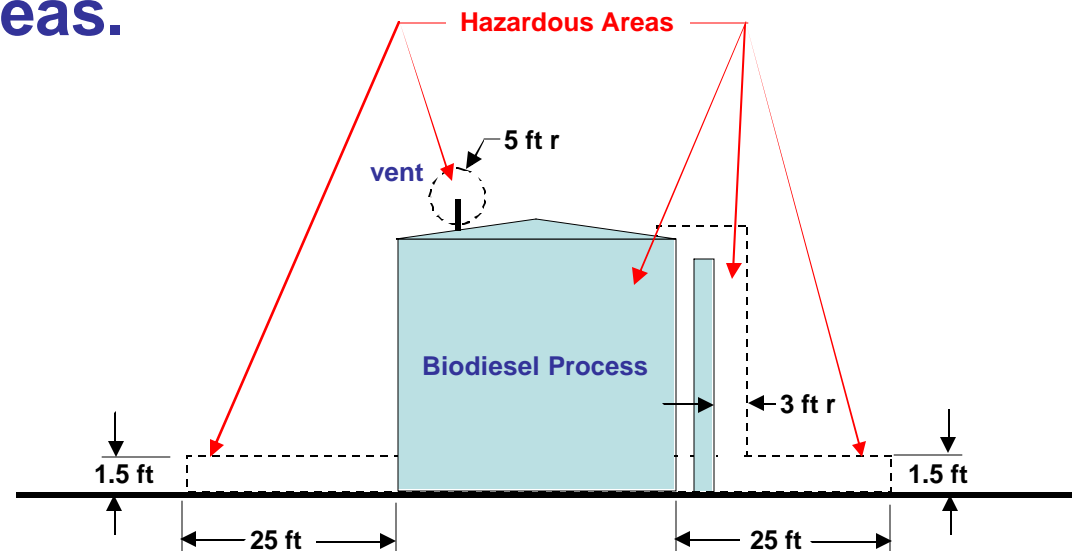
- **NFPA 30 chapter 7 requires a process building minimum ventilation of 1 cfm/ft<sup>2</sup> of solid floor area operating anytime there is flammable or combustible liquid in the building. This minimizes the potential of a flammable mixture or toxic level of methanol in the air.**
- **NFPA 30 chapter 7 requires control of ignition sources, such as no smoking, no hot work, etc. All potential spark-producing devices should remain outside the hazardous area unless a hot-work permit is issued.**

# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- NFPA 30 chapter 8 requires proper electrical systems for hazardous areas as per NFPA 497 Classifications of Hazardous Locations for Electrical Installations in Chemical Process Areas.



# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- NFPA 497 lists methanol vapor as having a flammability range of 6.0-36.0% by volume in air. This means that within this mixture, the vapor is flammable & explosive!
- Have a portable gas monitor available to check the % of LEL (lower explosive limit = 6%) to insure a flammable mixture is not present during operation.

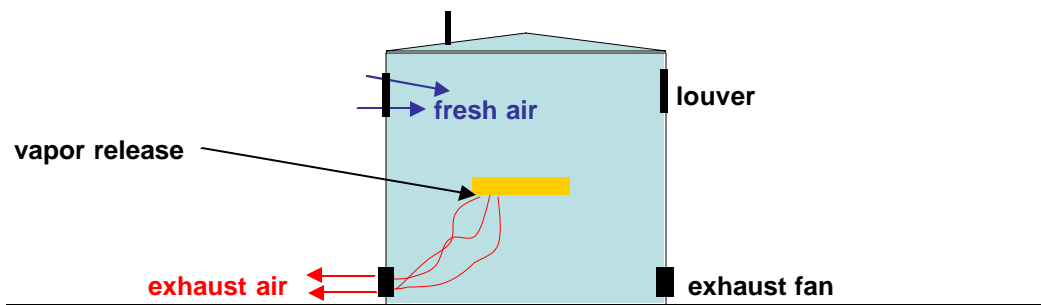


# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- NFPA 497 lists methanol vapor as a having a vapor density equal to 1.1 times that of air. Methanol vapor will sink in the building and collect in low places. Insure that the ventilation fans are always operating!



# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- **NFPA 497 is used to identify those areas in and adjacent to the process area that are class 1, division 1, group D explosion proof classification and those areas that are class 1, division 2, group D explosion proof classification.**
- **NFPA 497 provides a series of figures for determining the horizontal and vertical dimensions of the classified areas.**

# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- In adequately ventilated buildings, the division 1 classification is generally limited to the area below the curb elevation of the biodiesel process and the sphere of 5 ft radius around the process vent discharge. The remaining process area is considered division 2.
- A division 2 zone generally surrounds the process building as well at a distance extending 25 feet from the building horizontally and 1.5 feet above grade vertically.

# BIODIESEL PLANT SAFETY OVERVIEW



## NFPA COMPLIANCE

- **NFPA 70 National Electric Code provides the detail electrical apparatus specs for each area classification.**
- **Motors, lights, instruments, etc. must meet the minimum requirements for a class 1, division 2, group D explosion proof classification.**

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# BIODIESEL PLANT SAFETY OVERVIEW



## EPA COMPLIANCE

CAS No. Chemical Name

...

680319 Hexamethylphosphoramide

110543 Hexane

302012 Hydrazine

7647010 Hydrochloric acid

7664393 Hydrogen fluoride

7783064 Hydrogen sulfide

123319 Hydroquinone

78591 Isophorone

58899 Lindane

108316 Maleic anhydride

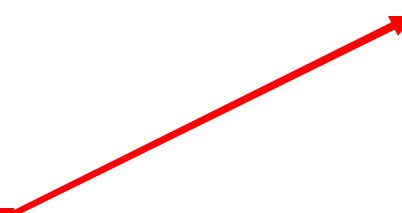
67561 Methanol

72435 Methoxychlor

74839 Methyl bromide

...

**Methanol is on  
the list of 188 EPA  
“hazardous air pollutants”**



# BIODIESEL PLANT SAFETY OVERVIEW



## EPA COMPLIANCE

- All biodiesel plants require that an air permit application be filed with the EPA prior to construction.
- The amount of methanol lost to the atmosphere will determine the complexity and duration of the permitting process.
- Annual methanol losses exceeding 10 tons will categorize a biodiesel plant as a “major source” of hazardous air pollutants, lengthening the process.

# BIODIESEL PLANT SAFETY OVERVIEW



## EPA COMPLIANCE

- The EPA requires that the vent of the biodiesel process be scrubbed with best available control technology (BACT) to remove 98% of the methanol from the vapors leaving the process.
- The EPA requires monitoring and recording of key parameters of the vent gas scrubbing system.
- Methanol storage tanks need to either be vented into the process vent scrubbing system, or have their own EPA approved vapor recovery system.

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## OSHA COMPLIANCE

**Is Methanol Poisonous? YES! As with many other fuels, methanol can be highly toxic and should never be taken orally. A few teaspoons of methanol can cause blindness and a few tablespoons can be fatal, if the exposure is not treated. It should be noted that the human body can metabolize and eliminate low concentrations of methanol with no ill effects. (Methanol is present in many cooked vegetables, and the artificial sweetener in diet soft drinks breaks down into methanol during digestion.) Methanol becomes poisonous only when it overwhelms the body's capacity to remove it.**

# BIODIESEL PLANT SAFETY OVERVIEW



## OSHA COMPLIANCE

**Toxic effects do not occur until several hours after exposure. Effective antidotes to methanol poisoning are readily available and can be administered during this interim period. If someone ingests methanol orally, or is subject to large amount of methanol skin exposure or breathes substantial vapor, take them to the emergency room for immediate treatment!**

**OSHA Permissible Exposure Limit (PEL) = 260 mg/m<sup>3</sup>  
which is 216 ppm or about 0.3% of LEL.**

# BIODIESEL PLANT SAFETY OVERVIEW



## OSHA COMPLIANCE

OSHA 29 CFR 1910.119

PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS.

**Purpose.** This section contains requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards.

**(a) Application.** (1) This section applies to the following:

**(ii) A process which involves a flammable liquid or gas on site in one location, in a quantity of 10,000 pounds (4535.9 kg) or more.**

**PSM applies to all biodiesel plants!**

# BIODIESEL PLANT SAFETY OVERVIEW



## OSHA COMPLIANCE

**OSHA 29 CFR 1910.119**

**PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS.**

**(b) Definitions.**

**(c) Employee participation.**

**-- All employees must be engaged in the PSM process.**

**(d) Process safety information.**

**-- MSDS's must be on hand for employees to review. Acids and caustics in addition to methanol and sodium methoxide need special handling care.**

**(e) Process hazard analysis.**

**-- A HAZOP analysis is a recommended method for process hazard analysis for biodiesel plants and must be completed prior to start-up.**

# BIODIESEL PLANT SAFETY OVERVIEW



## OSHA COMPLIANCE

**OSHA 29 CFR 1910.119**

**PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS.**

**(f) Operating procedures.**

**-- Written procedures for start-up, operation shutdown, emergencies, etc. must be in place prior to start-up.**

**(g) Training.**

**-- Must be conducted before start-up, for new employees, and refresher every 3 years, etc.**

**(h) Contractors.**

**-- Maintenance contractor training program must be in place such that contractors receive proper safety training before entering the hazardous area.**

# BIODIESEL PLANT SAFETY OVERVIEW



## OSHA COMPLIANCE

OSHA 29 CFR 1910.119

PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS.

(i) Pre-startup safety review.

-- Checklist to insure all PSM is in place prior to start-up.

(j) Mechanical Integrity.

-- Verify vessel wall thicknesses are sufficient, pressure relief devices are working, etc. on an ongoing basis.

(k) Hot work permit.

-- Issued prior to any cutting, welding, etc. to insure area is safe. OSHA 1910.106(h)(7)(ii) defines when a hot-work permit may be issued. All combustibles within 35 feet must be removed and the immediate area must be purged free of methanol vapor.

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## OSHA COMPLIANCE

**OSHA 29 CFR 1910.119**

**PROCESS SAFETY MANAGEMENT OF HIGHLY HAZARDOUS CHEMICALS.**

**(l) Management of change.**

-- Process for documenting and training on process changes. P&IDs and operating instructions must be kept up to date.

**(m) Incident investigation.**

-- Investigation within 48 hours of any potential methanol release.

**(n) Emergency planning and response.**

-- An emergency response plan for the entire plant.

**(o) Compliance audits.**

-- Every 3 years to insure compliance with PSM requirements.

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**Always remember ...**



**... production second.**