The Biodiesel Production Process
Types of Biodiesel Production

• **Batch Process**
  – Most common small-scale and home-brewing process
  – Slow reaction times 1-8 hrs.

• **In-line Shear Reactors**
  – Large-scale
  – Fast reaction times 1-2 hrs.

• **Ultrasonic Reactors**
  – Not widely practiced in current production
  – Potential to dramatically reduce amount of catalyst used and reaction time requirement 15 min.
The Raw Materials

• **Biodiesel Feedstock** – the oil starting material that will be chemically converted into alkyl esters (biodiesel)

• These can be oils from any biological source, botanical oils or animal fats.
Triglycerides

- Triglycerides are the most commonly converted oils.
- Phospholipids, waxes, and other polar lipids tend to emulsify and are removed via
- This is what a triglyceride molecule ‘looks’ like:
  - $\text{C-H}_2\text{OCOR}'$
  - $\text{C-H}_2\text{OCOR}''$
  - $\text{C-H}_2\text{OCOR}'''$
- The three carbons form the glycerol backbone
- The R groups represent fatty acid chains
The Reaction Tank

- Location of the transesterification
- The reaction tank is a closed vessel
- The tank must be made of solvent resistant materials: polyethylene or stainless steel
Heating the Oil

• Heat acts as a catalyst to drive the transesterification reaction

• The oil can either be heated in the reaction tank or heated prior to adding to the tank

• Oil in the reaction tank is at a temperature of 55°C

• Temperature is critical as methanol boils at 64.7°C
Transesterification of the Oil

• An **alcohol**, usually methanol, is combined with a strong **base**, potassium hydroxide (KOH) or sodium hydroxide (NaOH)

• This creates **methoxide**, which is then added to the reaction tank with the oil to initiate the transesterification reaction
Glycerol Settling

- During the transesterification reaction two products are created:
  - Alkyl esters and Glycerol

- Glycerol settles to the bottom of the reaction vessel and the Alkyl esters float on top

- The glycerol is drained from the bottom of the reaction vessel
Washing the Biodiesel

- The remaining alkyl esters contain small amounts of the base catalyst, free glycerol, and saponified fatty acids.
- These are all water soluble and can be washed out of the biodiesel.
- Wash water is drained off the bottom of a washing tank.
Drying Biodiesel

- Water, however, is undesirable within a diesel engine

- All residual wash water must be removed from the washed biodiesel

- Either through intensive heating (100°C), passive evaporation, or settling
Ready to use Fuel!

• Raw vegetable (or animal) oil has now been transesterified into alkyl esters

• These alkyl esters have been washed to increase the purity level

• And dried to remove all water

• The fuel is ready to run in any diesel engine
Quick Overview

1. Pour Oil Into Processor
2. Heat Oil To 120° F
3. Check Titration Level
4. Mix Lye & Methanol In Separate Container

5. Pour Solution Into Processor
6. React Oil By Mixing
7. Allow Oil To Separate
8. Remove Glycerin Layer