7.Separation of Substances

The natural variety, Japan camphor, is obtained by steam distillation of the wood of the camphor tree (Cinnamomum camphora).

Hemanth's mother sent him to a grocery store to buy grocery and vegetables. He purchased green chilli, coriander seeds tomato, red gram, wheat flour and kept them safely in a bag. While returning home he fell on the ground and all the items in the bag got mixed. How will he separate them now? Which material will he separate first? How would he separate tomato and chilli? How would he separate wheat flour? How would he separate coriander seeds?

Fig. 1

We separate components in mixtures for different purposes in our daily life. For example, we remove small stones from rice before cooking, remove worms and dust from flour before preparing roti. Similarly we separate impurities from water, tea leaves from tea etc.

Mixtures

Have you observed tea being prepared? What substances are used for preparing tea? List them in table 1. and also list out the different substances that are used to make the items given in table 1.

Fig. 2

Table 1

Item	Substances
Tea	Milk, ...
Laddu	
Lemon Juice	
Concrete	
Soil	

The above items are **mixtures** as they contain more than one substance. Combination of more than one substance forms a mixture. Some mixtures are natural like soil. Some mixtures are man-made like laddu, lemon juice etc.

Write in table 2 some mixtures that you know and their components. Also mention whether they are natural or man-made.

Table 2

Mixture	Components	Natural / Man made
Lemon water	Lemon juice, sugar, water	Man-made

• Identify the mixtures among the following : Jangree, coffee, sand, haldi, red chilli

• From which mixture in the examples mentioned above are you able to separate components?

Activity-1: Use of water in separation

Collect some solid materials such as ghee, wax, sand, sugar, salt, turmeric powder, dal, plastic, wood, iron nails. Take a bucketful of water and a beaker. Now try to discover the following.

• Which materials float on water?

• Which materials sink in water?

• Which materials are soluble in water?

• Which materials are not soluble in water?

Fig. 3

You have studied about materials and their properties in a previous chapter. We make use of several properties of the materials for separating the desired items from the mixture.

You might come across some situations where you have to separate some components from a mixture. Write down two examples of such situations.

1. _____

2. _____

What do you do to separate the components?

• Were you able to separate each component from the mixture?

• Are the methods used to separate the components the same in all these instances?

• What are the properties of the components that are used, in separating them?

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 in your day to day life.

Hand Picking

Fig. 4

• How are stones separated from pulses and rice?

Stones are separated by **hand picking** from rice and pulses (see fig. 4).

• Can you separate salt from sand in this manner? What differences in the properties of rice, pulses and stone help us in separating them by the above method?

Sonu gave following examples for hand picking method of separation.

1. Rotten fruits are removed from fresh fruits.

2. Separating oranges and apples.

Try to give some more examples where the hand-picking method is used.

1. .....

2. .....

3. .....

Winnowing

When farmers thresh their crops, they get a mixture of husk and grain. How do the farmers separate the husk from the grains?

On a windy day, a farmer stands on a high platform and allows the mixture of grain and husk to drop slowly from the flat pan. The wind carries the husk forward and the grains fall vertically downward. A separate heap of grain is formed (Fig. 5).

Fig. 5

• What property helped in separating the husk from grain?

Husk is very light as compared to the grains, and farmers use this property.

Activity-2: Sedimentation and decantation

Take a mixture of soil and water in a glass tumbler and keep it undisturbed for sometime. What do you observe?

You will find that the sand and the mud particles in the soil settle down at the bottom of the glass tumbler (Fig 6(a)). These are called sediments. This process of separation of mud and sand is called **sedimentation**.

After sedimentation, the tumbler is gently lifted. The tip of the tumbler is inclined on the edge of another tumbler without disturbing the sediments (Fig. 6 (b)). The water gets seperated from the sediment(mud). This process is called **decantation**.

Fig. 6 (a)

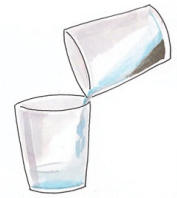

Fig. 6 (b)

• Why did mud particle settle at the bottom of the tumbler?

Laxmi says that sedimentation and decantation are used at home while cleaning rice and pulses for cooking. Describe the sediments in this process.

• Think of other examples where we use this method of separation and list them.

_____

_____

Sieving and filtration

• How will you separate the tea-leaves from tea?

Tea-leaves are separated from tea using a strainer. Which property helped in separation of tea-leaves from tea?

You must have seen flour being seived in the kitchen (Fig. 7). The flour particles are very fine and pass through the holes of a sieve, but the husk particles being large are left on the sieve.

Fig. 7

We use sieves to separate tea leaves from tea and sand from gravel. What are the differences between the sieves used in the two instances?

Do you know?

Farmers separate grains which are bigger in size from the smaller ones by sieving. The bigger grains are then used as seeds or sold at higher price

Can you separate mud from muddy water using a sieve? How small should the pores of the sieve be to do this? Use a cloth as a sieve and try to do this.

• Is the water clear after sieving?

• Gowthami filtered mud water with a filter paper. Can you do it? (See Fig. 8)

• After using the filter paper to filter water what do you find? What do you see left behind on the paper? What is obtained in the beaker?

Fig. 8

Filter paper

Filter paper is a sieve made of paper which has very fine holes. We can filter very small particles using this type of sieve.

Activity-2: Why can't we filter salt from salt water

- Take water in a beaker. Dissolve some salt in it. Filter this mixture with a filter paper. Were you able to separate the salt from the salt water?
- Why could you not filter the salt from salt water?

The pores in a filter paper are so minute that we cannot see them with naked eyes. Think, how small should the particles of salt dissolved in water be if they are to pass through filter paper!

Activity-3: Crystallization

Fig. 9

Heat some salt water in a beaker,
over a flame. Stir the solution with a glass rod (Fig. 9). Continue heating till all the water in the beaker has evaporated. What is left behind in the dish? You will find salt crystals and powder in the dish.

Do you Know?

Water is generally evaporated in sunlight. We use this property while extracting salt from sea water. Sea water is captured in wide pans and is exposed to air and sunlight. Then water evaporates and the salt is left behind in the pans.

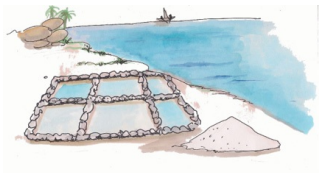

Fig. 10

Distillation

Before administering injections to patients, doctors mix injection powder with some liquid.

What is it? Is it water or any other liquid?

This is water and it is known as distilled water. Where does this distilled water (pure water) come from?

- Do you know the process of distilling water?

Activity-4: Get your own distilled water

Fill a conical flask with water, close it with a cork having a hole. Insert a glass tube through the hole. Take an another conical flask with a cork having a hole and insert another glass tube through it. Connect both tubes with a plastic tube. Now heat the flask containing water using a burner (Fig. 11).

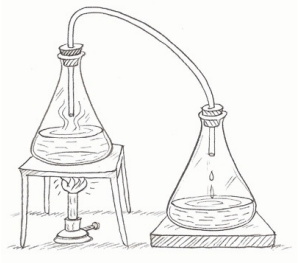

Fig. 11

After some time, water vapour goes into the second conical flask through the glass tube. The water vapour will slowly turn to water. The water in the second conical flask is called distilled water. It is free from impurities.

Sublimation

In order to separate the components of a mixture we make use of their difference in color, shape, size, weight, solubility.

- Can we use these features for separating mixtures of powdered salt and camphor?
- What other properties can we use?

Activity-5: Sublimation of camphor

Take a mixture of camphor and powdered salt in a china dish and cover it with a funnel. Close the tube of the funnel with cotton. Place the dish on a stand and heat it with a burner (Fig. 12).

Fig. 12

- What do you observe in the dish?

When camphor is heated, it transforms to gaseous form without changing into liquid. Similarly, on cooling, the gaseous form of camphor changes directly into a solid without going to the liquid state. The process in which a substance changes directly from solid to gaseous form and vice-versa is called **sublimation**.

Chromatography: A novel method of separation

Can we separate colours from a mixture of colours? Let us do an interesting activity.

Activity-6: A chalk with diffrent colours

Take a whole stick of white chalk. Around the curved surface of the chalk put an ink mark with blue or black ink.

Now pour some water in a plate and keep the piece of chalk in the water (Fig. 13). Ensure that the water in the plate is very little and does not touch the ink mark.

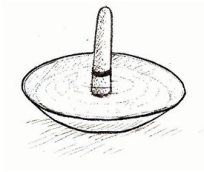

Fig. 13

Now observe the colour patterns that form on the piece of chalk after some time.

- Does chalk absorb water?
- Can you find any change in ink mark on the chalk?

Remove the chalk before the water reaches its top. Which colours do you see on the chalk from the bottom to top? Draw a picture of the chalk in your notebook and the colours you have seen on the chalk. From where did these colours come?

The ink appears to be made of a single colour but it is actually a mixture of many colours hidden in it. This method is an example of chromotography. Try to do chromatography with different inks and find out which colours they contain.

- Where do we use the chromatography method?

We know that a leaf is green in colour. Try to find whether the leaf consists of only one colour or more than one colour?

Separation using more than one method

We have studied some methods for separation of substances from their mixtures. Often one method is not sufficient to separate the different substances present in the mixture. In such situations, we need to use more than one of these methods.

Activity-7: Separation of diffrent materials from the mixture

Take a mixture of sand, saw dust and salt in a beaker half-filled with water. Stir the mixture well. Allow to undisturb for 10 minutes. What do you observe?

- Which substance floats on the water?
- How can you collect it?
- Which substance settles at the bottom of the beaker?
- How can you collect it back?
- Which substance is dissolved in the water?
- How can you get it back?

Think about suitable methods to separate the substances that are floating (or) settled at the bottom of the beaker (or) dissolved in water and write them in your notebook.

Separation of substances is a very important scientific activity and is also important in our daily life.

We are using different types of separation techniques for various purposes to get desirable quantities of material.

Keywords

Mixture, separation, handpicking, winnowing, sedimentation, decantation, sieving, filtration, crystallization, distillation, sublimation, chromatography

What we have learnt

- Substances can be separated from a mixture.
- Hand picking is used to separate substances when their sizes are sufficiently large.
- If mixtures have light and heavy substances, winnowing can be used for separation.
- An insoluble substance in a liquid can be separated by sedimentation and decantation.
- Sieving can be used for separating larger and smaller substances in a mixture.
- Crystallization is used for separation of dissolved substances from a liquid.
- Distillation is used to remove impurities from water.
- More than one method of separation can be used to separate the components of some mixtures.

Improve your learning

1. Is it possible to separate sugar mixed with wheat flour? If yes, how will you do it? If powdered sugar is mixed with wheat flour, how do you separate them?
2. Why is hand picking necessary after winnowing?
3. Srikar accidentally mixed mustard seeds with rice and salt. How can he separate them?
4. Which separation process is used when one component is in a mixture :

a. Heavier than the other?

b. Bigger than the other?

c. Different shape and color from the other?

d. One is soluble in water and the other is not?

e. One floats and the other sinks in water?

5. Visit a nearby dairy and report about the processes used to separate cream from milk.
6. Divya suggested some methods to separate mixtures given below. Are they correct? Find whether they are possible or not. Give reasons.

a. Pure water can be obtained from sea water by the process of filtration.

b. Cheese is removed from curdled milk by the process of decantation.

c. Separation of sugar from tea can be done by filteration.

7. Collect information from your parents regarding various methods used by us to clean food grains at home and prepare a chart to show them.
8. We observe that kerosene rises up in the wick of a lantern. Take a wick and put a spot of ink at one of its ends. Then dip the wick in kerosene just as you had dipped the chalk in water in the chromatography activity. Will your experiment be successful in seperating the colour ink spot. Try it.
9. Match the following; and write sentences in your note book.

A) A substance obtained by mixing 1. Sublimation ( )
two or more pure substances.

B) A clear liquid obtained after filtration 2. Decantation ( )

C) A solid changing directly into vapour 3. Mixture ( )

D) A method for removing the husk 4. Winnowing ( )
from grain

E) Removing insoluble impurities from 5. Filtrate ( )
muddy water by allowing it to settle

10. Draw a picture of article used for separation of mixture in your house.

11. Kiran observed his father separating husk and grains by winnowing method in the field and appreciated how wind flow helped in seperation. On evaporation salt is formed from sea water. Isn't it? How would you appreciate this process?

* * * * *

A vitamin is a substance that makes you ill if you don't eat it.
Concrete is the combination of sand, stones, and cement, which is filled in Iron frames.
You can walk on waters of Dead Sea it is a salt lake bordering Jordan to the east and Israel and the West Bank to the west.
Handpicking is an excellent method of controlling pests especially when only a few plants are infested.
Soil and rock layers naturally filter the ground water to a high degree of clarity.
Chilka lake is the India's largest salt water lake.
Distilled water will hamper metabolic processes - if distilled water is consumed for longer period.
Solid form of Corbondioxide is called Dry Ice.
In the Middle Ages, salt was so expensive it was sometimes referred to as "white gold".