Chemical Change

Introduction

How much copper is in a new penny? Less than you think!
Hollow out the interior of a penny by dissolving the Zinc inside with toilet bowl cleaner.

Goals

Demonstrate how chemical changes can separate matter.

Equipment

• Lots of pennies, 1983 or newer (Note: You may legally experiment and alter your coins as long as you do not misrepresent the coin's true value.

Use 1983 or newer pennies

• Beaker
• **Liquid toilet bowl cleaner** from a supermarket. This cleaner must contain Hydrochloric acid (HCL). ...look at the label.
Or 3M to 6M Hydrochloric acid solution.
Or Muriatic acid from a pool supply store.
Or Vinegar can also be used: it's safer, but takes a lot longer.
• Eye protection
• A rough surface, such as a sidewalk, parking lot, or metal file
• Glass stirring rod

Setup

Since different cleaners use differing concentrations of HCL, the amount of toilet cleaner needed may vary. Try the following ratio: For every penny interior that is to be dissolved, pour about 25 to 40 ml of cleaner into a beaker. Wear goggles whenever working with acid.


Scrape side of penny
on the ground (asphalt, concrete...)

To Do and Notice

While holding a penny on edge, scrape it on a sidewalk or other rough surface. By dragging the edge of the penny on a rough surface, you scratch off the copper coating and expose the shiny Zinc (Zn)

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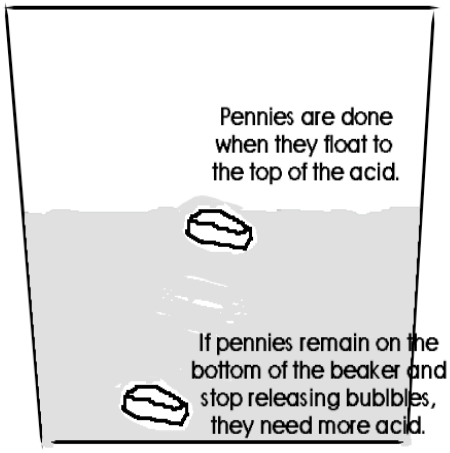
interior. The more Zn you expose, the quicker it will be chemically changed when dropped into acid. (Be careful to leave some copper on the side edge so that the top and bottom of the penny won't totally separate from each other.)

Place the scraped pennies into the beaker of toilet bowl cleaner.

Let the penny sit in the cleaner for several days. Additional cleaner might have to be added to the beaker to dissolve all the zinc. This is also true of other low molarity HCL solutions.

There are several ways to tell when your penny is done. Your can poke it with a stirring rod. If it bends, it's probably done. Another, even easier way to tell is to check to see if your penny is floating. If it floats, it's done. The pennies float to the surface because hydrogen gas bubbles cling to the inside of the hollow pennies. The buoyancy of the bubbles causes the pennies to rise.



Before handling pennies, place the beaker under running water for several minutes. This will dilute any remaining acid and help clean out the interior of the pennies.

You will immediately notice upon touching the pennies, that the copper is paper-thin and the interior is missing, they're hollow! Handle pennies carefully.

What's Going On?

Zinc tends to react readily with the hydrochloric acid in the toilet bowl cleaner to form zinc chloride and hydrogen gas. The formula, written with symbols, is:

$$2Zn_{(S)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(s)} + H_{2(g)}$$

The copper of the penny reacts little if at all with HCl. If you touch the insides of the penny, you might notice a gray or black powder. This is the zinc chloride. You might see the $ZnCl_2$ powder floating around inside the beaker, too.

*Pennies separated in this way not only help demonstrate chemical change, but teach about economics. Zinc is much cheaper than copper!

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