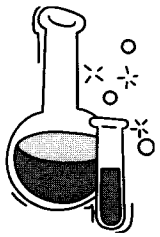
Chemical Reactions – Experiment # 11:
MAKING YOUR PENNIES CLEAN

Objective: To discover which substances are the most effective at cleaning pennies.

Materials:

- Several discolored pennies
- Plastic cups
- Ketchup
- Vinegar
- Lemon juice
- Coca-Cola
- Plastic wrap
- Rubber bands



Safety Precautions: Always read the label before using any household substance, and exercise proper precautions accordingly.

Procedure:

1. Place a penny in each of several plastic cups.
2. Add enough of each of the above substances to completely cover each penny. Cover each with plastic wrap and secure with a rubber band.
3. Label each accordingly.
4. Make daily observations for one week.

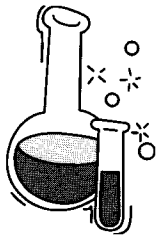
Explanation: The most effective copper cleaners will be those that are acidic – ketchup, carbonated beverages, vinegar, and lemon juice. Numerous types of corrosion appear on copper, due to reactions with compounds in the air or other substances the copper may come into contact with. The dark coating on the surface of pennies is often composed of copper(II) oxide or cupric oxide, formed from the oxidation of the copper with oxygen in the air. Acids react with the copper(II) oxide, as well as other types of corrosion, and remove it, thus forming clean pennies.

Chemical Reactions – Experiment # 4:
HOW TO REMOVE RUST

Objective: To determine which substances are most effective at removing rust.

Materials:

- Vinegar
- Lemon juice
- Coca-Cola
- Ammonia
- Plastic cups
- Rusty nails or bolts
- Plastic wrap
- Rubber bands
- pH paper (available from a pet shop or pool supply store)



Safety Precautions: Bleach and ammonia are toxic if ingested or inhaled – exercise caution. Wear safety goggles. Never mix bleach and ammonia – toxic fumes are released.

Procedure:

1. Pour a quarter-cup of each of the above liquids.
2. Drop a rusty nail in each. Cover each with plastic wrap, and secure with a rubber band. Allow to remain undisturbed for one week.
3. Remove each nail and observe for signs of rust.
4. Test the pH of each substance with pH paper, to determine if this has an effect on its rust-removing abilities.

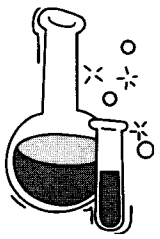
Explanation: You should notice that the acidic substances – Coca-Cola, lemon juice, and vinegar – were the most effective at removing rust. This can be verified by testing with pH paper, if available. Acidic substances have a pH less than 7 at 25°C. Most other substances either have no effect or may have even hastened the rusting process. Acids remove rust by chemically reacting with it.

Chemical Reactions – Experiment # 13:
GENERATION OF OXYGEN

Objective: To produce oxygen gas using yeast.

Materials:

- 3% hydrogen peroxide
- Active, dry yeast
- Glass jar
- Match
- Wooden coffee stirrer



Safety Precautions: Exercise caution when using open flames. Hydrogen peroxide is toxic if ingested.

Procedure:

1. Add about 30 mL of hydrogen peroxide to a glass jar.
2. Add about ½ teaspoon of yeast, and gently swirl. After a few minutes, bubbles will form.
3. After bubbles have formed, light a wooden coffee stirrer.
4. Blow out the flame, so only glowing embers remain.
5. Lower the glowing coffee stirrer down into the jar. It will burst into flames. Blow out the flames and again insert into the jar.

Explanation: Yeast are one-celled fungi that secrete enzymes which act as catalysts. These catalysts break down hydrogen peroxide into water and oxygen. The balanced chemical equation is as follows:

$$2H_2O_{2(l)} \Rightarrow 2H_2O_{(l)} + O_{2(g)}$$

Oxygen supports the combustion of other materials, but does not itself burn. In the presence of oxygen the glowing embers therefore burst into flames. This explains why blowing on the embers of a campfire can cause them to ignite.