PHYSICAL PROPERTIES:
Specific Gravity of Biodiesel Blends

Georgia Performance Standards: SCSh2, SCSh3, SCSh4, SCSh5, SCSh6, SC1b

National Science Standards: Content Standards A, B: structure and properties of matter

Objective: Students will use the biodiesel blends made in the previous exercise and will test their properties. Students will find out how the specific gravity (or density) of the fuel changes as a different percentage of biodiesel is added to petroleum diesel.

Essential Questions:

- What is a biodiesel blend?
- What is the naming convention of blends?
- Why are blends useful?

Background: There are several reasons why using blends of biodiesel with petroleum diesel can be advantageous. Having some biodiesel blended into the petroleum will help offset the use and dependence on oil. Using at least a small percentage of biodiesel will also help in engine maintenance due to the natural lubricity of the fuel. Most blends used today are either B5 (5% biodiesel 95% petroleum diesel) or B20. Blends higher than that can require some minor engine modifications for some vehicles since biodiesel dissolves rubber components. Higher blends can also damage an engine if biodiesel that is not properly made and cleaned is accidentally used. Blending biodiesel with petroleum diesel is also advantageous in colder climates. Since the petroleum diesel has a lower freezing point than biodiesel, the blends can allow consumers to still use some percentage of biodiesel without worrying about gelled fuel lines in the winter. Currently the U.S. government offers a $1.00 per gallon tax credit for blenders.

Density is mass per unit volume. Since absolute density can change depending on where you are, specific gravity can be used since it is just a relative comparison. Specific gravity is sometimes easier to use because you don't have to worry about units. Specific gravity is a measure of a substance's density compared to the density of water. In biodiesel production, specific gravity is used to test the purity of biodiesel. B100 should have a specific gravity between 0.86-0.90 (no units on specific gravity).

Procedure: 1. Obtain the blends of bio/petroleum diesel that you made in the previous lab.
2. Obtain a specific gravity bottle from your instructor.
3. Weigh the empty specific gravity bottle and record the weight.
4. Fill the bottle up to the very top with water. (Your instructor will show you how to use the bottles)
5. Weigh the bottle + water and record the weight.
6. Determine the weight of just the water and record your answer.
7. Empty the bottle, rinse it several times with the next blend you will use (this time it is B5) and then fill it with B5 blend and record the weight of the bottle + B5. Never wash the bottle out with water until you are completely finished.
8. Determine the weight of just the B5 and record your answer.
9. Divide the determined weight of B5 by the determined weight of water and record your answer. That is your specific gravity.
10. Repeat steps 7-9 for each of the biodiesel blends (B5, B20, B50, B80, B95). Also measure B100 (pure biodiesel) and pure petrodiesel.
11. Using a piece of graph paper, plot the specific gravity of the blends versus the percentage of biodiesel.

Materials:

- Specific gravity bottles (see instructor notes)
- Balances, preferably electronic
- Graph paper
- Biodiesel blends from previous lab
- B100
- Petroleum diesel
- Water

Assessment: Lab rubric

Questions: Answer the following questions in your lab report or on a separate sheet of paper.

1. Is there any noticeable difference in the appearance of the blends?
2. What happened to the specific gravity (or density) of the blends as you had more biodiesel present?

Lab Data Sheet – Specific Gravity of Biodiesel Blends

Weight of empty specific gravity bottle: _____ g

Weight of bottle + water: _____g
Weight of water: _____g

Blend	Weight of bottle + blend (grams)	Weight of blend (grams)	Specific Gravity (no units)
Petroleum diesel			
B5 (5% biodiesel)			
B20			
B50			
B80			
B95			
B100			

Calculations:
(Show all your calculations for determining the numbers in the table above for full credit. Don't forget to pay attention to significant figures!)

Graph: On a separate sheet of graph paper, graph the specific gravity versus the percentage of biodiesel in the blend. What do you notice about the graph? Make a one sentence statement analyzing the graph.

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Instructor Notes

Specific gravity bottles such as those in the picture can be obtained from any scientific supply company such as Flinn, Sargent-Welch, or Fisher.

If you would rather have your students determine absolute density instead of specific gravity, the alternate procedure can be used and the data sheet can be modified.

Alternate Procedure (using density):

1. Obtain the blends of bio/petroleum diesel that you made in the previous lab.
2. Obtain a 10 mL graduated cylinder.
3. Weigh the empty graduated cylinder and record the weight.
4. Add exactly 10 mL of B5 to the graduated cylinder. Make sure that the bottom of the meniscus hits exactly on the line.
5. Weigh the cylinder + B5 and record the weight.
6. Determine the weight of just the B5 and record your answer.
7. Calculate the density of the B5 blend and record your answer (think about the definition!).
8. Thoroughly clean the graduated cylinder by rinsing with the next blend you are going to use several times. Do not wash the cylinder with soap and water until you are completely finished.
9. Repeat steps 4-8 for each of the biodiesel blends (B5, B20, B50, B80, B95). Also measure B100 (pure biodiesel) and pure petrodiesel.
11. Using a piece of graph paper, plot the density of the blends versus the percentage of biodiesel.