

Background

Biodiesel is a renewable, green fuel produced from plant and animal sources. It contains no petroleum but it can be blended at any proportion with petroleum diesel. This creates a biodiesel blend that can be used in compression-ignition (diesel) engines with little or no modification. Biodiesel is renewable, biodegradable, non-toxic and is essentially free of sulfur and aromatics.

Biodiesel is produced from vegetable oils such as palm, rapeseed (canola), soy and sunflower seed oils and from animal fats such as tallow. Palm oil is the most abundant vegetable oil in the world and has the potential of becoming the number-one source of biodiesel to the world.

Safety precautions

Safety glasses and rubber gloves must be used!

Methanol is extremely poisonous and must not come into contact with skin or eyes. Methanol is a poison that attacks the eyes (ocular nerves) even if it comes into contact with your hands.

Sodium hydroxide is very corrosive and reacts with oils in your skin. Use extreme care when blending methanol and sodium hydroxide.

Biodiesel is flammable.

Put on your glasses and gloves BEFORE opening the chemicals. Do your work close to a sink or hose, or have a bucket of water handy to wash any part of your body immediately if it comes in contact with these chemicals.

It is important that water is not used in the process and that all equipment is clean and dry. Water reacts in the process to produce soap instead of biodiesel.

Equipment required (per group)

- safety glasses for each person
- gloves
- vegetable oil (200 mL)
- methanol (40 mL)
- sodium hydroxide (solid, 0.5 g)
- 2 x 500 mL beaker
- 250 mL beaker
- glass stirring-rod
- sample jar
- 2 x measuring cylinder

Procedure

1. Using a measuring cylinder, measure 200 mL of vegetable oil (canola or peanut). Transfer it to the 500 mL beaker.
2. Using a clean measuring cylinder, measure 40 mL of methanol. Transfer it to the 250 mL beaker.
 - **Caution: methanol is poisonous and can be absorbed through the skin.**
3. Using an electric balance, weigh out 0.5 g of sodium hydroxide.

- **Caution: sodium hydroxide is a corrosive chemical. Avoid skin contact.**

4. Slowly add solid sodium hydroxide to methanol in 250 mL beaker.

- **Caution: the product of this reaction, sodium methoxide, is poisonous. Avoid skin contact.**
- **Gloves and safety glasses are essential during this phase of preparation.**
- **This step should be conducted in a well-ventilated area or a fume cupboard to avoid inhalation of fumes.**

5. Stir methanol/sodium hydroxide mixture gently with a glass rod until solid sodium hydroxide is completely dissolved. Sodium hydroxide is slow to dissolve, so patience is required.

6. Add methanol/sodium hydroxide mixture to vegetable oil in 500 mL beaker. Transfer mixture to a 2 L plastic drink bottle. Seal and shake gently for several minutes to mix thoroughly.

7. Leave mixture to settle overnight. The lighter coloured layer on the surface is biodiesel. The darker coloured layer at the bottom is glycerol.

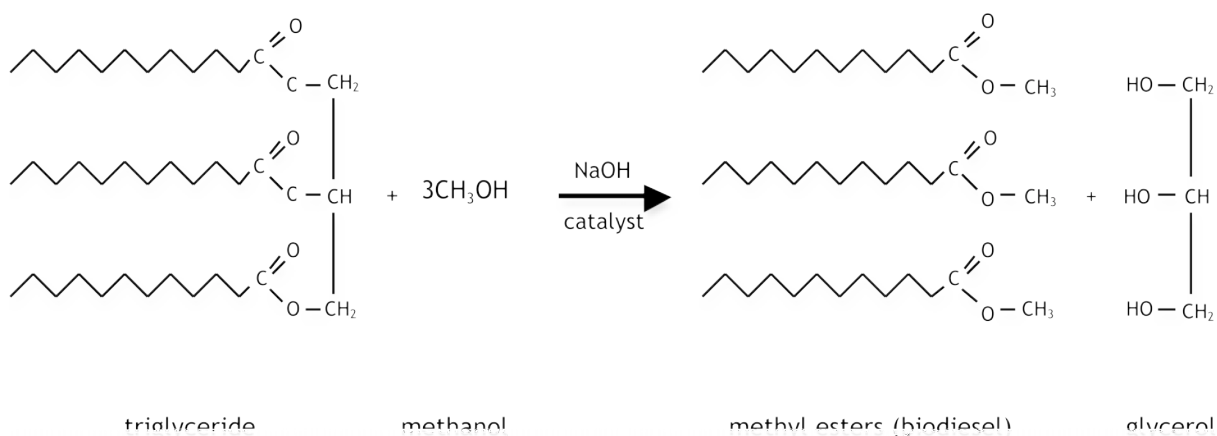
- **Caution: the product of this reaction, biodiesel, is flammable.**

8. Decant biodiesel from glycerol into a clean 500 mL beaker. This biodiesel would need further processing before it could be used in an engine.

The basis for production of biodiesel is reaction of fat or oil (triglyceride) with an alcohol (methanol). Triglycerides or fat molecules are composed of a glycerol molecule plus three fatty acid molecules.

The process of making biodiesel is known as transesterification because esters (which are molecules made from part of an alcohol and part of an acid) and glycerol are formed.

The chemical reaction for biodiesel production is shown below:



Your teacher may ask you to keep a small amount of your biodiesel so that you can compare its properties to other hydrocarbons in the activity, *Comparing fuels*. This should be kept in a suitably labelled glass storage bottle.