**Potent Plant Power…Living Fuels**

**Teacher notes**

**Time needed to complete lab:** 3 hours

**Target grade level**: high school chemistry

**Objectives:**

The student will be making biodiesel.

The student will analyze the biodiesel sample with an IR.

The student will burn the biodiesel sample and determine the heat of combustion.

**Major concepts**:

Could be used when talking about chemical reactions, acid/bases, energy.

**Preparation:**

\*To make the 9M KOH: Add 50.49 grams of KOH pellets to 100 grams of water.

\*KOH is used as a drain cleaner and can be found next to Drano

\*HEET® Gas-Line Antifreeze in the yellow bottle is methanol and is available in auto supply stores

\*For Homemade Bunsen burner: buy 5/8” brass compression nuts at a local hardware store & you must use 100% cotton cosmetic pads OR a brass hose end cap works well too!

**Typical results or sample data:**

 Table 1: Info for Heat of Combustion (Results will vary!!!)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  **Type of Biodiesel** | **Initial Mass****(g)** | **Final Mass****(g)** | **Change in Mass (Initial-Final)** | **Starting Temp. of Water (°C)** | **Ending Temp. of Water (°C)** | **Change in Temp. (Final - Initial)****ΔT** |
| **Canola** |  |  |  | 23 | 56 | 33 |
| **Coconut** |  |  |  | 22 | 60 | 38 |
| **Corn** |  |  |  | 55 | 80 | 25 |
| **Olive** |  |  |  | 72 | 100 | 28 |
| **Safflower** |  |  |  | 27 | 71 | 44 |
| **Vegetable** |  |  |  | 24 | 49 | 25 |

 Table 2: Heat of Combustion Values for Each Biodiesel

|  |  |  |
| --- | --- | --- |
| **Type of Biodiesel** | **ΔE** | **Rank from Highest to Lowest** |
| **Canola** | 10255.4 | 3 |
| **Coconut** | 11924.4 | 2 |
| **Corn** | 7845 | 5 |
| **Olive** | 8786.4 | 4 |
| **Safflower** | 13807.2 | 1 |
| **Vegetable** | 7845 | 5 |

**Sample calculations**

s = 4.184 J/g°C

m = mass of water (75g)

(HINT: 1 mL of water has a mass of 1 gram.)

ΔT = from data table

Then calculate your ΔE using the equation:

ΔE = s x m x ΔT

 (SEE TABLE ABOVE)

**Answers to questions:**

**Guiding questions:**

1. Fossil fuels are nonrenewable resources that are being consumed at a rapid rate, what are some possible fuel ideas that are renewable?

Switch grass, Corn, Sugar Cane, Vegetable Oil, Peanut Oil

1. What are some advantages of using biodiesel?

Renewable, cleaner, recycling of used oil, fairly easy to make, use by-products for soaps

**Questions:**

1. Which oil produced the best biodiesel and why? Use the data to support your answer. Safflower oil made the best biodiesel because it had the greatest heat of combustion, with 13807.2 J of energy. (RESULTS WILL VARY because there are too many variables, such as type of can, distance from flame, etc.)
2. What sources of error could affect your yield of biodiesel from your specific oil and determining the heat of combustion?standardizing the amount of KOH needed per type of oil, not collecting all the biodiesel from the glycerin, not washing the biodiesel therefore limiting the purity of the sample, collecting salt water from the wash into the sample, spilling any of the oil/biodiesel mixture, evaporation of the methanol before the KOH was added
3. When making the biodiesel, how do you know that a chemical reaction actually takes place? The mixture separates into two distinct layers, much different in appearance and smell from the reactants.

**Extension:**

* Once students have removed biodiesel from the glycerin, they could use the glycerin to make soap, which is saponification. Students could also develop their own research project based on biodiesel and types of oils that could be used.
* Students could research and compare the various oils to their major fatty acids and how those fatty acids relate to the heat of combustion calculated during the lab.