Chemistry | Inorganic Chemistry

Test for Iodide Radical

General Aim

Detection of the presence of iodide ion as an acid radical in inorganic salts such as potassium iodide.

Method

Detection of the presence of iodide as acid radical using specific chemical reagents.

Learning Objectives (ILOs)

- Define and differentiate between iodide ions and other acid radicals through their chemical formulas.
- Classify inorganic salts according to their acid radicals.
- Compare between iodide and other halide members in terms of chemical structures, properties and reactions.
- Identify iodide radicals containing salts experimentally.
- Select the appropriate reagents to detect the presence of iodide radical.
- Balance the chemical equations of chemical reactions.

Theoretical Background/Context

- Iodide is the anion of iodine that possesses -1 charge. Iodide forms the acid radical (negative portion) of some inorganic salts such as sodium iodide, potassium iodide, calcium iodide, etc.

Abundance of Iodide in nature:

Iodargyrite is a naturally occurring crystalline silver iodide. Iodide anions are also found as combined salts with mercury, copper and lead. Iodide salts are highly abundant in seawater, egg shells, tuna fish, etc. One of the most abundant iodide salts is potassium iodide.

Preparation of Potassium Iodide:

Potassium iodide (NaI) can be prepared industrially through the reaction of potassium hydroxide and iodine.

Chemical Properties of Potassium Iodide:

Potassium iodide is a white crystalline inorganic salt that dissolves in water producing colorless aqueous solution. It is the highest abundant commercially available iodide salt. Iodide is a mild reducing agent so it gets oxidized easily forming iodine. Therefore, aged samples turn yellow due to their oxidation over the time.

Uses of Potassium Iodide:

- Potassium iodide is used in some medical applications in the treatment of hyperthyroidism, skin sporotrichosis and phycomycosis as well as dietary supplement. In addition, it has been used in various industries such as photography, and filming.
- Iodide ion is classified as a member of acidic radicals of the second group in which concentrated sulphuric acid is used as a group reagent. Sulphuric acid displaces iodide ions in its salts leading to liberation of violet iodine gas.
- In addition, iodide could be detected through some confirmatory tests using silver nitrate solution or lead acetate solution since they react together forming silver iodide or lead iodide, respectively as yellow precipitates. This returns back to the low solubility product of silver and lead iodides salts so they precipitate very easily at very low concentrations.
- Finally, mercuric chloride and copper sulfate tests are carried out as a specific test for detection of iodide ion, where the results give red and brown precipitates, respectively.

Principle of Work

- In this experiment, iodide ion in potassium iodide is detected through some identification and confirmatory tests. In addition, these tests can be used to differentiate between halide class and other acid radical classes. Moreover, confirmatory and specific tests are used to differentiate between the presence of different halides.

First: Physical Properties

In this test, a sample of the iodide salt is tested for its physical properties in terms of color, odor, etc.

Second: Solubility Test

In this test, a sample of the iodide salt is tested for its solubility in distilled water on cold.

Third: Concentrated Sulphuric Acid Test

It depends on the fact that conc. sulphuric acid can displace iodide ions in its potassium salt forming potassium sulphate salt, Sulphur dioxide, water and violet iodine gas as shown in the reaction below.

$$2\ KI + 2\ H_2SO_4 \rightarrow K_2SO_4 + 2\ H_2O + SO_2 + I_2\uparrow$$

Fourth: Silver Nitrate Test

Silver nitrate solution is added to a solution of potassium iodide leading to the precipitation of silver iodide salt as a yellow precipitate due to its low solubility product. The reaction of the test is:

$$KI + AgNO_3 \rightarrow KNO_3 + AgI\downarrow$$

Fifth: Lead Acetate Test

Lead acetate solution is added to potassium iodide solution resulting in precipitation of lead iodide as a yellow precipitate due to low solubility product as shown in the following chemical reaction:

$$2\ KI + (CH_3COO)_2Pb \rightarrow 2\ CH_3COOK + PbI_2\downarrow$$

Sixth: Mercuric Chloride Test

Mercuric chloride test is considered as a specific test for detection of the presence of iodide ion as the acid radical of a salt. The test depends on adding mercuric chloride on a potassium iodide solution which results in formation of a reddish precipitate of mercuric iodide. Afterwards, the precipitate dissolves in excess potassium iodide as shown in the following reactions.

$$HgCl_2 + 2KI \rightarrow HgI_2\downarrow + 2KCl$$

$$HgI_2 + 2KI \rightarrow \underset{\text{Soluble}}{K_2[HgI_4]}$$

Seventh: Copper Sulfate Test

Copper sulfate test is considered as a specific test for detection of the presence of iodide salt as they react together forming a brown precipitate of copperous iodide as shown in the following reaction.

$$4KI + 2\ CuSO_4 \rightarrow 2CuI\downarrow + 2K_2SO_4 + I_2$$