



Common Ion Effect *Preparer's Version*

Introduction

In this engaging demonstration, three acid solutions – hydrochloric acid (HCl), acetic acid (CH₃COOH), and a mixture of acetic acid with sodium acetate (NaCH₃COO) – are poured onto identical amounts of calcium carbonate (CaCO₃). All three react to produce carbon dioxide (CO₂) gas, forming froth. However, the rates of reaction differ markedly: the froth rises fastest with HCl, more slowly with acetic acid, and slowest with the acetic acid-acetate mixture. This difference visually illustrates the common ion effect, an important concept in chemical equilibria.

Safety Hazards

- Personal Protective Equipment:
 - Safety glasses/goggles
 - Nitrile gloves
 - Chemical & flame retardant lab coat
- Physical Hazards
 - Universal indicator is a highly flammable liquid and vapor.
 - Acetic acid is a flammable liquid and vapor.
 - Hydrochloric acid may be corrosive to metals.
- Chemical Hazards
 - Acetic acid causes severe skin burns and eye damage.
 - Hydrochloric acid causes severe skin burns and eye damage and may cause respiratory irritation.

Materials

- 2mL Universal Indicator
- 3x 25g Calcium carbonate
- 9.2mL Acetic acid, glacial (17.4M)
- 27g Sodium acetate trihydrate
- 16.7mL Hydrochloric acid, concentrated (12M)
- 3x 250mL graduated cylinders
- Polypad

Safety Data Sheet(s)

- [Universal indicator](#)
- [Calcium carbonate](#)
- [Acetic acid, Glacial \(17.4M\)](#)
- [Hydrochloric acid, concentrated \(12M\)](#)
- [Sodium acetate trihydrate](#)



Procedure

1. Prepare Solution A (2M Hydrochloric Acid):
 - a. Measure 16.7mL of concentrated hydrochloric acid (12M) and add it to 83.3mL deionized water. The resulting solution should be approximately 100mL 2M hydrochloric acid.
2. Prepare Solution B (2M Acetic Acid):
 - a. Measure 11.5mL of glacial acetic acid and add it to 88.5mL deionized water. The resulting solution should be approximately 100mL 2M acetic acid.
3. Prepare Solution C (2M Acetic Acid & 2M Sodium Acetate):
 - a. Measure 9.2mL of glacial acetic acid and add it to 70.8mL deionized water. The resulting solution should be approximately 80mL of 2M acetic acid.
 - b. Dissolve 27g of sodium acetate trihydrate in 80mL of 2M acetic acid.
 - c. Dilute the resulting solution to a total volume of 100mL with deionized water.
4. Place a large polypad mat on the presentation table and arrange the three 250mL graduated cylinders in a row on the mat.
5. Add 10 – 20 drops of Universal indicator in the bottom of each 250mL graduated cylinder.
6. Cover the Universal indicator in each cylinder with 25g calcium carbonate powder.

Tips & Tricks

- Pour in the following order: Hydrochloric acid (Solution A), Acetic acid (Solution B), Acetic acid & Sodium acetate (Solution C).
- Be sure to bring extra deionized water, 70% isopropyl alcohol, and paper towels in case you make a mess!
- Hydrochloric acid should react faster/better than acetic acid. If you want to pour in order of least reactive to most, do Solution B, Solution A, and finish with Solution C.

Clean-Up Procedures

1. Neutralize the solution using weak acid/weak base.
 - a. For universal indicator, aim for a neutral green for a pH of approximately 7.
 - b. When the solution is acidic, you can use either dilute sodium hydroxide (0.01M or 0.1M works well, but be careful not to overshoot) or baking soda. When the solution is basic, you can use dilute acetic acid (0.5M or 1M works well).
2. Pour into an acid/base waste stream with other compatible substances.
3. Rinse the labware thoroughly with deionized water at least three times, emptying the runoff into the waste stream.
4. Clean thoroughly with laboratory detergent.