Chapter 2: Is Matter Around Us Pure?

Is Matter Around Us Pure?

Everyday vs. Scientific Meaning

For a common person, 'pure' means having no adulteration. But for a scientist, most things like milk, ghee, and juice are mixtures of different substances and hence not pure. Milk, for example, is a mixture of water, fat, and proteins.

Scientific Definition of Pure

When a scientist says something is pure, it means all the constituent particles of that substance are the same in their chemical nature. A pure substance consists of a single type of particle.

What is a Mixture?

Definition

Mixtures are constituted by more than one kind of pure form of matter. For example, sea water, minerals, and soil are all mixtures.

Properties

A mixture contains more than one pure substance. Dissolved sodium chloride can be separated from water by evaporation, but sodium chloride itself is a pure substance.

Types of Mixtures

Homogeneous Mixtures

Mixtures which have a uniform composition throughout are called homogeneous mixtures or solutions. Examples include salt dissolved in water and sugar dissolved in water.

Heterogeneous Mixtures

Mixtures which contain physically distinct parts and have non-uniform compositions are called heterogeneous mixtures. Examples include mixtures of sodium chloride and iron filings, salt and sulphur, and oil and water.

What is a Solution?

Definition

A solution is a homogeneous mixture of two or more substances. Examples include lemonade and soda water. In a solution, there is homogeneity at the particle level.

Solute and Solvent

A solution has a solvent and a solute as its components. The component that dissolves the other component (usually present in larger amount) is called the solvent. The component that is dissolved (usually present in lesser quantity) is called the solute.

Examples

Tincture of iodine has iodine (solid) as the solute and alcohol (liquid) as the solvent. Air is a mixture of gas in gas.

Properties of a Solution

Particle Size

A solution is a homogeneous mixture. The particles are smaller than 1 nm in diameter and cannot be seen by naked eyes.

Path of Light

Because of very small particle size, they do not scatter a beam of light passing through the solution. So, the path of light is not visible in a solution.

Stability

The solute particles cannot be separated by filtration. The solute particles do not settle down when left undisturbed, meaning a solution is stable.

Concentration of a Solution

Dilute vs. Concentrated

Depending upon the amount of solute present, a solution can be called dilute, concentrated, or saturated. At any particular temperature, a solution that has dissolved as much solute as it is capable of dissolving is said to be a saturated solution.

Solubility

The amount of solute present in the saturated solution at this temperature is called its solubility.

Calculating Concentration

The concentration of a solution is the amount of solute present in a given amount of solution. Common methods include mass by mass percentage and mass by volume percentage.

What is a Suspension?

Definition

A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium. Particles of a suspension are visible to the naked eye.

Properties of a Suspension

Visibility and Scattering

Suspension is a heterogeneous mixture. The particles can be seen by the naked eye. They scatter a beam of light passing through it and make its path visible.

Instability

The solute particles settle down when a suspension is left undisturbed, meaning it is unstable. They can be separated by filtration.

What is a Colloidal Solution?

Definition

A colloid is a mixture that appears homogeneous but is actually heterogeneous (like milk). The particles are uniformly spread throughout the solution.

Tyndall Effect

Because of the small size of colloidal particles, we cannot see them with naked eyes. However, they can scatter a beam of visible light. This scattering is called the Tyndall effect.

Properties of a Colloid

Nature

A colloid is a heterogeneous mixture. The size of particles is too small to be seen with naked eyes but big enough to scatter light.

Stability

They do not settle down when left undisturbed, so a colloid is quite stable. They cannot be separated by filtration but can be separated by centrifugation.

Components

The components are the dispersed phase (solute-like) and the dispersing medium. Examples include fog (liquid in gas), smoke (solid in gas), and milk (liquid in liquid).

Physical and Chemical Changes

Physical Changes

Properties that can be observed and specified like colour, hardness, density, melting point are physical properties. Changes like interconversion of states (ice to water) are physical changes because they occur without a change in composition or chemical nature.

Chemical Changes

Burning is a chemical change. During this process, one substance reacts with another to undergo a change in chemical composition. Chemical change brings change in chemical properties and we get new substances. It is also called a chemical reaction.

What are the Types of Pure Substances?

Classification

On the basis of chemical composition, substances can be classified as elements or compounds.

Elements

Robert Boyle was the first to use the term element. Lavoisier defined an element as a basic form of matter that cannot be broken down into simpler substances by chemical reactions. Elements are divided into metals, non-metals, and metalloids.

Metals and Non-metals

Metals are usually lustrous, ductile, malleable, and good conductors (e.g., gold, iron). Non-metals are poor conductors and not lustrous (e.g., hydrogen, oxygen).

Compounds

Definition

A compound is a substance composed of two or more elements, chemically combined with one another in a fixed proportion.

Properties

The properties of a compound are totally different from its constituent elements. For example, water (a liquid that extinguishes fire) is made of hydrogen (combustible gas) and oxygen (supports combustion).

Mixtures vs. Compounds

Formation

In mixtures, elements or compounds just mix together and no new compound is formed. In compounds, elements react to form new compounds.

Composition

A mixture has a variable composition. A compound has a fixed composition.

Properties and Separation

A mixture shows the properties of its constituents and can be separated by physical methods. A compound has different properties and can be separated only by chemical reactions.