Lab 5: Soap Making – How Does Soap Make You Clean?

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. Under LOW heat, heat the mixture with continual and consistent stirring using a glass rod. The mixture will take some time to dissolve (~5 minutes or less). Once it dissolves, it should 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, you must continue to stir the mixture with the glass rod. Let this mixture continue to heat for another 10 minutes with stirring (so it should be on the heat for approximately 40 to 45 minutes total with continual and consistent stirring).
5. 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.
6. Let the beaker cool for 10 minutes on the lab bench.
7. 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.
8. Pour the cooled beaker with the gel into the 400 mL beaker.
9. Mix this solution thoroughly with a glass stirring rod for 2 to 3 minutes.
10. Pour the solution back into the 1000 mL beaker.

11. Test the pH using pH paper. The pH will most likely be very basic (the pH paper will turn blue). Slowly add vinegar and stir until the pH is around 7 (the pH paper will be orange).
12. 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.
13. Rinse the solid in vinegar again if necessary (if the pH still seems basic). Drain the vinegar from the solid again.
14. "Pour" the solid into a plastic cup. The **solid** is your soap! Keep this to use for testing.

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 glove) and shake each test tube 25-30 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 25-30 times. Observe the height of the suds in each test tube (in mm). Record your observations.

Part Four: Testing the Products in Hard Water

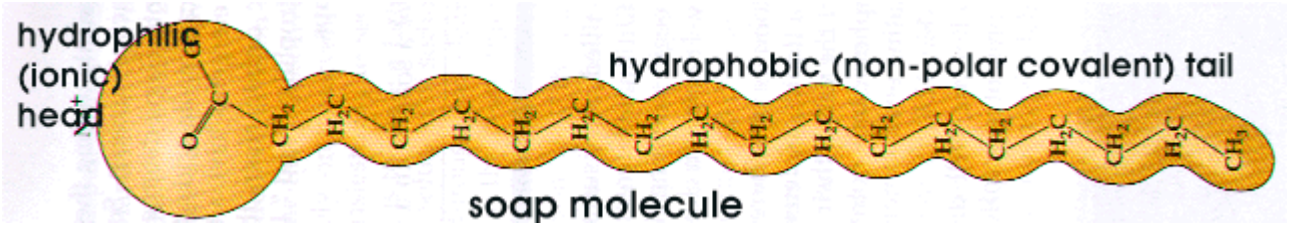
1. Half-fill four test tubes with hard water (made with magnesium sulfate).
2. Add a pea-sized sample of each of the soaps and detergent to separate test tubes, and about 1 mL of shampoo to the last test tube.
3 Stopper and shake each test tube 25-30 times. Observe the height of the suds in each test 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 25-30 times. Observe the height of the suds in each test tube (in mm). Record your observations.

Part Six: Making Soap Directly from Glycerin Bars

1. Obtain 2-3 glycerin bars and place them in a decent-sized beaker.
2. These bars melt quickly in the microwave. Heat for 30 seconds on high. Stir with a glass rod and then continue to heat in short intervals until the soap is thoroughly melted.
3. The ideal temperature for pouring soap is 145 – 150°F. Use a candy-deep fry thermometer to make this measurement.
4. If desired, add fragrance and coloring dye sparingly to melted soap. Stir well.
5. Pour soap into desired molds and allow to cool.



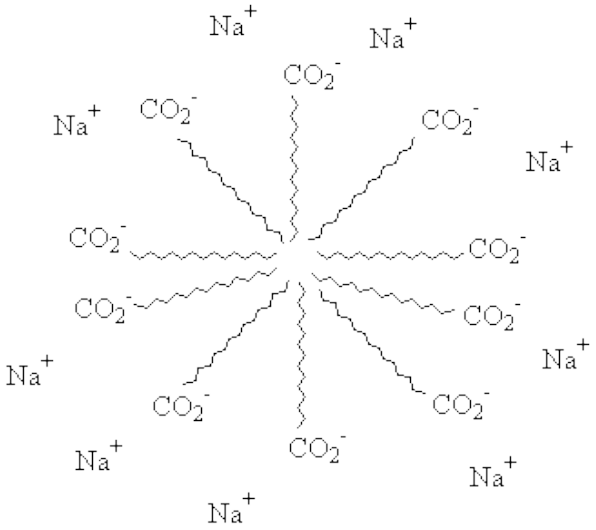


Diagram of Soap Micelle