Hong Kong Student Science Project Competition 2022
Template of Extended Abstract (Investigation)
(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: SBBC297

Project Title: Comparison of biodiesel produced from different vegetable oil

Project Type: Investigation

To our best knowledge and after thorough literature research, as at 28/06/2022 , there are no similar works.

1. **Comparison of biodiesel productivities of different vegetable oils by acidic catalysis: https://www.researchgate.net/publication/50392768_Comparison_of_biodiesel_productivities_of_different_vegetable_oils_by_acidic_catalysis**
2. **Chemistry of biodiesel: https://youtu.be/47tGa-iOtLU**
3. **Transesterification: https://www.e-education.psu.edu/egee439/node/684**
4. **Effect of methanol/ oil volume ratio on the biodiesel yield: https://www.researchgate.net/figure/Effect-of-methanol-oil-volume-ratio-on-the-biodiesel-yield-in-the-four-hydroxide_fig1_330908435**
5. **Transesterification of biodiesel calculation: https://youtu.be/tUIuP4H8Rek**

I. Background

Fossil fuels will be used up due to the large demand of energy, biodiesel can help with this problem because it is a renewable energy source. Vegetable oil is easy to access than other oil to make biodiesel.We want to find out the differences in biodiesel produced from different vegetable oils as different oils have different triglyceride composition and we want to compare them in terms of combustibility, energy value, amounts of pollutants formed when combusting, etc. as to find out which vegetable oil is best suitable for production of biodiesel.

II. Objectives

To compare the differences in different biodiesels formed from different vegetable oils

III. Hypothesis

The differences in different biodiesel are due to the different triglyceride content in vegetable oils.

IV. Methodology

Chemicals used:(per trial)

1. ~1.1g of NaOH
2. ~200 mL of vegetable oil
3. ~50mL of methanol
4. ~13.8 cm^3 2M HCl

Apparatus used:

1. 1x 250mL separating funnel
2. 2x 250mL measuring cylinders
3. 1x 10mL measuring cylinder
4. 1x hot plate
5. 1x 500mL conical flask
6. 2x 150mL conical flasks
7. 1x filter funnel
8. 1x stand
9. 2x clamps
10. 1x thermometer
11. 1x wash bottle
12. 2x crucible
13. 1x Bunsen burner
14. 1x Magnetic stirrer

Production of biodiesel:

1. 200 mL vegetable oil was poured into a conical flask, the flask was put on the hot plate and heated to 60 ℃
2. 50 mL methanol was poured to 250 mL beaker and added 1.1g of sodium hydroxide to the solution to form sodium methoxide .
3. The solution mixture was added to the vegetable oil, the solution mixture was let to react for an hour. Temperature was maintained between 55℃ to 65℃
4. 13.8 cm^3 2M HCl was added to the solution mixture to neutralise the NaOH
5. The solution was poured to the separation funnel and rested for at least 20 minutes
6. The lower glycerin layer of the solution was separated and flowed to a beake.
7. Another beaker was used to hold the upper biodiesel layer of the solution
8. The biodiesel part was heated at 100°C until a constant mass was reached to remove impurities

9. The experiment was repeated with another vegetable oil

Tests:

1. Test for presence of glycerin(Dustan's Test) :
    1) Add a 5mL of colourless sodium tetraborate solution into the test tube
    2) Add a few drops of phenolphthalein indicator into the test tube
    3) The solution mixture will turns from colourless to pink
    4) Add the sample solution into the solution mixture and shake it gently
    5) If the colour of the solution change from pink to colourless in 25℃
    6) The sample solution is glycerin
2. Combustibility Test:
    1) Add a few drops of warm biodiesel sample into a crucible
    2) Place the crucible above a pipe-clay triangle, tripod and Bunsen burner
    3) Ignite a non-luminous Bunsen flame
    4) Record the time taken for the biodiesel to self-ignite

Theory:

Transesterification between triglyceride and methanol with NaOH as a catalyst. Triglyceride breaks down into backbone and 3 fatty acids then react with methanol to form biodiesel(fatty acid methyl ester) and glycerin.

V. Results

Type of oil	Grapeseed oil	Extra virgin oil
Oil Volume	200mL	200mL
NaOH Volume	1.11g	1.11g
Methanol Volume	50mL	50mL
Hydrochloric acid(2M) Volume	13.75 mL	13.75mL
Mass of oil and methanol	225.75g	218.54g
Mass of biodiesel layer	161.55g	163.10g
Time to time for biodiesel to self-ignite	15 secs	12 secs

Biodiesel produced from extra virgin oil takes less time to self-ignite, so it has a higher combustibility.

Improvements:

Use different catalysts to remove more impurities from the biodiesel and increase the rate of reaction
Use more accurate apparatuses for measurement.
Try more types of vegetable oil, other than those used.
Use vacuum distillation to remove the impurities from the biodiesel

Limitation:

1. Transport error
2. Presence of impurities
3. Data of only two types of oil are collected
4. Cannot measure the amount of other pollutants formed

Further Work:

1. Investigate amount of energy released by each biodiesel
2. Find the pollutants produced by different biodiesel
3. Find the ignition point of biodiesel
4. Compare the suitability of biodiesel made from vegetable oil and other sources

Importance of our investigation:

Compare the more suitable biodiesel that is produced from vegetable oil in terms of higher combustibility.

VI. Conclusion

Extra virgin oil is the vegetable oil which is more suitable to make biodiesel compared to grapeseed oil.