

Wood Splints Flame Test

A Colorful and Fiery Demonstration



Introduction

Just as a fingerprint is unique to each person, the color of light emitted by metals heated in a flame is unique to each metal. In this activity, the characteristic color of light emitted for several metals will be observed.

Concepts

- Flame Tests
- Absorption/Emission

Materials

| | |
|--|---------------------------------------|
| Calcium chloride, $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$, 1 g | Water, distilled or deionized, 250 mL |
| Copper(II) chloride, $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$, 1 g | Beakers, 250-mL, 2 |
| Lithium chloride, LiCl, 1 g | Laboratory burner |
| Potassium chloride, KCl, 1 g | Watch glasses or weighing dishes, 6 |
| Sodium chloride, NaCl, 1 g | Wooden splints soaked in water, 6 |
| Strontium chloride, $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$, 1 g | |

Safety Precautions

Copper(II) chloride is moderately toxic; avoid contact with eyes, skin, and mucous membranes. Lithium chloride is a body tissue irritant. Rinse the wooden splints before discarding them in the trash to avoid trashcan fires. 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.

Procedure

1. Fill a 250-mL beaker about half-full with distilled or deionized water. Place the wood splints in the water and allow them to soak for at least several hours.
2. Fill a second 250-mL beaker about half-full with distilled or deionized water. Label this beaker "rinse water".
3. Label six watchglasses CaCl_2 , CuCl_2 , LiCl, NaCl, KCl, SrCl_2 . Place a small scoopful (about 1 g) of each metallic solid in the corresponding watchglass. Light the laboratory burner.
4. Dip the soaked end of one of the wooden splints in one of the metallic salts, then place it in the flame. Observe the unmistakable color of the flame! Immerse the wooden splint in the "rinse water" to fully extinguish it, then discard it in the trash.
5. Repeat for the other five metallic salts.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulation that may apply, before proceeding. Each of the metallic salts may be disposed of in the trash according to Flinn Suggested Disposal Method #26a.

Tips

- The flame colors are best observed if the wooden splints are soaked overnight.
- The flame colors are due to the metal in each compound, not the chloride ion. If other ionic metal solutions were used, such as nitrates [$\text{Ca}(\text{NO}_3)_2$, $\text{Cu}(\text{NO}_3)_2$, LiNO_3 , NaNO_3 , KNO_3 , and $\text{Sr}(\text{NO}_3)_2$], the same results would be observed.
- Avoid all contact between the wooden splints used for the various salts. If cross contamination occurs, the flames observed will either be mixtures of the two colors, or one of the colors will mask the other. Distorted flame colors may also be observed if any solid salt drops into the barrel of the Bunsen burner.
- As an extension, have students look at the flames through a diffraction grating or piece of C-Spectra[®] to observe the line emission spectrum for each metal. Each element has a unique line emission spectrum. Students can sketch the line emission spectrum for each solution, then use them to identify unknown solutions.

Discussion

When a substance is heated in a flame, the substance's electrons absorb energy from the flame. This absorbed energy allows the electrons to be promoted to excited energy levels. From these excited energy levels, the electrons naturally want to make a transition, or relax, back down to the ground state. When an electron makes a transition from a higher energy level to a lower energy level, a particle of light called a *photon* is emitted. A photon is commonly represented by a squiggly line (see Figure 1). The energy of each emitted photon is equal to the difference in energy between the excited state and the state to which the electron relaxes. The energy of the emitted photon determines the color of light observed in the flame.

The color of light observed when a substance is heated in a flame varies from substance to substance. Because each element has a different electronic configuration, the electronic transitions for a given substance are unique. Therefore, the difference in energy between energy levels, the exact energy of the emitted photon, and its corresponding wavelength and color are unique to each substance. As a result, the color observed when a substance is heated in a flame can be used as a means of identification.

Acknowledgment

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Materials for *Wood Splints Flame Test* are available from Flinn Scientific, Inc.

| Catalog No. | Description |
|-------------|-----------------------------|
| C0196 | Calcium Chloride, 100 g |
| C0096 | Copper(II) Chloride, 100 g |
| L0026 | Lithium Chloride, 100 g |
| P0183 | Potassium Chloride, 100 g |
| S0061 | Sodium Chloride, 500 g |
| S0129 | Strontium Chloride, 100 g |
| AP4455 | Wood Splints, 500/pkg. |
| AP1714 | C-Spectra, 89 × 109 Sheet |
| AP5607 | Wood Splints Flame Test Kit |

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