Chemistry | Inorganic Chemistry

Test for Calcium Radical

General Aim

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

Method

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

Learning Objectives (ILOs)

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

Theoretical Background/Context

- Calcium is a metallic element which occupies the 20th element in the periodic table. It is located among group 2 metals that are called alkaline-earth metal. Its chemical symbol is Ca. Calcium is the fifth most abundant element in both Earth's crust and sea water by mass, where it represents around 3.4% of their mass. Calcium has a silver metallic soft appearance.

Abundance of Calcium in Nature

Calcium is the fifth most abundant element in Earth's crust, where it is not commonly found as a pure element. However, it is widely abundant as limestone (CACO3), quick lime (CaO) and calcium fluoride (CaF2).

Properties and Uses of Calcium

Calcium is the lightest metal on Earth as its density is 1.55 gm/cm3. It was first isolated as pure calcium in the 1800s through electrolysis process. Calcium is an essential element in life. Calcium is one of the main constituents of aquatic organisms' shells, egg shells, coral reefs, human bones, and cow milk.

Calcium Salts

There are many calcium salts that are used in various purposes. For instance, calcium carbonate is the main constituent of limestone and chalk. Calcite is a fundamental constituent of marbles and pearls. Calcium carbonate is also used as an antacid and as a dietary supplement for treatment of calcium deficiency or osteoporosis. Calcium nitrate is used as a fertilizer.

Preparation of Calcium Chloride

Calcium chloride can be prepared through the reaction of calcium hydroxide and hydrochloric acid as shown below:

$$Ca(OH)2 + HCl \rightarrow CaCl2 + H2O$$

Theoretical Background/Context (Cont')

Properties and Uses of Calcium Chloride

- Calcium chloride is a white crystalline salt that is highly soluble in water producing colorless aqueous solutions.
- Calcium chloride has the chemical formula of $CaCl_2$ with molecular weight of 110.984 gm/mol.
- Calcium chloride salt possesses a melting point and boiling point of 782 ^{0}C and 1600 ^{0}C, respectively.
- Calcium chloride is commonly hydrated possessing a general formula of $CaCl_2.xH_2O$, where x is the number of water molecules.
- Since calcium chloride is highly hygroscopic in its anhydrous form, it is used as desiccant.

Principle of Work

- In this experiment, calcium ion in calcium chloride is detected through some identification and confirmatory tests. The calcium radical is among the fifth group of basic radicals.
- During the experiment, salt solubility in water will be tested. Then confirmatory tests will be carried out which are ammonium carbonate test, calcium sulfate, potassium chromate and flame test.

First: Physical Appearance Test

In this test, the physical appearance of calcium salt is investigated in terms of color, odor, texture, etc.

Second: Solubility Test

In this test, a sample of the calcium chloride salt is tested for its solubility in cold and hot water if needed.

Third: Ammonium Carbonate Test

It depends on the fact that ammonium carbonate will react with calcium chloride forming calcium carbonate as white precipitate that crystallizes upon boiling.

Fourth: Calcium Sulfate Test

It depends on the fact that no precipitate will be formed as no reaction will be accomplished which confirms that the tested sample is calcium salt.

Fifth: Potassium Chromate Test

It depends on the fact that no precipitate will be formed as no reaction will be accomplished which confirms that the tested sample is calcium salt.

Sixth: Flame Test

It is also called a dry test as it uses the calcium chloride salt as it is without dissolving it in water. It depends on the fact that calcium chloride can change the non-luminous benzene flame into an ignited yellowish red colored flame.