

Pennies, Pennies, Nails

This is a three part lab do don't dispose of your materials until the very end. Record all of your observations in a word document to send back to me.

Materials

- 20-30 dull pennies
- 1/4 cup white vinegar (which is dilute acetic acid)
- 1 teaspoon salt (NaCl)
- 1 shallow, clear glass or plastic bowl (not metal)
- 1-2 clean steel screws or nails
- water
- measuring spoons
- paper towels

Shiny Clean Pennies

1. Pour the salt and vinegar into the bowl.
2. Stir until the salt dissolves.
3. Dip a penny halfway into the liquid and hold it there for 10-20 seconds. Remove the penny from the liquid. What do you see? Record your observations.
4. Dump the rest of the pennies into the liquid. The cleaning action will be visible for several seconds. Leave the pennies in the liquid for 5 minutes.
5. Proceed to 'Instant Verdigris!'

Pennies get dull over time because the copper in the pennies slowly reacts with air to form copper oxide. Pure copper metal is bright and shiny, but the oxide is dull and greenish. When you place the pennies in the salt and vinegar solution, the acetic acid from the vinegar dissolves the copper oxide, leaving behind shiny clean pennies. The copper from the copper oxide stays in the liquid. You could use other acids instead of vinegar, like lemon juice.

Instant Verdigris!

1. Note: You want to keep the liquid you used to clean the pennies, so don't dump it down the drain!
2. After the 5 minutes required for 'Shiny Clean Pennies', take half of the pennies out of the liquid and place them on a paper towel to dry.
3. Remove the rest of the pennies and rinse them well under running water. Place these pennies on a second paper towel to dry.
4. Allow about an hour to pass and take a look at the pennies you have placed on the paper towels. Write labels on your paper towels so you will know which towel has the rinsed pennies.
5. While you are waiting for the pennies to do their thing on the paper towels, use the salt and vinegar solution to make 'Copper Plated Nails'.

Rinsing the pennies with water stops the reaction between the salt/vinegar and the pennies. They will slowly turn dull again over time, but not quickly enough for you to watch! On the other hand, the salt/vinegar residue on the unrinsed pennies promotes a reaction between the copper and the oxygen in the air. The resulting blue-

green copper oxide is commonly called 'verdigris'. It is a type of patina found on a metal, similar to tarnish on silver. The oxide forms in nature as well, producing minerals such as malachite and azurite.

Copper Plated Nails

1. Place a nail or screw so that it is half in and half out of the solution you used to clean the pennies. If you have a second nail/screw, you can let it sit completely immersed in the solution.
2. Do you see bubbles rising from the nail or the threads of the screw?
3. Allow 10 minutes to pass and then take a look at the nail/screw. Is it two different colors? If not, return the nail to its position and check it again after an hour.

The copper that coats the nail/screw comes from the pennies. However, it exists in the salt/vinegar solution as positively charged copper ions as opposed to neutral copper metal. Nails and screws are made of steel, an alloy primarily composed of iron. The salt/vinegar solution dissolves some of the iron and its oxides on the surface of the nail, leaving a negative charge on the surface of the nail. Opposite charges attract, but the copper ions are more strongly attracted to the nail than the iron ions, so a copper coating forms on the nail. At the same time, the reactions involving the hydrogen ions from the acid and the metal/oxides produce some hydrogen gas, which bubbles up from the site of the reaction - the surface of the nail or screw.

Questions:

1. Are the changes in this lab chemical or physical?
2. What are three indicators that a chemical reaction is occurring?
3. What does verdigris mean?
4. Why can the copper coat the nails?
5. What are the six main types of chemical reactions?
6. Distinguish between chemical and physical properties.
7. Distinguish between chemical and physical changes.