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LAB 1: HAND SANITIZER: FORMULATION AND EVAPORATION RATE

Lab Overview

Hand-rub sanitizers represent a convenient method for sanitizing one's hands in the absence of soap and water. Ethyl alcohol-based hand sanitizers kill harmful microorganisms and, due to various additives, will also leave your hands moisturized. Besides the active component (the alcohol), most commercial gel hand sanitizers we are using in daily lives contain additional components, such as water and gelling-inducing compounds called carbomers. A carbomer is a type of polymer that acts as a thickening agent due to its super-absorbant properties. Super-absorbant polymers (SAP) can absorb large amounts of water, thus only a small amount of carbomer is needed to form a gel. Addition of the carbomer is also controlling the evaporation rate of the active ingredient (alcohol); slow evaporation is necessary to properly sanitize one's hands. ***In this week's lab you will learn to formulate a hand sanitizer based on ethyl alcohol and investigate the evaporation rate of your hand sanitizer by monitoring the evaporation through change in mass over time.***

Materials:

- One 1-inch stir bar, one 250-mL beaker, one 100-mL graduated cylinder, one small funnel, one scoopula, one plastic pipette, two small plastic bottles

Reagents:

- Dionized water, Lubrizol Carbopol Ultrez 10 (carbomer), Ethyl alcohol (ethanol), Triethanolamine
  Note: Triethanolamine used as a neutralizer in this experiment is a strong base. Ethyl alcohol is flammable. Measurements must be as exact as possible.

Experimental Procedure

Part 1. Formulation of an alcohol-based hand sanitizer

1. In a 250-mL beaker, place a 1-inch stir bar and add 40 mL deionized water.

2. Weigh out 0.25 g Carbopol Ultrez 10 (carbomer) onto a weighing paper using your scoopula. Sprinkle the carbomer onto the surface of the water. Let the mixture sit for 15-20 minutes, or until the carbomer becomes clear and no white chunks are visible.

3. Using a 100-mL graduated cylinder, measure exactly 77 mL of ethyl alcohol. Gently stir your mixture on the magnetic stirrer, and slowly add small portions of the alcohol. Continue stirring your mixture slowly, allowing for as many air bubbles to escape as possible.

4. With a small plastic pipette, add exactly **4 drops** of Triethanolamine to your beaker containing the sanitizer mixture.

5. Slowly increase the speed of stirring and allow for 5 minutes of stirring at higher speed.

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6. Use a small piece of pH paper to test the acidity of your mixture. Your hand sanitizer should be neutral (pH 7).

7. Carefully pour your hand sanitizer into a plastic bottle.

Part 2. Evaporation of hand-rub sanitizer gels (Based on Pinhas, A. ***Journal of Chemical Education*** **2010**, *87*, 950)

In Part 2 of today's lab you will investigate the rate of evaporation of your gel. The rate of reaction indicates how quickly a reaction takes place. In practical applications, pharmaceutical efficacy or toxicity are both dependent on reaction rates of molecular interactions. In general, investigation of reaction rates involves a systematic monitoring of the concentration of one of the component in a given sample over time. Your hand sanitizer gel contains several components, but you will be focusing today on the active ingredient (the alcohol). During this experiment, you will record the mass of gel over time. As alcohol evaporates, there will be less sanitizer gel and this is simply indicated by the decrease of your gel sample's mass.

1. Place a weighing paper on a balance and press "Tare". On the tared weighing paper, add about 0.5-0.7 g of hand sanitizer gel prepared in Part 1. Spread the gel evenly across the weighing paper using you finger (you must wear gloves)

3. Record the mass at this time as time zero. Without removing your sample from the balance, monitor and record the mass of your sample for 20 minutes at intervals of one minute.

Time (minutes)	Sample mass	Time (minutes)	Sample mass
0		11	
1		12	
2		13	
3		14	
4		15	
5		16	
6		17	
7		18	
8		19	
9		20	
10			

4. In Excel, plot your data as **mass vs. time**; as **change in mass ($mass_{t=0} - mass_t$) vs. time**; and as **$ln(mass_{t=0}/mass_t)$ vs. time**. Obtain the equation (add trendline) and give the slope from the linear regression of your graphs.

POST-LAB. After you process your raw data, return to bblearn and complete your post-lab quiz.

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