

SEPARATION OF SUBSTANCES



Concepts Covered

- Mixtures and Its types.
- Methods of separation, Handpicking, and Winnowing.
- Sedimentation, Decantation.
- Sieving and Filtration, Crystallization.
- Distillation, Sublimation.
- Separation using more than one method.

Introduction

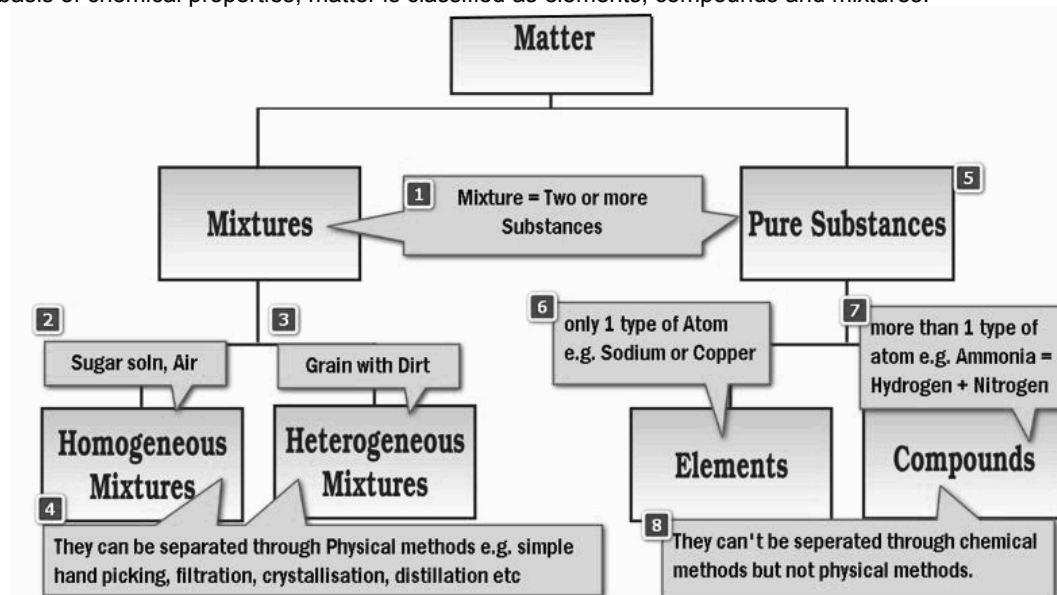
Matter is anything which occupies space and has mass is called matter. Air and water, sugar and sand, hydrogen and oxygen etc are example of matter. Matter is made up of very small tiny particles. Particles of matter have space between them. They attract each other.

Matter is made up of one or more components known as substances. In terms of science, a substance is a kind of matter which cannot be separated into any other types of matter by physical means. Such a substance which has only one component and nothing else in it is called pure substance. Substances mostly mix with one another and their combination is known as mixture.

Classification of Matter

On the basis of physical properties, matter is classified as solids, liquids and gases.

On the basis of chemical properties, matter is classified as elements, compounds and mixtures.



Pure Substances

A pure substance means a single substance (or matter) which cannot be separated into other kinds of matter by any physical process. A pure substance is made up of only one kind of atom.

Characteristics of Pure Substances

- A pure substance is homogeneous throughout its mass.
- A pure substance cannot be separated into other kinds of matter by any physical process.
- A pure substance has a fixed composition as well as a fixed melting point and boiling point.

Impure Substances: Mixture

A mixture is the combination of two or more substances (elements or compounds) which do not combine chemically with each other and may be present in any proportion.

Example:

The salt solution is a mixture of two pure substances: salt and water, sugar solution is also a mixture, air is a mixture of different gases; milk is also a mixture etc.

Pure substances are classified into two types:

- Elements
- Compounds

Mixture

A mixture is the combination of two or more substances (elements or compounds) which are not chemically combined with each other and may also be present in any proportion.

Example:

- Sugar solution is a mixture of sugar and water
- Steel is an alloy i.e. mixture of - iron, carbon (0.2-2.1 %) by weight, sometimes other elements like manganese, chromium, tungsten, and nickel may also be present.
- Air is a mixture of gases like oxygen, nitrogen, argon, carbon dioxide and water vapour.
- Pure gold i.e. 24-carat gold is not useful in making coins or ornaments because it is very soft. It is generally mixed with a small amount of copper or silver and its purity is reduced. This is commonly used in making ornaments and coins etc.



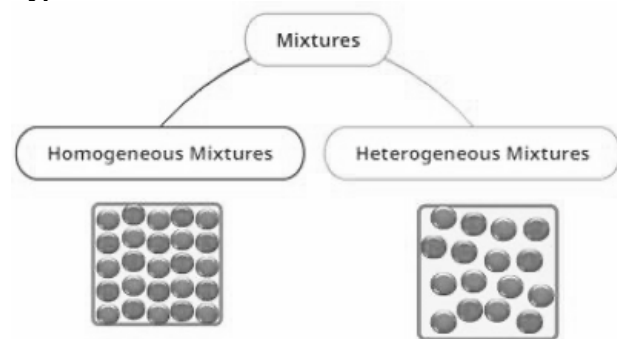
Check Your Concept - 1



A vitamin is a substance that makes you ill if you do not eat it.

- Which materials float on water?
- Which materials sink in water?
- Which materials are soluble in water?
- Which materials are not soluble in water?

Types of Mixtures



Homogeneous Mixtures:

A mixture is said to be homogenous if the different constituents or substances present in it are uniformly mixed and are indistinguishable from one another. The composition is uniform and every part of the solution has the same properties.

Example:

- Solution of sodium chloride or sugar in water is a homogeneous mixture- Different constituents are uniformly mixed throughout. It is not possible to identify them.
- Air is also a homogenous mixture of a number of gases like nitrogen, oxygen, carbon dioxide, water vapour, inert gases etc. All the gases present in air are uniformly mixed throughout. It is not possible to identify gases present in air.

- Copper sulphate solution in water is also homogenous. The solution formed has the same intensity of blue colour throughout.

Heterogeneous Mixtures:

A mixture is said to be heterogeneous if it does not have a uniform composition and also has visible boundaries of separation between the constituents.



Heterogeneous Mixtures

In these types of mixtures, substances remain separate and one substance is spread throughout the other substance as small particles, droplets or bubbles.

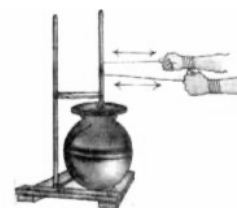
Example:

- A mixture of sugar and sand is heterogeneous. The constituents have clear boundaries of separation. The particles of sugar and sand can be easily identified in the mixture.
- All suspensions and colloids are heterogeneous mixtures.

Example:

There are many instances when we notice a substance being separated from a mixture of materials. Tea leaves are separated from the liquid with a strainer, while preparing tea. Grain is separated from stalks, while harvesting. Milk or curd is churned to separate the butter.

Before we use a substance, we need to separate harmful or non-useful substances that may be mixed with it. Sometimes, we separate even useful components if we need to use them separately. The substances to be separated may be particles of different sizes or these may be solids, liquids or even gases.



Churning

Methods of Separation

We will discuss some simple methods of separating substances that are mixed together. You may come across some of these methods being used and seen in your day to day life.

(i) **Threshing:** The process that is used to separate grain from stalks is threshing. In this process, the stalks are beaten to free the grain seeds. Sometimes, threshing is done with the help of bullocks. Machines are also used to thresh larger quantities of grain.

(ii) **Winnowing:** Winnowing is used to separate heavier and lighter components of a mixture by wind or by blowing air. This method is commonly used by farmers to separate lighter husk particles from heavier seeds of the grain. The seeds of grain get separated and form a heap near the platform for winnowing. The separated husk is used for many purposes such as fodder for cattle.

Threshing
Direction of the air →



Winnowing



Concrete is the combination of sand, stones, and cement, which is filled in iron frames

(iii) **Handpicking:** The method of handpicking can be used for separating slightly larger sized impurities like pieces of dirt, stone, and husk from wheat, rice or pulses. The quantity of such impurities is usually not very large. In such situations, we find that handpicking is a convenient method of separating substances. by handpicking from rice and pulses.



Handpicking

(iv) **Sieving:** In a flour mill, impurities like husk and stones are removed from wheat before grinding it. Usually, a bagful of wheat is poured on slanting sieve. Sieving removes pieces of stones, stalk and husk that may still remain with wheat after threshing and winnowing. Similar sieves are used at construction sites to separate pebbles and stones from sand.



Sieving

(v) Magnetic Separation:

The mixture which contains magnetic components can be separated by magnets.

Example:

- Iron filings and sulphur present in a mixture can also be separated with the help of a horseshoe magnet.
- This mixture is placed in a dish and the magnet is repeatedly moved over the mixture.
- The iron filings stick to the magnet in each operation and can be removed.
- After some time, the entire iron filings present in the mixture will be removed leaving behind sulphur which is of non-magnetic nature.



Magnetic Separation

(vi) Sedimentation, Decantation and Filtration: Sometimes, it may not be possible to separate components of a mixture by winnowing and handpicking. For example, there may be lighter impurities like dust or soil particles in rice or pulses. Rice or pulses are usually washed before cooking.

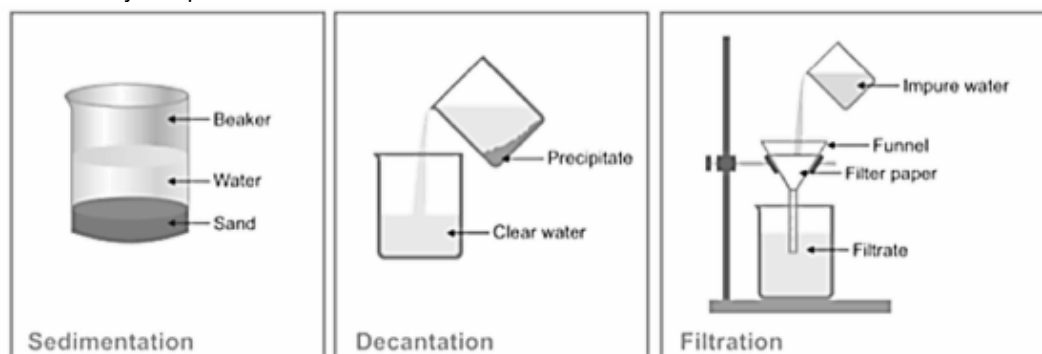
When you add water to these, the impurities like dust and soil particles get separated. These impurities go into water, which becomes a little muddy.

When the heavier component in a mixture settles after water is added to it, the process is called sedimentation. When the water (along with the dust) is removed, the process is called decantation.

The same principle is used for separating a mixture of two liquids that do not mix with each other. For example, oil and water from their mixture can be separated by this process. If a mixture of such liquids is allowed to stand for some time, they form two separate layers. The component that forms the top layer can then be separated by decantation.

A mixture of insoluble solid and liquid can be separated by the process of filtration.

If water is muddy, impurities can be separated by a filter that has even smaller pores. A filter paper is one such filter that has very fine pores.



The figure shows the steps involved in using a filter paper. A filter paper folded in the form of a cone is fixed onto a funnel. The mixture is then poured on the filter paper. Solid particles in the mixture do not pass through it and remain on the filter. Fruit and vegetable juices are usually filtered before drinking to separate the seeds and solid particles of pulp.

(vii) Evaporation: The process of conversion of water into its vapour below its boiling point is called evaporation. The process of evaporation takes place continuously wherever water is present. Sea water contains many salts mixed in it. One of these salts is the common salt. When sea water is allowed to stand in shallow pits, water gets heated by sunlight and slowly turns into water vapour, through evaporation. In a few days, the water evaporates completely leaving behind the solid salts. Common salt is then obtained from this mixture of salts by further purification.

(viii) Sublimation: The process of sublimation is used to separate those solids from their mixtures which directly pass into the vapour state upon heating without passing through the liquid state and the vapours on cooling change to the solid state again.

Example:

Separation of substances like naphthalene, camphor, ammonium chloride, benzoic acid, iodine etc. from the non-volatile components present in the mixture.

Use of More than One Method of Separation

Often, one method is not sufficient to separate the different substances present in a mixture. In such a situation, we need to use more than one of these methods. For example: We take a mixture of sand and salt. Handpicking would not be a practical method for separating these. In order to separate them, we keep this mixture in a beaker and add approximately water 10 mL and leave it aside for some time. We will see the sand settling down at the bottom. The sand can be separated by decantation or filtration. Now, we need to separate salt and water from the decanted liquid. For this, we transfer this liquid to a kettle and close its lid. The kettle is heated for some time. We notice steam coming out from the spout of the kettle. Then we hold a metal plate with some ice on it just above the spout of the kettle. Let all the water in the kettle boil off.

When the steam comes in the contact with the metal plate cooled with ice, it condenses and forms liquid water. The process of conversion of water vapour into its liquid form is called condensation. After all the water has evaporated, salt is left behind in the kettle. We have, thus separated salt, sand and water using processes of decantation, filtration, evaporation and condensation.



Solved Examples

- (1) **The method in which stalks are beaten to free the grain seeds is called.**
Answer: Threshing
- (2) **The method by which impurities and bran can be removed from the flour is**
Answer: Sieving.
- (3) **How can sand be separated from water?**
Answer: Sand can be separated from water by sedimentation.
- (4) **Grapes can be separated from the mixture of nuts and grapes by**
Answer: Handpicking.
- (5) **Which type of impurities can be separated by handpicking?**
Answer: Hand picking is used to separate slightly large sized impurities. It is used when the quantity of impurities is not very large.
- (6) **What is done in threshing? How can it be done?**
Answer: In threshing, the stalks are beaten to free the grain seeds. Threshing can be done with the help of bullocks or machines.
- (7) **What is sedimentation?**
Answer: When the heavier component of a mixture settles after water is added to it, the process is called sedimentation.
- (8) **What is evaporation?**
Answer: The process of conversion of water into vapour is called evaporation. This process takes place continuously where water is present. Common salt from sea water is obtained using this method.
- (9) **Is it possible to separate sugar mixed with wheat flour? If yes, how will you do it?**
Answer: Sugar can be separated from wheat flour by sieving. Due to difference in the size of particles, sugar will stay on sieve and wheat flour will pass through it.
- (10) **What is filtration? Give two common examples of filtration.**
Answer: Filtration is the process of separating insoluble solid impurities from a liquid by passing it through a filtering device. Insoluble solid particles are retained in the filtering device but the liquid passes through it. Examples: Filtration of tea leaves after preparation of tea using a strainer, and filtration of water to remove solid impurities.

Exercise

FILL IN THE BANKS

- (1) The changing of liquid into vapours is called
- (2) Sedimentation can be done more quickly by adding into it.
- (3) Mixture may be solid, liquid or
- (4) Breaking of stalks from grains is done by a machine called
- (5) The process of separating grains from the stalks is called
- (6) Cream is separated from milk by the process of
- (7) Common salt is obtained from sea water by
- (8) is used to separate husk from wheat.
- (9) and are the types of mixtures.
- (10) Milk is a mixture of, and

TRUE OR FALSE

- (1) Milk is a pure substance.
- (2) Evaporation is a continuous process.
- (3) Air is a mixture of gases.
- (4) A mixture of chalk powder and water is separated by sieving
- (5) Filtration can remove any solid substance which are dissolved in a liquid.
- (6) A mixture of oil and water can be separated by decantation
- (7) Loading helps the suspended clay particles to settle down
- (8) Common salt is a pure substance
- (9) Ink loses its properties when mixed in water.
- (10) Rocks are pure substances.

OBJECTIVE TYPE QUESTIONS

- (1) Technique used to separate grains from stalks is
 (A) Handpicking (B) Threshing
 (C) Winnowing (D) Sieving
- (2) The method used to separate heavier and lighter components of a mixture is
 (A) Handpicking (B) Threshing
 (C) Winnowing (D) Sieving
- (3) Sieving is used to
 (A) Separate impurities from wheat (B) Separate pebbles and stones from sand
 (C) Separate impurities from flour (D) All of these
- (4) Cream is separated from milk by _____ and tea leaves are separated from tea by ____
 (A) Filtration, decantation (B) Winnowing, filtration
 (C) Decantation, filtration (D) Decantation, decantation
- (5) Salt is obtained from sea water by the process of
 (A) Filtration (B) Winnowing
 (C) Evaporation (D) Decantation
- (6) Grain and husk can be separated by
 (A) Handpicking (B) Threshing
 (C) Winnowing (D) Sieving
- (7) The steam when comes in contact with cold surface, converts in water. The process is called
 (A) Evaporation (B) Condensation
 (C) Sublimation (D) Melting
- (8) The mixture of sand, salt and water can be separated by
 (A) Sublimation (B) Filtration
 (C) Distillation (D) (b) followed by (c)
- (9) The difference between sieving and filtration is of
 (A) Size of particles (B) Phase of particles
 (C) Density (D) None of these
- (10) We can obtain sugar from sugar solution by -
 (A) Sedimentation (B) Evaporation
 (C) Filtration (D) Decantation

Answer Key

FILL IN THE BANKS

- | | |
|-----------------|----------------------------------|
| (1) Evaporation | (6) Fixed |
| (2) Alum | (7) Mixture |
| (3) Gas | (8) Handpicking |
| (4) Threshers | (9) Heterogeneous, homogeneous |
| (5) Threshing | (10) milk-proteins, water, cream |

TRUE OR FALSE

- | | |
|-----------|------------|
| (1) False | (6) True |
| (2) True | (7) True |
| (3) True | (8) True |
| (4) False | (9) False |
| (5) False | (10) False |

OBJECTIVE TYPE QUESTIONS

- | | |
|---------|----------|
| (1) (B) | (6) (C) |
| (2) (C) | (7) (B) |
| (3) (D) | (8) (D) |
| (4) (C) | (9) (B) |
| (5) (C) | (10) (B) |