Food Storage

By Doaa George, based on the workshop investigation by Amanda Peters

Introduction

A local company plans to use some of their excess metal to produce cans for food and soft drink storage. They are aware that some metals become highly reactive on contact with the acids found in food while others are not. They have asked for your help in sorting the metals they have, based on their reactivity. The company asks for your recommendation on the best metal to use for can production.

Risk analysis

This experiment involves the use of glassware, corrosive acid and matches. Make sure you are following the safety rules:

1. Wear safety glasses.
2. Wear gloves.
3. Wear an apron or a laboratory coat.
4. Wear closed shoes.
5. Report any glass breakage to your teacher.
6. Never taste or smell the ingredients in the test tubes to test for changes.

Questions

Aim: Which metal is best for food and drink storage?

Plan

A procedure is provided for you below, but you will need to think about which variables should be kept constant during the experiment to ensure a fair result.

Different foods and drinks contain a variety of acids, including acetic acid (vinegar), citric acid (found in orange and lemon juice), ascorbic acid (vitamin C), phosphoric acid (found in soft drinks), benzoic acid (a preservative) and many more. In this experiment, in order to standardise each test, you will be using one acid and seeing how it reacts with different metals. The acid you will be using is hydrochloric acid. The metals that react the least with the hydrochloric acid will be the best metals to use for food cans.

Materials

- Safety glasses
- Apron or laboratory coat
- Bench mat
- Test tubes and test-tube rack
- Pieces of metal-sodium, calcium, magnesium, aluminium (source 1), aluminium (source 2), zinc, copper
- Dropping bottle containing 2 mol L^{-1} hydrochloric acid solution
- Rubber stoppers
- Matches

Conduct

Procedure

Some metals might react with hydrochloric acid to produce a gas.

Hydrochloric acid in water is made up from hydrogen, oxygen and chlorine. To distinguish between the three gases, you can use a lighted match.

- If hydrogen gas is present, the lighted match will ignite the hydrogen gas, making a popping sound
- If oxygen is present, the lighted match will flare up.
- If chlorine gas is present, the lighted match will be extinguished.

The following are the steps for the experiment:

1. Clean the piece of metal with sandpaper.
2. Place the metal piece in a test tube.
3. Add hydrochloric acid to the test tube to a depth of 2 cm. Do not push the stopper into the test tube firmly. Just hold it at the top of the test tube for a few seconds.
4. Remove the rubber stopper and then place a lighted match at the mouth of the test tube.

5. Record your observations and, you can use your phone to take a photo of each of the results.
6. Repeat steps 1-5 for the other metals.

Tabulate your results as follows:

Metal	Result of combining acid with metal	Result of the lighted match	Order of reactivity (from least reactive to most reactive)

Analysis:

Use a graph or a diagram to best represent your results:

Discussion-Problem solving and reasoning

What is the aim of this experiment? What scientific question are you trying to answer?

How did you determine the order of reactivity of metals?

What do you think is happening in the test tube to make the chemical reaction? Draw a picture with labels explaining your answer.

When zinc metal reacts with hydrochloric acid, zinc chloride and a gas are formed. What did you determine to be the gas? Write a word equation to describe this reaction.

If any of your reactions produced a ‘pop’ with the lighted match test, hydrogen gas reacted with oxygen in the air to form water. You may have noticed the water form at the top of the test tube after you performed the match test. Write a word equation for this chemical reaction.

Conclusion: Based only on the reactivity of metals with acid, which metal or metals would be best for food and drink storage?

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