

EXPERIMENT # 15

IDENTIFICATION OF METALLIC IONS BY FLAME TEST

Purpose:

1. To become familiar with the characteristic color imparted to the flame of the Bunsen burner by some metallic ions.
2. To identify the metallic ion present in unknown solutions by the use of flame tests.
3. To identify the metallic ion present in some everyday chemicals.
4. To test for the presence of Na^+ in food and drugs.

Principals:

If energy is applied to an atom in the form of heat or an electrical discharge, the atom can be made to emit light. This is the process responsible for the light of neon signs and fluorescent light fixtures. If the emitted light is passed through a prism or a diffraction grating, the light can be split into its component wavelengths and is called a spectrum. When gases are made to emit light in this way, the spectrum consists of a series of lines and is called an **emission spectrum**. The observed spectrum is characteristic of the element producing it and it can be used for analyzing unknown materials.

A number of salts can produce emission spectra when introduced into the flame of a Bunsen burner imparting a characteristic color to the flame. In fact, the kind of color given off by each atom is so exact that it can be used to identify that atom. In the samples studied here, only the metallic ions produce observable colors when the atoms are excited by the flame of the Bunsen burner. The non-metallic ions do not produce radiation in the visible region and hence they do not interfere with the analysis.

Procedure:

1. Flame Tests of Known Metallic Ions

- (a) Fill a 250 ml or 400 ml beaker about two thirds with deionized water. Pick up about 30 wood applicator sticks and place them in water (in your beaker).

Note: The applicator sticks have been pre-soaked. Make sure you place the wet end of the applicator sticks in the water.

- (b) Procure solid samples (about the size of a pea) of each of the following substances: LiCl , NaCl , KCl , CaCl_2 , SrCl_2 , and BaCl_2 . Place each solid sample in one of the depressions of your spot plate. Be careful not to contaminate the samples with each other by accidental mixing. Keep track in your notebook which sample is in which depression.
- (c) Light the Bunsen burner and set it to a very hot flame (inner blue cone clearly visible).
- (d) Dip the wet end of the applicator stick in one of the solid samples to pick up a few crystals of the solid.
- (e) Place the applicator stick in the flame, just at the upper tip of the inner blue cone. Observe and record the color of the flame. Discard the applicator stick after each test and use a new applicator stick for every subsequent test.
- (f) Repeat the test for all the known solid samples while carefully observing and recording the color of the flame.

Note: To observe the potassium flame, view it through cobalt (blue) glass. Cobalt glass screens out contaminating colors.

2. Flame Tests of Unknown Metallic Ions:

- (a) Obtain three unknown solid samples and record the sample numbers.
- (b) Test each of the unknowns in the same manner as above and record the color observed and identify the metallic ion present in each.

Note: If you are in doubt about the identity of any of your unknowns, you may test for comparison of your unknown sample and a known sample both at the same time. Use two different applicator sticks (one for known and one for unknown) and place them in two different flames at the same time to see if they produce the same or different colors.

3. Metallic Ions in Everyday Chemicals:

- (a) Repeat the same procedure used above to identify the metallic ion present.

Note: If the household chemical is provided as a bulky piece of solid, grind it into a powder using your spatula to obtain smaller pieces and/or the bottom of test tube on a piece of weighing paper or in an evaporating dish. Then pick up a few specks of the solid with the applicator stick and introduce it in the flame.

- (b) For each sample; record the color observed and identify the metallic ion present in the household chemical.

4. Testing for Sodium in Food and Drugs:

Sodium chloride in moderate amounts is essential to life. An example is how it is important in the exchange of fluids between cells and plasma. The presence of salt increases water retention and a high volume of retained fluids can cause swelling and high blood pressure (hypertension). Most physicians agree that our diets generally contain too much salt, hence too much sodium ions. In addition to regular table salt some foods, artificial sweeteners, and medicines may also contain sodium. You can easily determine which ingredients are practically sodium free and which contain sodium ions since the Na^+ imparts a characteristic yellow color to the Bunsen burner. The presence or the absence of this color will indicate if a particular sample contains, or if it does not contain detectable amounts of sodium ions.

- (a) Test the solid samples provided, note the color of the flame and record your conclusion.

Note: Many of the samples tested in this section contain carbon. When a carbon containing compound is introduced in the flame, the sample burns and a bright whitish luminous flame is produced. Make sure that you do not mistake the white "luminous" flame produced by carbon containing compounds with the characteristic yellow color produced by sodium containing compounds. If a sample contains carbon, but not sodium, only the whitish "luminous" flame is produced. On the other hand if the sample contains both carbon and sodium, the yellow color imparted to the flame by the sodium ions is easily observed since it tends to obscure the whitish "luminous" flame, and for that matter, any other color of the flame.

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Name: _____

Date: _____

Partner: _____

1. Flame Tests of Known Metallic Ions

Li⁺ _____

Na⁺ _____

K⁺ _____

Ca²⁺ _____

Sr²⁺ _____

Ba²⁺ _____

2. Flame Tests of Unknown Metallic Ions:

Unknown Number	Metallic Ion Present
_____	_____
_____	_____
_____	_____

3. Metallic Ions in Everyday Chemicals:

Sample Tested	Metallic Ion Present
Salt substitute	_____
Emergency flare	_____
Baking powder	_____
Cream of tartar	_____

4. Testing for Sodium in Food and Drugs:

Sample Tested	Sodium Detected? (Yes or No)	Sample Tested	Sodium Detected? (Yes or No)
Alka-Seltzer	_____	Sugar	_____
Aspirin	_____	Lite salt	_____
Rolaids	_____	Sweetaste	_____
Corn starch	_____	Equal sweetener	_____