

Online Performance Test for the Graphing Benchmark

By Steve Stultz
J.C. Harmon High School
Kansas City, KS School District
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Introduction

- Biodiesel is made from vegetable oil. Just like cooking oils, biodiesel can go bad. After a certain time period it becomes rancid (decay).
- Rancid means that it smells bad, looks cloudy and gels – YUCK!

Shelf-Life of Biodiesel

- Biodiesel decays over time. This means that it has a “shelf-life,” which is how long something can be stored without going bad (decaying).
- When biodiesel becomes rancid it becomes acidic, which of course could cause harm to an engine.

Increasing Biodiesel Shelf-Life

The main source for making biodiesel is soybean oil. Coconut oil can also be used to make biodiesel. But, coconut oil is a solid at room temperature (like butter). Biodiesel from coconut oil must be used at higher temperatures to avoid gelling and clogging an engine.

Coconut oil doesn't decay as fast as soybean oil. Hmm... maybe blending these 2 would increase biodiesel shelf-life.

Scenario

Imagine that you're a scientist.

You work for Dr. Williams at the University of Kansas.



Your job is to make biodiesel with a longer shelf-life. In order to do this you will have to test for rancidity.

Your Job

Your going to test whether or not blending coconut oil with the soybean oil increases biodiesel shelf-life.

Let's get started...

Making Biodiesel: Step 1

Measure out the required number of grams of each of the oils and place them in the reaction vessel shown here.



Making Biodiesel: Step 2

Add a catalyst to the reaction vessel, and place the vessel in a heated mineral oil bath.

The vessel is attached to a cooling column to maintain the temperature at 65 degrees C, as shown below.



The production process pictured below runs for two hours.





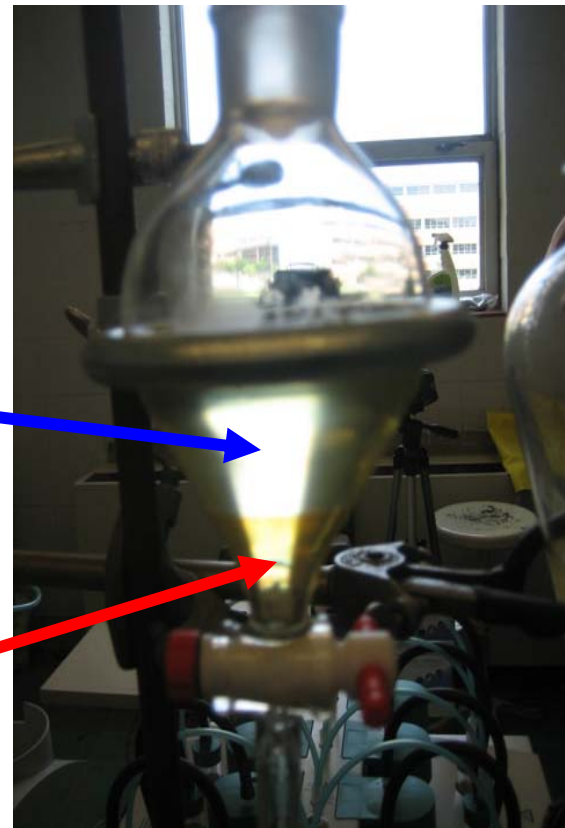
After the processing time the mixtures are poured into separatory funnels as shown above.

Reaction Products

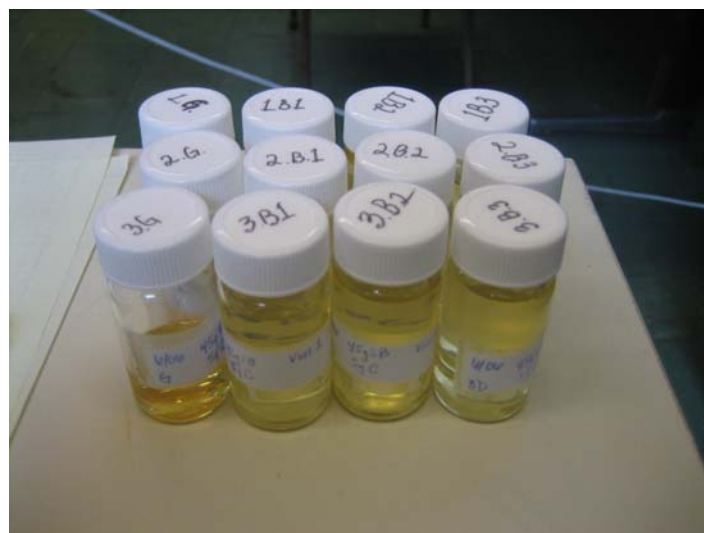
The mixture sits for 24 hours in the funnels and separates into 2 layers.

The top layer is biodiesel (clear/whitish).

The bottom layer is glycerin (yellowish) as shown here.



The products are collected into vials for testing.



Calculate Blend Percentages

You have made the following blends of coconut and soybean oil. Copy this table and calculate the % of coconut oil present in each blend.

Tube #	Grams of coconut oil (g)	Grams of Soybean Oil (g)	Percent coconut oil (%)
1	50	0	
2	0	50	
3	5	45	
4	10	40	
5	15	35	
6	20	30	
7	25	25	
8	30	20	
9	35	15	
10	40	10	
11	45	5	

Table for Collecting Data

Copy the data table below and record the % coconut oil. This table will be used in the following rancidity test.

Tube #	% Coconut Oil	Induction Time in Hours (h)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		

Rancidity Test

You have made different percent blends of coconut and soybean oil.

You will use a machine called a “Rancimat” (pictured on the right) to test how long it takes for these blends to become rancid. The machine forces the samples to become rancid in hours instead of months.

Rancimat Machine:

Side View

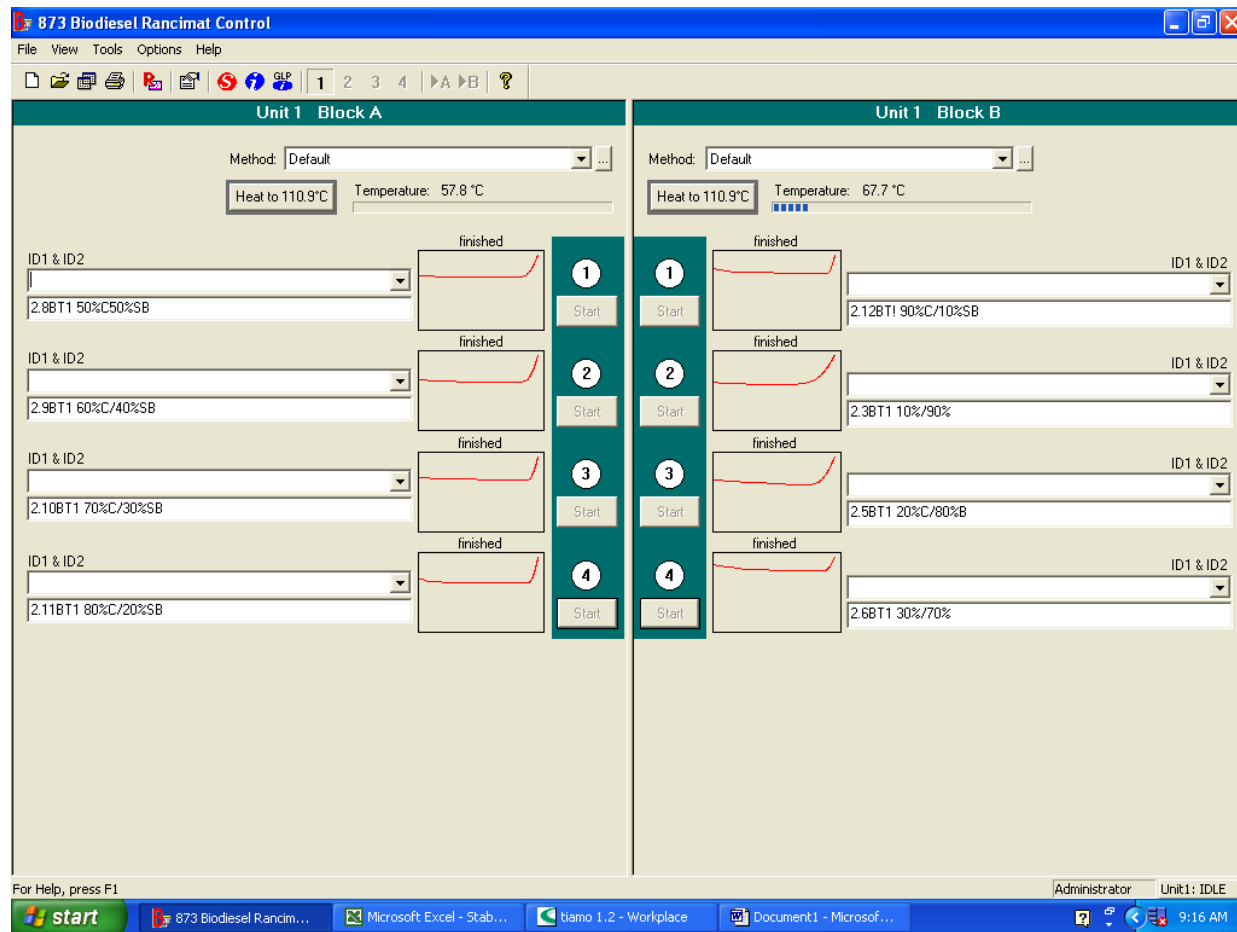


Top View



Results of Rancidity Tests

Example of a Rancimat report:



Rancidity Data

Here is the data you received from the Rancimat machine.

The longer it took to become rancid the longer the shelf-life.

Tube #	Induction Time in Hours (h)
1	18.75
2	6.58
3	5.11
4	10.62 and 6.31
5	7.02
6	8.82
7	9.09
8	11.28
9	12.71
10	15.68
11	16.67

Copy these results onto your data table. Include both times for tube four as the cap on tube four was loose and ran longer than it should have and had to be redone.

Graph the Data

Choose the appropriate graph and graph the data from your table. Plot % coconut oil against time it took to turn rancid. Make sure to correctly graph all data (Hint: tube 4).

Questions

1. What conclusions can you draw about shelf life and the % of coconut oil?
2. Should you make biodiesel with 100% coconut oil? Why or why not?
3. Was there any outlier data points? If so what was it and what caused it?

Rancidity Data – Statistical Analysis

To verify your results you tested some of the samples three times. Here is the data you received from the Rancimat machine.

Tube #	Induction time in hours (h)			Mean	Median	Mode
1	18.75	17.86	19.22			
2	6.58	5.25	4.99			
3	5.11	5.72	5.11			

Copy this table and calculate mean, median and mode.

Rubric for Scoring Science Performance Assessment: Inquiry 1.1.3

	Distinguished (Wow!)	Basic (Acceptable)	Unsatisfactory (Redo)
	5	3	1
Graphing	<p>The correct graph format is chosen.</p> <p>The data is represented accurately and in the correct fashion.</p> <p>The graph is neat and easily interpreted.</p> <p>Axes are properly labeled and have units.</p> <p>Independent and dependent variables are on the proper axis</p> <p>A good title is present and the communication of data through the graph is accurate.</p>	<p>The correct graph format is chosen.</p> <p>The data is represented accurately and in the correct fashion. One data point may be incorrectly graphed</p> <p>Some sloppiness can be found that doesn't prohibit interpreting the data.</p> <p>Axes are properly labeled and have units</p> <p>A title is missing but the general communication of data through the graph is accurate.</p>	<p>The incorrect graph format has been chosen and/or the graph is so poorly made that the communication of the data is lost</p> <p>Axes labels are incorrect, missing or do not have units</p>
Mean, Median, Mode	<p>The mean, median and mode are correctly calculated</p> <p>The answers provided include units.</p> <p>Work or explanation of work is provided for all answers</p>	<p>The mean, median and mode are correctly calculated.</p> <p>Work is shown or an explanation of how the calculation was done is present.</p> <p>One math error is acceptable if the explanation or work provided is correct.</p> <p>Units may be missing on the answers</p>	<p>One or more calculations are in error.</p> <p>No work or explanation of how the answer was obtained is present</p>