Lab 5: Soap Lab

Report:
You are hired by the publisher of the magazine “Odyssey: Adventures in Science” to write an article about soap.

Write a brief paragraph about how soap works (water and oil do not mix, yet soap dissolves in both; how, in general, does this work?). Also briefly discuss what is meant by the term “hard water” and why soap is not as effective in hard water. Then, discuss your results, making sure to address the following points (providing specific examples from your observations).

1. How did each sample (your soap, store soap, detergent, and shampoo) compare in sudsing action in deionized water?
2. How did each sample (your soap, store soap, detergent, and shampoo) compare in sudsing action in tap water?
3. How did each sample (your soap, store soap, detergent, and shampoo) compare in sudsing action in hard water?
4. How did each sample (your soap, store soap, detergent, and shampoo) compare in sudsing action in oil?
5. Based on your observations, does soap generally work better in soft or hard water?
6. Based on your observations, which works better in hard water -- soap or detergent?
7. From your observations, would you conclude that shampoo is more like soap or detergent? Explain your answer.

Procedure:
Part One: Making the Soap
1. Place 20 g of lard in a 1000 mL (1 L) beaker.
2. SLOWLY add 30 mL of 6 M sodium hydroxide (NaOH).
3. Add 100 mL of pure ethanol (ethyl alcohol; 200 proof).
4. Carefully add the stir bar to the beaker and chemicals.
5. Under LOW heat (the second “tick mark” on the hot plate), heat the mixture. Using tongs or a glass rod, place the stir bar to spin as fast as possible without it getting off balance (about a ½ to ⅔ the maximum setting for the stir bar). The mixture will take some time to dissolve (5 minutes or less). Once it dissolves, it will turn to a clear but yellowish mixture. After 20 to 30 minutes, the mixture will start to become gel-like (although it may not until you take it off the hot plate). While this is happening, slow the stir bar so that it is still spinning. Let this mixture continue to heat for another 10 minutes (so it should be on the heat for approximately 40 to 45 minutes total).
6. Turn the heat off (but leave the mixture on the hot plate) and let it cool for awhile before adding 40 mL of deionized water. Let this mixture mix for 5 to 10 minutes. After the 5 to 10 minute period, take the beaker off of the hot plate. CAUTION: The beaker and hot plate may still be hot, so use paper towels or gloves to hold the beaker as you take it off, and place the beaker on a paper towel.
7. Let the beaker cool for 10 minutes on the lab bench.
8. While you are letting the mixture cool, dissolve 24 grams of sodium chloride (NaCl) in 100 mL of deionized water. A 400 mL beaker works best for this.
9. Pour the cooled beaker with the gel into the 400 mL beaker.
10. Mix this solution with a glass stirring rod for 2 to 3 minutes.
11. Pour the solution back into the 1000 mL beaker.
12. Test the pH. The pH will most likely be very basic (the pH paper will turn blue). Slowly add vinegar until the pH is around 7 (the pH paper will be orange).
13. Once the pH is around 7, place two paper towels over the beaker. Hold the paper towels tightly on the beaker and pour the liquid into a 400 mL beaker. The solid should stay in the 1000 mL beaker. You will lose some of the soap on the paper towel.
14. Rinse the solid in vinegar again if necessary (if the pH still seems basic). Drain the vinegar from the solid again.
15. If you brought a fragrance, rinse your solid in your fragrance and then drain the liquid again.
16. “Pour” the solid into a plastic cup. The solid is your soap! Keep a small portion of it to use for testing.
17. Let the solid dry for 1 week. (NOTE: The pH inside the chunks may not be 7. It may still be very basic, so do not put it on your hands.)

Part Two: Testing the Products in Deionized Water
1. Half-fill four test tubes with deionized water.
2. Add a pea-sized sample of each of the soaps (yours and store-bought) and detergent to separate test tubes, and about 1 mL of shampoo to the last test tube.
3. Stopper with your finger (covered with a finger glove) and shake each test tube 15-20 times. Observe the height of the suds in each test tube (in mm). Record your observations.

Part Three: Testing the Products in Tap Water
1. Half-fill four test tubes with tap water (from the faucet at your lab bench).
2. Add a pea-sized sample of each of the soaps and detergent to separate test tubes, and about 1 mL of shampoo to the last test tube.
3. Stopper and shake each test tube 15-20 times. Observe the height of the suds in each test tube (in mm). Record your observations.

Part Four: Testing the Products in Hard Water
1. Half-fill four test tubes with hard water (made with magnesium sulfate).
2. Add a pea-sized sample of each of the soaps and detergent to separate test tubes, and about 1 mL of shampoo to the last test tube.
3. Stopper and shake each test tube 15-20 times. Observe the height of the suds in each test tube (in mm). Record your observations.

Part Five: Testing the Products in Oil
1. Half-fill four test tubes with deionized water.
2. Add about 3 mL of cooking oil to each test tube.
3. Add a pea-sized sample of each of the soaps and detergent to separate test tubes, and about 1 mL of shampoo to the last test tube.
4. Stopper and shake each test tube 15-20 times. Observe the height of the suds in each test tube (in mm). Record your observations.
Paper Idea II:
Write a paper on the history of soap. What is the earliest recorded evidence of people making soap? How, in general, is soap made? How has the recipe changed over the years? How has it remained similar? What is the difference between soap and detergent? How, in general, does soap work? What is meant by “hard water”? What effect does it have on the effectiveness of soap, and what can be done about it? Include chemical structures in your paper.

Note: Do not merely answer these questions given in the description in the given order, but write a coherent paper that addresses these issues. The paper must be typed, should not be longer than 5 pages (double spaced, reasonable margins), and must include at least 2 references (web references are fine). The work must be your own.