**Stoichiometry in Action: Lab Protocol**

**Objective:** Use the principles of stoichiometry to determine the theoretical yield in a simple reaction, measure the actual yield, and calculate the percent yield.

**Background:** A balanced chemical equation includes a lot of useful information including what the reactants and products are as well as the relative amounts of each substance. The coefficients in the balanced chemical equation give the mathematical relationships that exist among the moles of each substance involved.

In this experiment, you will react a measured amount of sodium carbonate with hydrochloric acid. The products of the reaction are sodium chloride, water, and carbon dioxide (a gas). The carbon dioxide gas will bubble out of the solution and will be lost. You will measure the decrease in mass to give the amount of carbon dioxide produced. Further, when the carbon dioxide bubbles, the isolated product will be water and sodium chloride. By drying the product, the amount of sodium chloride produced can be determined.

**Materials:**

Scale 2 pipets Safety goggles

1 reaction cup 1 piece of filter paper Sodium Carbonate

1 square of plastic wrap 1 beaker 1M Hydrochloric Acid

**Safety precautions:**

* SODIUM CARBONATE – Hazardous in case of skin contact (irritant), of eye contact (irritant), or ingestion, or inhalation (lung irritant)
* HYDROCHLORIC ACID – Very hazardous in case of skin contact (corrosive, irritant, permeator), of eye contact (irritant, corrosive), of ingestion. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering. If spilled, neutralize with dilute sodium bicarbonate solution; ring thoroughly with water if contacted with skin.

**Procedure:**

1. Gather the following materials: Triple beam balance, 1 cup, 1 square of plastic wrap, safety goggles, and sodium carbonate.
2. Use the balance the find the mass of the reaction cup. Record the mass of the empty cup in the data table.
3. Tare the scale by pressing the “Zero” button until the scale reads 0.00 with the empty reaction cup on it.
4. Add sodium carbonate slowly to the cup until you have reached the 1.0 gram mark. If you add too much, DO NOT RETURN THE SODIUM CARBONATE TO THE REACTANT BEAKER. Record the exact mass of the cup with sodium carbonate. Return the reactant beaker to the supply bin.
5. Wrap a small piece of plastic wrap TIGHTLY over the top of the cup.
6. Using a very sharp pencil/pen, poke 3 holes in the plastic wrap that are just big enough for the tip of the pipet. Distribute the holes so that they are equally spaced around the plastic on top of the cup but not too close to the edges.
7. Take your pipets and empty beaker to the supply bin and fill them with the 1 M hydrochloric acid (HCl). Place the pipets bulb down (tip up) in the beaker and CAREFULLY transport it back to your lab station.
8. Remove all materials from the scale and begin the reaction. BE SURE YOUR GOGGLES ARE SECURELY IN PLACE.
9. Insert the tip of one pipet through one of the holes in the plastic wrap and lower it about halfway into the cup of sodium carbonate. Add the acid one drop at a time and wait for the bubbling to slow down before adding more acid. After adding about 10 drops of acid, gently swirl the solution to mix it. Continue to add acid and swirl gently until the reaction stops. You may have to use acid from the second pipet. Make certain that there are no tiny pieces of unreacted solid in the condiment cup. *If you run out of 1M HCl, DO NOT get more. Move on with what you have.*
10. Record your observations of the reaction in the cup.
11. Add two more drops of acid to make certain that all of the sodium carbonate has reacted. If it has not, continue adding drops until no more reaction occurs.
12. Place both pipets with any remaining acid back into their beaker and return them to the supply bin.
13. Write your name on the filter paper and find the mass of a clean piece of filer paper. Record the mass in the data table.
14. Over an Erlenmeyer flask and funnel, carefully and slowly pour the product from your reaction cup onto the filter paper. Place the filter paper onto a piece of paper towel and place in your class section to dry overnight. Be careful not to disturb others’ experiments.
15. After approximately 24 hours, find the mass of the filter paper and record it in the data table.

**Stoichiometry in Action: Data & Analysis**

**Data Table:**

|  |  |  |
| --- | --- | --- |
| Mass of empty reaction cup (g) | Mass of reaction cup + sodium carbonate (g) | Mass of sodium carbonate (g) |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| Mass of filter paper (g) | Mass of filter paper + filtrate (Step 17) | Mass of sodium chloride (g) |
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**Observations of Reaction:**

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**Analysis:**

1. What was the actual yield of sodium chloride? (Show your work)
2. What was the percent yield of sodium chloride? (Use the TY from your pre-lab; show your work)
3. Was your percent yield 100%? If not, what factors do you think caused errors?
4. If you had to do this lab again, what would you do differently to improve your results? Explain using specific examples.