

Test for Lead Radical



General Aim

Detection of the presence of lead ion as a base radical in inorganic salts such as lead nitrate.

Method

Detection of the presence of lead as a base radical using specific chemical reagents.

Learning Objectives (ILOs)

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

Theoretical Background/Context

Lead is heavy metal whose symbol is Pb. It possesses higher density than most of the other metals. It is characterized by being soft and easily reshaped. In its pure form, lead has a silvery color with a slight blue tinge. Lead is not a highly reactive post-transition metal, however, it can turn into grey upon its exposure to air for long times due to its oxidation.

Abundance of Lead in Nature

Lead is not commonly abundant in the Earth's crust. However, it could be refined and used easily. In addition, various lead isotopes are liberated at the ending stage of the natural decay of various elements such as actinium, thorium, and uranium.

Properties and Uses of Lead

Once cut, lead possesses a blue-white color. However, it turns into dull grey upon being exposed to air for long times due to its oxidation into Pb₂O. Most stable lead compounds are formed of lead in its 2+ oxidation state. Its main use is in the manufacture of lead-acid storage batteries that are used in automobiles. In pure form it is too soft to be used for much else.

Lead Salts

Lead nitrate is one of the most known and commonly abundant lead salts. Lead nitrate is an inorganic compound with a chemical formula of Pb(NO₃)₂. Unlike most lead salts, lead nitrate is soluble in water. Lead nitrate has been known as plumb dulics.

Preparation of Lead Salts: Lead(II) nitrate can be prepared on a small scale using either metallic lead or lead oxide and nitric acid.



In the 19th century, lead(II) nitrate started to be prepared for commercial uses in Europe and the United States.

Properties and Uses of Lead Nitrate

- Lead nitrate is a white crystalline or powder salt that is soluble in water forming colorless aqueous solutions.
- Lead nitrate is a strong oxidizing reagent.
- Lead nitrate is a toxic compound, and is listed as a carcinogenic agent to humans according to the International Agency for Research on Cancer.
- Lead nitrate has been used as a raw material for manufacturing pigments of lead paints. However, titanium based paints have shown less toxicity.
- Lead nitrate solutions are used to improve the leaching process in gold cyanidation.

Lead nitrate has been used long ago in stabilizing heat in the industries of nylon, polyesters as well as in photo-thermographic papers coatings.

Principle of Work

- In this experiment, lead ion in lead nitrate is detected through some identification and confirmatory tests. The lead radical is among the first group of basic radicals in which hydrochloric acid is used as group reagents.
- During the experiment, salt solubility in water will be tested. Then the behavior of the salt will be tested with hydrochloric acid followed by confirmatory tests which will be performed using sodium hydroxide, potassium iodide, potassium chromate and sulfuric acid reagents to confirm the presence of lead radical in the salt.

First: Solubility Test

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

Second: Dilute Hydrochloric Acid Test

It depends on the fact that dil. HCl can displace nitrate ions in lead nitrate salt forming insoluble lead chloride salt that precipitate as white precipitate.



Third: Sodium Hydroxide Test

Sodium Hydroxide solution is added to aqueous lead nitrate leading to the precipitation of lead hydroxide as a white precipitate due to its low solubility product. The reaction of the test is:



Fourth: Potassium Iodide Test

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



Fifth: Potassium Chromate Test

Potassium chromate test is considered as a specific test for detection of the presence of lead ion as the basic radical of a salt. The test depends on adding potassium chromate solution to aqueous lead nitrate solution leading to the formation of yellow colored precipitate of lead chromate according to the following reaction:



Sixth: Sulfuric Acid Test

Sulfuric acid test is considered as a specific test for lead salts as they react together forming a white precipitate of lead sulfate according to the following reaction:

