

Test for Mercuric Radical



General Aim

Detection of the presence of mercuric ion as a base radical in inorganic salts such as mercuric chloride.

Method

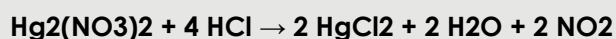
Detection of the presence of mercuric ions as base radicals using specific chemical reagents.

Learning Objectives (ILOs)

- Define and differentiate between members of the second group cations and those of other cation groups.
- Classify inorganic salts according to their base radicals.
- Compare between mercuric containing salts and other members of the same group in terms of chemical structures, properties and reactions.
- Identify mercuric radicals containing salts experimentally.
- Select the appropriate reagents to detect the presence of mercuric radicals.
- Balance the chemical equations of chemical reactions.

Theoretical Background/Context

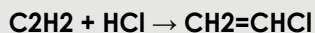
- **Mercury** is one of the few and rare elements that are abundant naturally in a liquid form. Mercury dissolves in oxidizing acids leading to the formation of either Hg_2^{2+} or Hg^{2+} according to the excess reagent. In addition, mercury element dissolves in aqua regia (a mixture of nitric and hydrochloric acids) forming HgCl_4^{2-} .
- **Properties and Uses of Mercury:** Mercury has a melting point of -38.87°C and boiling point of 356.57°C . Its density is 13.546 g/cm^3 . It has two common oxidation states which are +1 and +2. Mercury is used in the manufacture of thermometers and scientific instruments. In addition, it is used as an electrical conductive element. Mercury vapor is used in streetlight signs and fluorescent signs. Mercuric chloride was used long ago by the Arab physicians as a wound disinfectant. However, this has been prohibited in modern medicine as it has been proven to be toxic to humans.
- **Mercury (II) Salts:** Mercuric chloride, whose chemical formula is HgCl_2 , is one of the most commonly known mercuric containing salts. Mercuric chloride is also known as mercury (II) chloride and mercury dichloride. It has the molar mass of 271.496 gm/mol . It has been known as corrosive sublimate since it is sublimed then condensed in the form of rhombic crystals during its synthesis.
- **Preparation of Mercuric Chloride:** Mercuric chloride can be prepared through the reaction of either chlorine with mercurous chloride or hot hydrochloric acid with mercury (I) containing compounds such as mercurous nitrate as shown in the following reactions:



Furthermore, mercuric chloride can be prepared commercially on a large scale through heating a mixture of solid mercuric sulfate and sodium chloride leading to the formation of volatile mercuric chloride that could be separated by sublimation then condensed.

Properties and Uses of Mercuric Chloride

- Mercuric chloride is a white rhombic crystalline salt whose chemical formula is HgCl_2 .
- Mercuric chloride has been proven to be toxic to human beings.
- Mercuric chloride is sparingly soluble in cold water, while soluble in hot water and other organic solvents such as methanol, ethanol, acetone, ethyl acetate, etc.
- Mercuric chloride is used in organic synthesis procedures especially as a catalyst to convert acetylene into vinyl chloride as shown below:



- Mercuric chloride is used as a depolarizer in the manufacture of batteries.
- Mercuric chloride is used as a chemical reagent in analytical chemistry as well as stabilizing agents for some chemicals.

Principle of Work

- In this experiment, mercuric ions in mercuric chloride are detected through some identification and confirmatory tests. The mercuric radical is among the second group of basic radicals in which hydrogen sulfide is used as a group reagent.
- During the experiment, salt solubility in water will be tested. Then the behavior of the salt will be tested with hydrogen sulfide followed by confirmatory tests which will be performed using sodium hydroxide, ammonia, potassium iodide and copper to confirm the presence of mercuric radical in the salt.

First: Physical Appearance Test

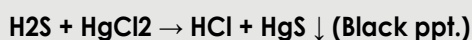
In this test, a sample of the mercuric salt is tested for its color, odor, texture, etc.

Second: Solubility Test

In this test, a sample of the mercuric salt is tested for its solubility in water.

Third: Hydrogen Sulfide Test

It depends on the fact that sulfide anions can displace chloride ions in mercuric chloride salt forming insoluble mercuric sulfide as a black precipitate which is insoluble in hot dilute nitric acid as the following reactions:



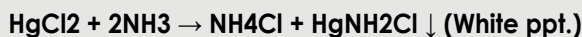
Fourth: Sodium Hydroxide Test

Sodium Hydroxide solution is added to aqueous mercuric chloride leading to the precipitation of mercuric oxide as a reddish brown precipitate as shown below:



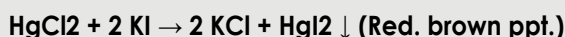
Fifth: Ammonia Test

Ammonia solution is added to aqueous mercuric chloride solution leading to the precipitation of amino mercuric chloride as a white precipitate which dissolves again in excess reagent due to the formation of the soluble complex:



Sixth: Potassium Iodide Test

Potassium iodide is added to aqueous mercuric chloride solution leading to the precipitation of mercuric iodide as a reddish brown precipitate as shown in the following reaction:



Seventh: Copper Test

A copper sheet is immersed in the aqueous mercuric chloride solution leading to the precipitation of silvery mercury metal layer on the copper sheet that becomes more silvery and shiny upon being rubbed according to the following reaction:

