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:
  - C-H₂OCOR’
  - C-H₂OCOR”
  - C-H₂OCOR””
- 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
9 Wash Biodiesel

10 Allow Water & Oil To Separate

11 Remove Water Layer

12 Transfer To Storage Container

13 Allow Biodiesel To Dry

14 Fill Fuel Tank

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