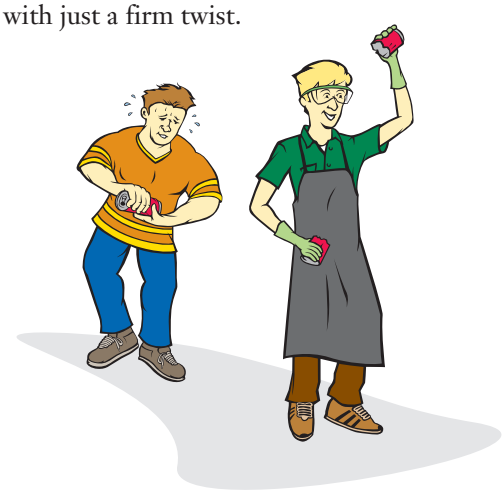
Can Ripper

Activity Series of Metals

Introduction

Show the power of chemistry by tearing apart an aluminum soda can with little effort. Just score the inside of a soda can to break the plastic lining, add some copper(II) chloride and water, and sit back—chemistry will do the rest. The single replacement reaction of aluminum metal with copper(II) ions "dissolves" the aluminum from the inside out. With only the paint on the outside of the can holding it together, the can will rip apart with just a firm twist.



Concepts

- Redox reaction
- Metal activity series

Materials

Aluminum soda can, Al

Copper(II) chloride, $CuCl_2$, 10 g

Tap water

Triangular file

Alternate Materials

Sodium hydroxide, NaOH, 1.5 M, 250 mL

Aluminum soda can, Al

Beaker, 600-mL

Beaker, 1-L

Electric sander

Pencil

Water

Safety Precautions

Do not leave the cans containing the copper(II) chloride solution in an area where they may be mistaken for soda. Torn cans have sharp edges; use caution when handling. Copper(II) chloride is a body tissue irritant and is highly toxic by ingestion. LD_{50} = 140 mg/kg. Avoid all contact with eyes, skin, and clothing. Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Please review current Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

1. Insert a triangular file into the opening of an empty aluminum soda can. Score a fine line around the inside of the can about half-way down. This breaks the inner plastic seal of the can.
2 Dissolve 10 g of copper(II) chloride in 200 mL of warm water. Add this solution to the can making sure to cover the scoring on the inside of the can. *Note:* Using warm water speeds up the reaction.
3. Wait about 3–5 minutes until the reaction is complete. The reaction is complete when the paint on the can begins to darken around the scoring. This indicates that the aluminum has been removed along the scoring line. The only thing holding the can together is the layer of paint.
4. Gently pour out the solution and rinse the can with water. The can is now ready to use for the demonstration.

Procedure

1. Hold the prepared can horizontally so that the scoring is between your hands.
2. Twist your hands in opposite directions to rip the can in half along the scoring. The can should rip with a firm twist.

Publication No. 91465
061616

Alternate Demonstration

The Can Shell

Preparation

1. Use an electric sander to remove the paint from the large center portion of a full pop can. Use fine or very fine sandpaper.
2. Empty the can and rinse with water. Completely fill the can with water.
3. Insert a pencil through the hole in the opener and suspend the can in a 600-mL beaker.
4. Add 250 mL of 1.5 M sodium hydroxide solution to the beaker around the can. Do this in an operating fume hood.
5. The sodium hydroxide will react with the aluminum in the can. Only the top and bottom portions of the can are left connected to the inner plastic lining. *Note:* Shell is very delicate!
6. Carefully empty the water from the can into the beaker and rinse the inside and outside of the shell with water.

Procedure

1. Support the shell by the pencil in a 1-L beaker for display.
2. Lift the can up and gently compress it vertically to show that only the inner plastic lining remains.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Copper(II) chloride solution may be rinsed down the drain with excess water according to Flinn Suggested Disposal Method #26b. Sodium hydroxide solution and solid can be disposed of in a solid waste disposal container.

Tips

- Copper(II) chloride, either anhydrous or dihydrate, may be used for this demonstration.
- A fun suggestion from a teacher: Prepare several cans ahead of time. Then, during class, ask for two unsuspecting volunteers who will take the challenge to see who can rip apart a soda can the fastest and easiest. Give the "stronger" student an untreated soda can that will not rip apart easily. Give the "weaker" student the copper(II) chloride–treated can, that should rip apart with just a firm twist.
- For a more conventional demonstration of the reaction of copper(II) chloride with aluminum, see "Foiled Again" in the Demonstrations section of *Chemical Reactions*, Volume 6 in the *Flinn ChemTopic™ Labs* series. "Foiled Again" is also available as a chemical demonstration kit from Flinn Scientific (Catalog No. AP5936).

Discussion

Aluminum cans are lined with a plastic coating to prevent liquid from reacting with the metal. Scoring the inside of the can breaks the coating and exposes the aluminum metal to the copper(II) chloride. An oxidation–reduction reaction occurs as the copper(II) ions from the copper(II) chloride oxidize the aluminum metal to aluminum ions, according to Equation 1. The copper(II) ions, in turn, are reduced to copper metal.

$$3Cu^{2+}(aq) + 2Al(s) \rightarrow 3Cu(s) + 2Al^{3+}(aq) \qquad \textit{Equation 1}$$

When the reaction is complete, only the paint and ink on the outside of the can are holding it together. The demonstration can be explained in terms of the reactivity of metals. Since aluminum metal is more reactive than copper metal, a redox reaction occurs and the aluminum metal is oxidized and dissolves in the solution in the form of aluminum ions. Ask students to predict what would happen if a different salt solution or if a different type of metal were used. Would all metal ion solutions give similar results? Why or why not?

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *Can Ripper* activity, presented by Jeff Hepburn, is available in *Activity Series of Metals*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *Can Ripper* are available from Flinn Scientific, Inc.

Catalog No.	Description
C0212	Copper(II) Chloride, $CuCl_2$, 25 g
S0447	Sodium Hydroxide, NaOH, 3 M, 500 mL

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.