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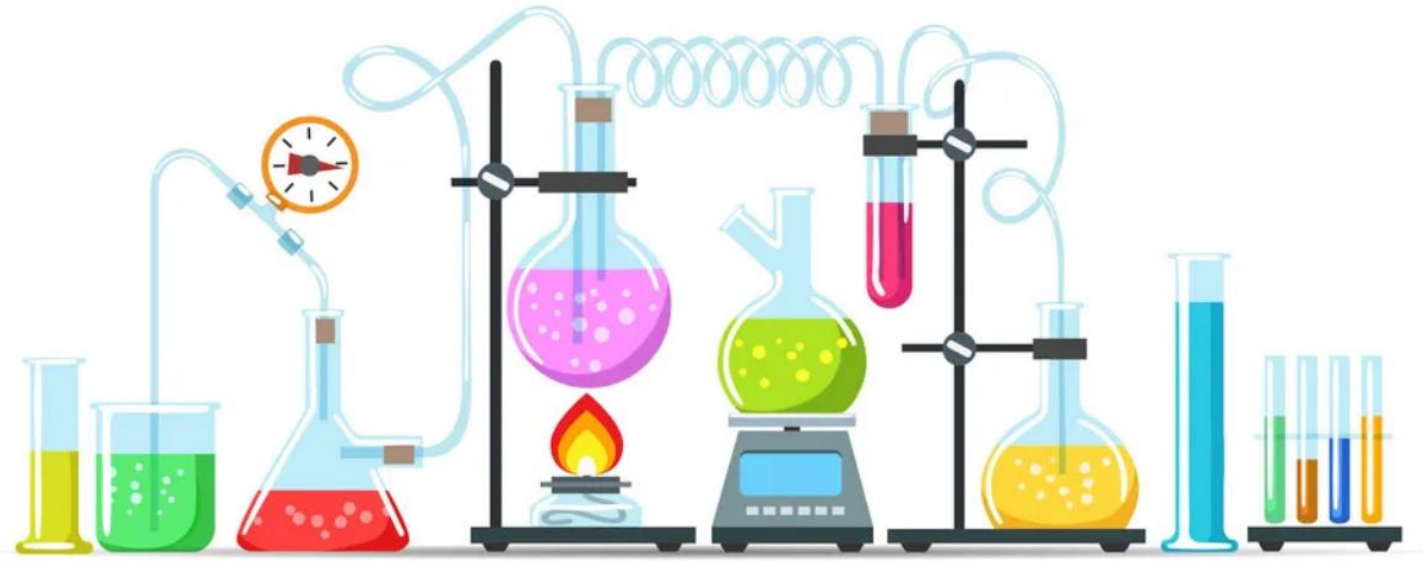
SCIENCE

Chapter 5: Separation of Substances



Separation of Substances

In nature, substances are often found in the impure state or mixed with other substances. A pure substance is made of only one type of atoms or molecules. Its components cannot be further separated by physical methods.

A mixture is an impure substance which contains different types of molecules (pure substances). It is a physically formed blend of two or more dissimilar substances.

Need for Separation of Mixtures

- To separate two or more substances, each being useful to us
- Examples: Rice and flour, sand and pebbles, kerosene and petrol, salt and iodine
- To separate useful substances from non-useful ones Examples: Sand and water, dirt and clothes, iron and garbage
- To separate impure or harmful substances from useful ones Examples: Stone and rice, pesticides and water, weeds and crops

Pure Substance

Pure substances are those substances that are made up of only one kind of particles. More precisely, they are composed of only one type of atoms or molecules.

There are two types of pure substances:

- **Element:** They consist of linking one or more same atoms. For example, hydrogen atoms, oxygen atoms and iron, etc.
- **Compound:** When different atoms or molecules are linked together, then they form a compound. For example, carbon dioxide, sodium chloride and water, etc.

Adulteration

When unwanted components are added to the food items then they are called adulteration, like small stones in rice (Figure 1).

Figure 1: Separation of small pieces of stones from rice.

Mixture

- The formation of any substance by mixing one or more substances is called a mixture. Moreover, the mixed substances possess unique property. Some examples are
- Milk is composed of a mixture of water and cream
- Water, carbon dioxide and sugar are mixed to form an aerated drink
- The mixture of water, dead organic matter and broken rocks, and minerals create soil
- The mixture contains different substances called its components that can be present in ratios.

Properties of Mixtures:

- The components ratio in a mixture cannot be fixed.
- The components can be separated by simple methods of separation. For example, separating stones from rice by hand.
- The melting and boiling point of mixtures is not fixed.

Types of Mixtures:

There are two types of mixtures:

Homogeneous mixture: In a mixture, the components are evenly distributed. Some examples of homogeneous mixture are the dissolution of salt in the water, alloys(made up of copper steel and bronze), and pure air

Heterogeneous mixture: These mixtures do not have evenly distributed components. Some examples are fruit salad and chocolate chip cookies, etc (Figure 4).

Figure 4: Heterogeneous mixture of dry fruits.

Separation Of Substances from Mixtures

The following purposes for separating components from mixtures are:

- To remove impurities or harmful components: The impurities affect health. Therefore, they need to be removed. For example, purifying river water for drinking, removing stones and other impurities from rice and pulses.
- To obtain useful components: The distillation of petroleum to obtain useful components like petrol, kerosene, diesel and white petroleum jelly.
- To obtain pure components: The separation of pure metals from their natural forms is called ores.

Methods of separation

1. Separation is a method of separating one substance from a mixture of two or more substances.
2. Separation of Solids from Other Solids
3. Separation solids from the mixture of solids can be performed by the following methods:

Different Methods of Separation

Handpicking:

It is a method of separation by using hands. The following purposes where handpicking is applicable are:

- When components are visible to the naked eye.
- The shape, size and colour of the components are different from the useful materials.
- The size of the components is large.

Some examples of handpicking methods are small stones, broken grains are separated from rice, wheat and pulses.

Threshing:

The process of separating grains from the harvested stalk is called threshing. It can be performed by the following ways (Figure 6):

- Beating the dry stalks on the hard surface by hands.
- Threshing machines are also used to separate dried grains.
- Crushing the stalks by animals like bullocks.

For example, threshing is used to separate the grains from the stalks of harvested rice and wheat crops.

Figure 6: Threshing process

Winnowing:

The process of separating grains from the husk is called winnowing. In this method, the mixture of grains and husk drops from a height, then the wind carried the husk away from the grains, as grains are heavier than the husk, they form a heap near the performer. Some examples of winnowing method are separation of sand from the powdered dry leaves (Figure 7).

Figure 7: Winnowing method

Sieving:

The process of separating the components according to their size is called sieving. A sieve is composed of a net or mesh. The size of the pores on the net or mesh depends on the size of the wanted materials (Figure 8).

The most common example of sieving method is the separation of bran from the wheat flour.

Figure 8: Sieving method.

Magnetic Separation:

The process of separating magnetic properties possessing materials from substances is called magnetic separation. In a mixture, one component is attracted to the magnet while the other one is not. For example, the separation of iron from the sand by a magnet (Figure 9).

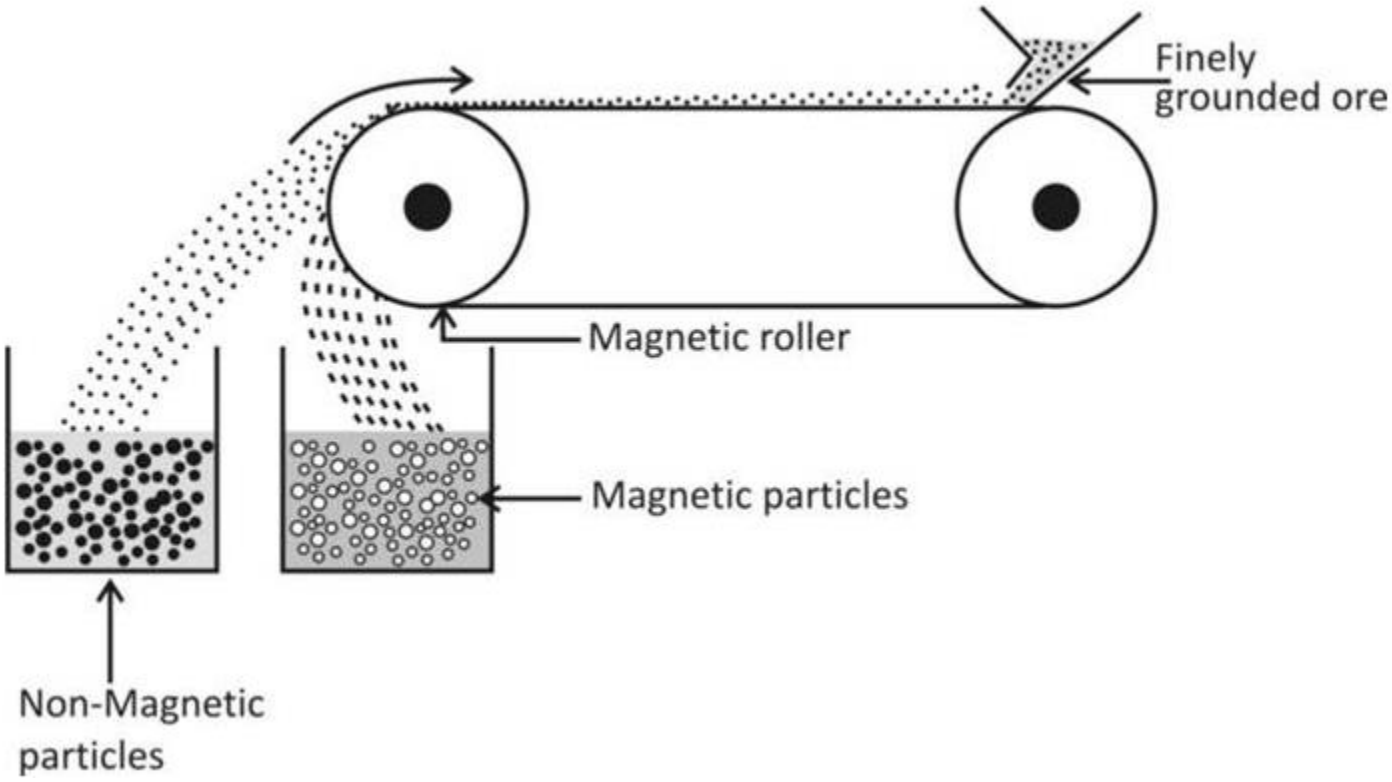


Figure 9: Magnetic separation method.

Separation of Solids from Liquids

In this separation, the method is dependent on the solubility of the substance.

Separating insoluble solids from liquids

Such particles that are not soluble in the water can be separated by the following methods:

Sedimentation and Decantation:

Sedimentation is the process of separating insoluble materials from liquid. The insoluble components settle down at the bottom of the liquid forms sediment, and the liquid above the sediment is called supernatant.

Afterwards, the supernatant is carefully removed out of the container without disturbing the sediment is called decantation. For example, separation of fine particles from the muddy water can be done by this method(Figure 10).

Figure 10: Sedimentation and decantation method:

Filtration:

The separation of insoluble components from the mixture using a filter is called filtration. The fine particles that are stored on the filter paper or funnel are called a residue, while the pure liquid that passes through the funnel into a container is called the filtrate (Figure 11).

Figure 11: Filtration.

Separating soluble from their solutions

The separation of soluble solids from the mixture as follows:

Evaporation: The process of separating the soluble materials from the solution by heating it is called evaporation. For example, the formation of the common salt from the seawater by evaporation occurs naturally (Figure 12).

Condensation: The process of converting the water vapors into the water by cooling is called condensation. Raining is a good example of this process (Figure 12).

Figure 12: Evaporation and Condensation.

Saturated and Unsaturated Solutions

Saturated Solution

A solution which cannot dissolve more solute at a given temperature is called a saturated solution.

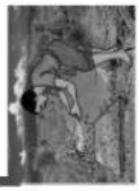
Unsaturated Solution

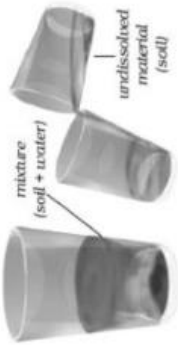
A solution which can dissolve more solute at a given temperature is called an unsaturated solution.

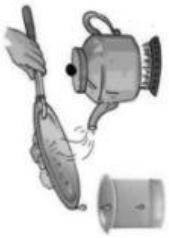
CHAPTER - 5 SEPARATION OF SUBSTANCES

Separation of Substances

- Separation need
  - Remove harmful components
  - **Separate two different but useful components**
- Handpicking
  - **Method to separate large sized impurities by hand**
- Threshing
  - Method to separate grain from husks
- Winnowing
  - **Method to separate** heavier & lighter components by wind or blowing air
- Sieving
  - **Method to separate Impurities through a sieve**
- **Sedimentation & Decantation**
  - Decantation - To remove water & dust
  - Sedimentation to Separate heavier component **by adding water to mixture**
- **Filtration**
  - method to separate impurities by using filrate
- **Evaporation & Condensation**
  - to separate liquid from solid
- Mixture
  - Homogeneous
    - **Uniform appearance & composition**
  - **Hetro geneous**
    - no uniform appearance & composition
- Saturated solution
  - can be added to solvent
  - no more solute




Important Questions

Multiple Choice Questions:

Question 1. A mixture of iodine and sand can be separated by:

(a) Decantation

(b) Centrifugation

(c) Filtration

(d) Sublimation

Question 2. A mixture of tea leaves and iron filling can be separated by:

(a) Filtration

(b) Evaporation

(c) Separating funnel

(d) Magnet

Question 3. A mixture of mustard oil and kerosene oil can be separated by:

(a) Sublimation

(b) Evaporation

(c) Separating funnel

(d) Filtration

Question 4. Insects are separated from wheat by:

(a) Hand picking

(b) Sieving

(c) Magnet

(d) None of these

Question 5. Larger quantity of salt can be dissolved in water by:

(a) Heating

(b) Coaling

(c) Icing

(d) None of these

Question 6. _____ cannot dissolve any amount of substances:

(a) Solid

(b) Water

(c) Gas

(d) Vapour

Question 7. To separate husk from grains in a field by

(a) Tailor

(b) Grocer

(c) Watchman

(d) Farmers

Question 8. The husk which is ……., is carried away by the wind and forms a Separate heap at a short distance from the heap of grain,

(a) Heavier

(b) Lighter

(c) Stronger

(d) None of these

Question 9. The grains which are fall vertically down on the ground,

(a) Heavier

(b) Lighter

(c) Stronger

(d) None of these

Question 10. A method of separation used when the components of a mixture are of different sizes is known as:

(a) Separation

(b) Winnowing

(c) Sieving

(d) None of these

Question 11. Water is cleared by the process of loading.

(a) Lemon water

(b) Milky water

(c) Muddy water

(d) None of these

Question 12. The method to separating seeds of paddy from its stalks is called:

(a) Filtration

(b) Hand-picking

(c) Decantation

(d) Threshing

Question 13. Common salt is then obtained from this mixture of salts by:

(a) Evaporation

(b) Filtration

(c) Purification

(d) None of these

Question 14. Which types of filters are used to purify drinking water ?

(a) Electric water filters

(b) Common water filter

(c) Pure it filter

(d) None of these

Question 15. Give an example of where filtration is used at home.

(a) Mustard oil and water can be separated by using filtration

(b) Husk from rice is separated by filtration

(c) Paneer from milk is separated by filtration

(d) All of these

Very Short Question:

1. What is strainer?
2. Name the method used to separate cream from curd.
3. How will you separate mango from a mixture of mango and apple?
4. You are given a mixture of salt and sand. Can you separate them by picking?
5. Name the method used to separate the pieces of stone from grain.
6. How can you separate grains from stalk?
7. What types of material can we separate by using handpicking?
8. Name the other methods used to separate solid materials of different size.
9. Name the process used to separate heavier and lighter components of a mixture.
10. Can the above stated method be used if both the components have same weight?

Short Questions:

1. What is mixture?
2. Write various methods of separation of components from their mixture.
3. Define the term handpicking.
4. What do you mean by threshing? Where is it used?

5. Write three methods of separation.

6. How will you separate oil and water from their mixture?

7. What is evaporation?

8. Define winnowing.

Long Questions:

1. What is threshing?

2. Describe the method to obtain salt from sea water.

3. What is decantation?

4. Where is decantation used? Give two examples.

5. How will you prepare cheese (paneer)?

6. Explain the method that can be used for separating the following mixture:

Answer Key-

Multiple Choice Answers:

1. (d) Sublimation

2. (d) Magnet

3. (c) Separating funnel

4. (a) Hand picking

5. (a) Heating

6. (b) Water

7. (d) Farmers

8. (b) Lighter

9. (a) Heavier

10. (c) Sieving

11. (c) Muddy water

12. (d) Threshing

13. (c) Purification

14. (a) Electric water filters

15. (c) Paneer from milk is separated by filtration

Very Short Answers:

1. Answer: Strainer is a kind of sieve which is used to separate a liquid from solid.

2. Answer: Centrifugation.

3. Answer: By picking.
4. Answer: No, we cannot separate them by picking.
5. Answer: Handpicking.
6. Answer: We separate grains from stalk by threshing.
7. Answer: The materials having different size and colour can be separated by handpicking.
8. Answer: Sieving.
9. Answer: Winnowing.
10. Answer: No, this method cannot be used.

Short Answer:

1. Answer: When two or more than two substances are mixed together in any ratio then it is called a mixture.
2. Answer:
   a. Handpicking
   b. Threshing
   c. Winnowing
   d. Sedimentation
   e. Decantation
   f. Filtration
   g. Evaporation
   h. Condensation
3. Answer: The process used to separate slightly larger particles from a mixture by hand is called handpicking. For example: Stone pieces can be separated from wheat or rice by handpicking.
4. Answer: Threshing is a process in which we separate grain from stalks. This process is used by farmer to separate gram, wheat, rice, mustard seeds in his field.
5. Answer: Handpicking, threshing and winnowing.
6. Answer: Oil, being lighter than water, will float on it. Two distinct layers are formed and slowly oil is allowed to flow into another container and is separated from water. Separating funnel can also be used to separate the two.

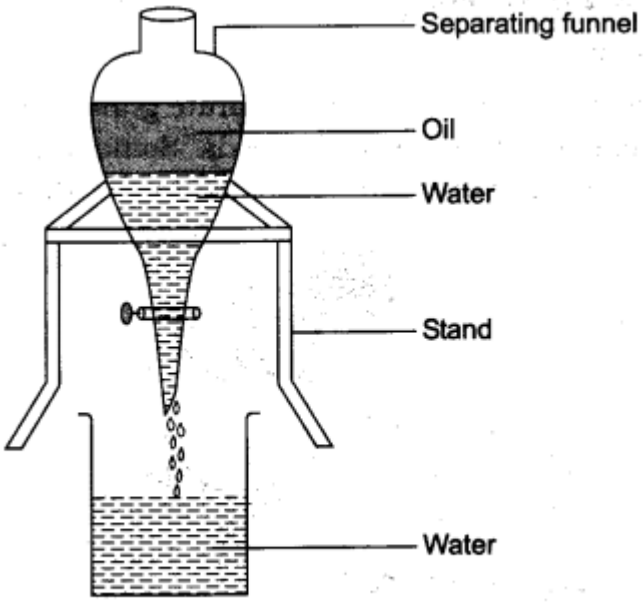


Fig. 5.13 Separation of liquids by separating funnel

7. 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.
8. Answer: The process is used to separate components from a mixture in which one component is heavier or lighter than other is called winnowing. Winnowing is done with the help of wind or by blowing air.

Long Answer:

1. Answer: Threshing is a process that is used to separate grain from stalks. 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 large quantities of grain.

Threshing

2. Answer: Sea water contains many salts mixed in it. One of them is common salt, when sea water is allowed to stand in shallow pits, water gets evaporated by sunlight and slowly turns into water vapour. 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.

3. Answer: Decantation is a process, of separation of insoluble solids from liquid. The suspension of solid particles in liquid is allowed to stand for some time. The solid particles then settle down at the bottom of the container and clean water goes up. Without disturbing the settled particles the clean water is transferred into other container.

4. Answer:

   (i) Decantation is used to separate insoluble solids or liquid from liquid. Rain water is a mixture of mud and water. It is purified by decantation.

   (ii) Oil and water also get separated by this method because oil floats up.

5. Answer: For making paneer, a few drops of lemon juice sire added to milk as it boils. This gives a mixture of particles of solid paneer and liquid. The paneer is then separated by filtering the mixture through a fine cloth or strainer.

6. Answer:

   (i) **Mixture of sand and husk:** Sand and husk can be separated by the method of winnowing.

   (ii) **Mixture of wheat, sugar and stalk:** For separating stalk from the mixture we should follow the winnowing method because milk is lighter than other two components and get separated. Wheat and sugar can be separated by sieving because they are in different sizes.

   (iii) **Mixture of water and petrol:** Water does not dissolve in petrol. So, it can be separated by the use of separating funnel.

   (iv) **Mixture of rice and salt:** Rice and salt can be separated by sieving.

   (v) **Mixture of sand and salt:** Sand and salt is mixed with water, salt dissolves in water and sand can be separated solution by sedimentation and decantation followed by filtration. After that using evaporation common salt is separated.