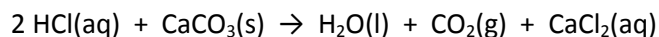


Objectives: Confirm the law of definite proportions.

Background:

The law of definite proportions states that a compound is comprised of a definite proportion of each of its elements by mass, regardless of sample size.

The reaction of hydrochloric acid, HCl, with solid calcium carbonate, CaCO₃, will completely consume the calcium carbonate to produce aqueous calcium chloride, CaCl₂, water, H₂O, and gaseous carbon dioxide, CO₂.



Bubbles of CO₂ are released, resulting in a loss of mass. As long as there is an excess of HCl (so that all of the CaCO₃ is reacted), the percent of mass lost should be constant, regardless of how much CaCO₃ is reacted. The theoretical % mass loss is calculated as follows:

$$\text{Molar mass of CO}_2 = 44.01\text{g}$$

$$\text{Molar mass of CaCO}_3 = 100.09\text{g}$$

$$\text{Theoretical percent mass loss} = (44.01/100.09) \times 100 = \mathbf{43.97\%}$$

Procedure:

1. Dispense roughly 100mL of 1.0M HCl directly into a 100mL graduated cylinder.
2. Pour the HCl from the 100mL graduated cylinder into a clean, dry 250mL beaker.
3. Weigh and record the combined mass of the beaker and HCl.
4. Dispense CaCO₃ into a weighing boat and record its mass. (For Trials 1, 2 and 3, use approximately 0.8, 1.0, and 1.2 g of CaCO₃ respectively.)
5. Record the initial mass of the beaker and contents.
6. *Slowly* pour the calcium carbonate from the weighing boat into the beaker of HCl while continuously mixing the contents of the beaker with a glass stir rod. Record your observations.
7. Continue stirring the mixture for two minutes after the last of the calcium carbonate has been added. Then, stop stirring, reweigh and record the final mass of the beaker and contents.
8. Calculate the mass loss
9. Calculate the experimental % mass loss.

CALCULATIONS

1. **Initial mass of beaker and contents** = Combined mass of beaker and HCl + Mass of calcium carbonate
2. **Mass Loss** = Initial mass of beaker and contents - Final mass of beaker and contents
3. **Experimental % Mass Loss** = (Mass Loss / Mass of calcium carbonate) X 100

Table 1a - Mass data

| | All masses in units of grams | Trial 1 | Trial 2 | Trial 3 |
|---------------|-------------------------------------|---------|---------|---------|
| Measure | Combined mass of beaker and HCl | | | |
| Measure | Mass of calcium carbonate | | | |
| Calculation 1 | Initial mass of beaker and contents | | | |
| Measure | Final mass of beaker and contents | | | |
| Calculation 2 | Mass Loss | | | |
| Calculation 3 | Experimental % mass loss | | | |

Table 1b - % Mass Loss Results

| | |
|----------------|--|
| AVERAGE | |
| STD DEV | |
| 95% CI | |