

Colored Flames

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Flame tests for elements provide a quick, qualitative method of identification of some common metal elements. The use of platinum or nichrome wire test loops does not provide for an exciting demonstration as colors are only briefly visible and must be repeated multiple times for a class to observe. Colors produced by a flare made from potassium chlorate and sugar with metal salts added are usually vivid, but the mixture is very exothermic producing smoke and vapors and must be performed in small quantities in a fume hood. The alcohol solutions of metal salts is probably the most popular method of showing flame colors, but can result in fires or explosions if the demonstrator does not keep all alcohol solutions sealed at a safe distance and does not attempt to add additional solution as the flames of a particular colored salt diminishes. A safer method, this demonstrator has used for over twenty-five years, produces vivid colors in a lecture class or in direct use by students by using small bottles containing small amounts of finely powdered anhydrous salts of the elements to be studied. In use, the bottle is shaken while sealed, then opened and held next to the air intake vents of a Bunsen burner or portable gas burner. This technique produces brilliantly colored flames with minimal fumes.

Materials Needed

Finely powdered salts of:

copper(II) chloride, CuCl_2 or copper(II) sulfate, CuSO_4

potassium chloride, KCl

lithium chloride, LiCl

sodium chloride, NaCl

strontium chloride, SrCl_2

barium hydroxide, $\text{Ba}(\text{OH})_2$ (this is more stable than anhydrous BaCl_2 over time)

calcium hydroxide, $\text{Ca}(\text{OH})_2$ (this is more stable than CaCl_2 over time)

60-mL (2 ounce) or 120-mL (4 ounce) glass or plastic wide-mouth bottles with tight fitting lids

Procedure

$\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$, or copper(II) sulfate pentahydrate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, must be dehydrated in a crucible or evaporating dish until they are light green, light blue, or almost white.

Each of the salts are dried in an oven at 100°C overnight.

After removal from the oven, the warm salts should be placed in a 60-mL (2-ounce) to 120-mL (4-ounce) plastic or glass bottle and sealed.

In use, as long as the bottles of salts are not left open to the air for any extended time, these solids have been stable for over five years.

To use these powders, shake the sealed bottle, open it, and place it near the air intake of the burner.

Note: Due to the vivid and persistent colored flame produced by the sodium chloride, the flame color of sodium should be demonstrated last.

When flame colors become less vivid and take on a yellowish tinge, it is time to dry them in an oven overnight.

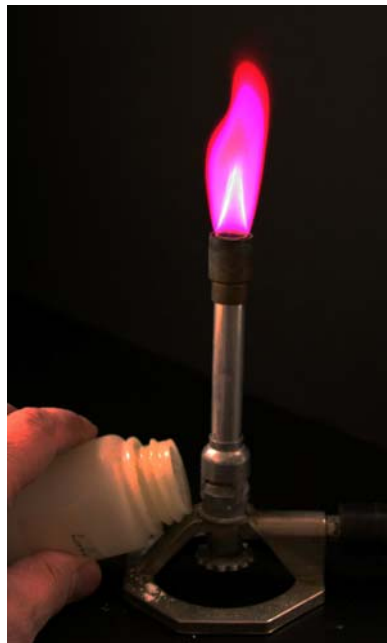


Figure 1. A lithium flame



Figure 2. A potassium flame



Figure 3. A barium flame



Figure 4. A calcium flame