Production of Lab Scale Biodiesel

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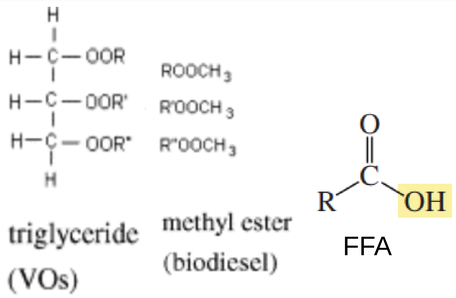
Summary

Plants produce oils that humans use for cooking every day. These oils are triglycerides thus defining them as esters. Oil can be converted into biodiesel (methylesters) using transesterification. However, if the oil is used for cooking, there is the formation of free fatty acids. Free fatty acids are difficult to convert into biodiesel because OH is a strong base. This means it is a poor leaving group and typically saponification occurs



Motivation

Fossil fuels are a non-renewable resource. On the other hand, plants are a renewable resource. Converting waste cooking oil into biodiesel is a much more environmentally friendly source of energy

Research Question

What are some different methods used for converting oil into biodiesel and which one is the most efficient

Are we able to convert regular cooking oil into biodiesel?

How do we measure the quality of biodiesel produced?

How can we avoid saponification?

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Methods & Materials

Procedure

1. Obtain: Soybean Oil, 250mL Beaker, Stir Bar.
2. Measure out 100mL of Soybean Oil, add a thermometer and stir bar
3. Place the beaker on the hot plate and begin heating to ~60°C wile stirring at 500 RPM
4. While the oil is heating, measure out desired amount of CH3OH and weigh desired amount of KOH. Mix the measured amounts in a separate container.
5. Once the Oil reaches ~60°C, turn the heater off and allow the oil to chill to around 50°C.
6. After the oil has chilled, add the KOH & CH3OH mixture.
7. Allow the reaction to occur for 15-30min
8. After the reaction has taken place, pour the mixture into a separatory funnel.
9. Allow the mixture to separate for at least 1 hour.
10. In a separate container empty the bottom layer of glycerol.
11. Collect the upper layer of biodiesel
12. Heat the biodiesel to 150°C to boil out any potential water from the sample
13. In a sealable container measure out 27mL of CH3OH and 3ml of biodiesel sample
14. Shake the container. If the mixture quickly returns to being clear the biodiesel passes the purity test

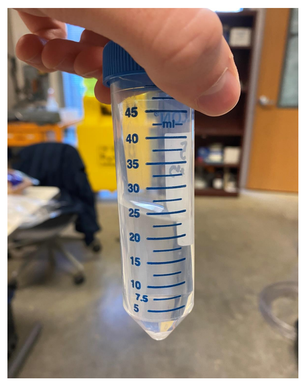
Materials

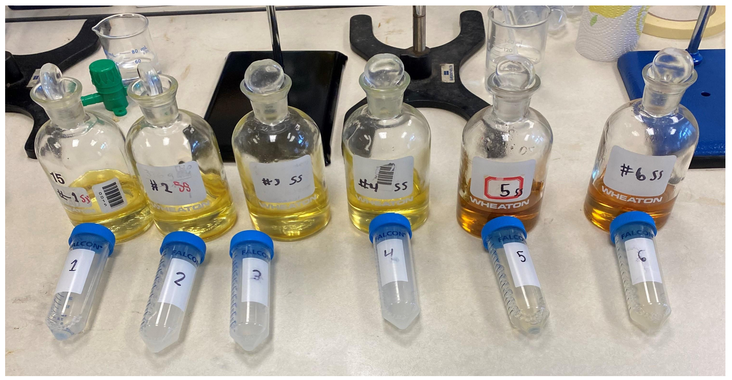
1. Soybean Oil
2. Sep Funnel
3. Hot Plate
4. Stir Bar
5. 250 mL Beaker
6. Methanol (CH3OH)
7. Potassium Hydroxide (KOH)
8. Thermometer
9. Scale
10. Container for KOH & CH3OH

Results and Discussion

Creating biodiesel from virgin cooking oil proved to be a daunting task. A base catalyzed homogenous reaction was chosen for my reaction. Out of the six trials ran, only one trial, trial 5, passed the methanol test. In the picture the capped jars were shaken and only trial 5 almost instantly turned clear. Trial one is the best trial that failed as it does return to be clear quickly, however, not as quickly as trial 5. Pass/fail was determined by the own researcher's judgment. Other quality test were proposed. The copper test was done to compare the pH effects of fatty acid, but when acid was added no reaction occurred.

Other Methods for biodiesel production were considered. For example, a heterogenous base catalyzed trial was considered. Based on the research papers read the reaction seemed very specific and difficult to replicate with given lab equipment. If the other biodiesel trials had been successful. Waste cooking oil was the next procedure. Unfortunately, time and the difficulties from free fatty acid content prevented further trials.





Conclusion

In conclusion, allowing the oil to react longer, using more catalyst, and allowing the mixture to evaporate water for longer proved to produce the purist biodiesel. For the experiment. Experiment three and four potentially had water contamination due to cleaning from previous trials

Table 1

Trial	1	2	3	4	5	6
Reaction Time	15min	15min	15min	15min	30min	30min
KOH (g)	0.794g	0.489g	0.809g	0.656g	1.32g	0.744g
CH3OH (ml)	22	23	25	18	24	22
H2O Evap Time	30min	30min	30min	30min	1hr	1hr
27:3 Test	Fail (best)	Fail	Fail	Fail	Pass	Fail

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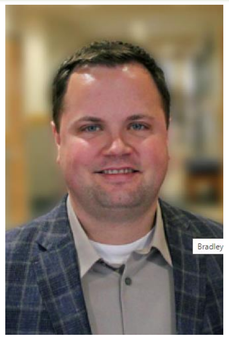

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