4 SEPARATION OF MATTER

In summer, we take a mixture of lemon- juice and sugar in water to quench our thirst. This lemon - juice, sugar and water form a mixture. Similarly, in case of acute stomach disorder doctors advise us to drink mixture of sugar and salt in water. This mixture is termed as ORS. There are many more examples of mixtures, which include solids, liquids and gases. Like the smoke coming out of a motor vehicle is a mixture of many gases. The substances, which form a mixture, are called constituents of a mixture. Seawater is also a mixture, whose constituents are the substances dissolved in it.

Make the table given below in your note- book, and complete it by adding names of other mixtures.

TABLE 4.1

S.NO	MIXTURE	CONSTITUENTS
1.	Air	Oxygen, Nitrogen, Dust particles
2.	Wheat taken from field	----------
3.	Pond water	----------
4.	Soil	----------
5.	----------	----------
6.	----------	----------

In the above examples we have seen that when two or more substances are mixed in a medium, they form a mixture. The characteristics of a mixture are dependent on the characteristics of its individual constituents. In our daily life, we see that before we use a material, we need to separate the more useful and less useful components of the material.

Make the table given below in your note-book and add more examples to understand it.

TABLE 4.2

S.NO	EXAMPLE	USEFUL PART	LESS USEFUL PART	METHOD OF SEPARATION
1.	Rice	Rice	Hay, small stones	Hand-picking, sieving
2.	Tea with tea leaves	----------	----------	----------
3.	Wheat	----------	----------	----------
4.	----------	----------	----------	----------
5.	----------	----------	----------	----------

Thus we have seen that by using one or more method of separation, we can separate various constituents of a mixture. This is called Separation.

4.1 Why do we need separation?

1. To remove the non-useful components: The smoke coming out of a chimney is treated in such a way to remove unburnt carbon and ash particles so that air pollution can be reduced . Also, in water treatment plants insoluble impurities and micro organisms are removed from water to make it drinkable.
2. To obtain a useful product: Sea water is evaporated to get common salt. Salt is used extensively in our kitchens and industries.
3. To obtain pure material: Pure sugar crystals are obtained from sugarcane juice, whereas the impurities remain in the juice.

ANSWER THESE

1. What do you understand by the term mixture?
2. What is separation?
3. Why do we need to separate substances?

4.2 Methods of separation

To separate components from a mixture we need to know the characteristics of its components. To separate the components from a mixture, a particular characteristic of one of the component is used. A characteristic which is not present in the other components. Now, let us understand some of the methods of separation.

1. Hand-picking— How do you separate the small stones from pulses and rice. When the impurity in the mixture is of a different shape, it can be separated by picking up by hand. This is called handpicking.

2. Sieving- Wheat flour is layered on a sieve, the impurities being bigger in size stay on the sieve while fine flour passes through the small holes on the sieve. This method is known as sieving.

The same technique is used at construction sites to separate pebbles and stones from fine sand. The stones present in the sand stay on the sieve while the sand passes through it.

(a) Sieving

(b) Sand Sieving

Fig 4.1

Sieving the flour removes the useful bran from flour. Thus we should not sieve the flour before kneading.

3. Winnowing and Threshing – You must have seen farmers in the field, removing the grain seeds from bundles of stalks. A farmer stands on an elevated platform, and slowly slides the mixture of grain seeds and stalks. Since grains are heavier , they fall straight on the ground. While the stalks being lighter fall at a little distance away. In this way we see two heaps, one of stalks and other of grain. This method is known as Winnowing.

Fig.4.2 Winnowing

Similarly, stalks with grains are beaten to separate the light and heavy components. The lightest stalk fall in front and the heavier grains are separated. This method is known as **threshing.**

4. Magnetic separation

ACTIVITY 1

Materials required: Sand, iron fillings, magnet, paper

Spread the mixture of sand and iron fillings on a piece of paper. Now bring a magnet near this mixture. What do you observe? Iron fillings are attracted towards the magnet and hence get separated. Repeat this activity till the iron fillings are entirely separated from the sand. Sand remains on the paper. This method is known as **magnetic separation.**

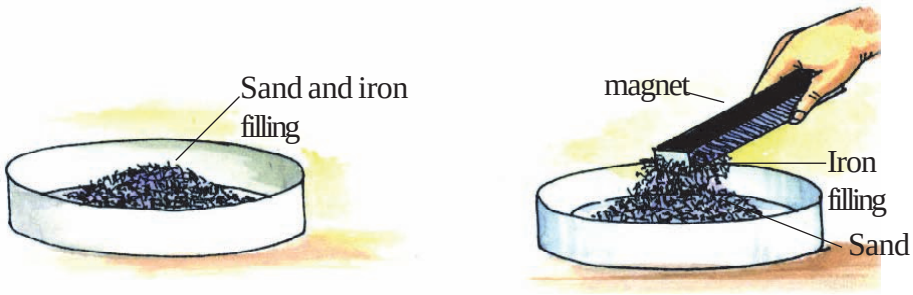


Fig.4.3 Magnetic separation

In industries, iron pieces are separated from other materials by this method(figure 4.4)

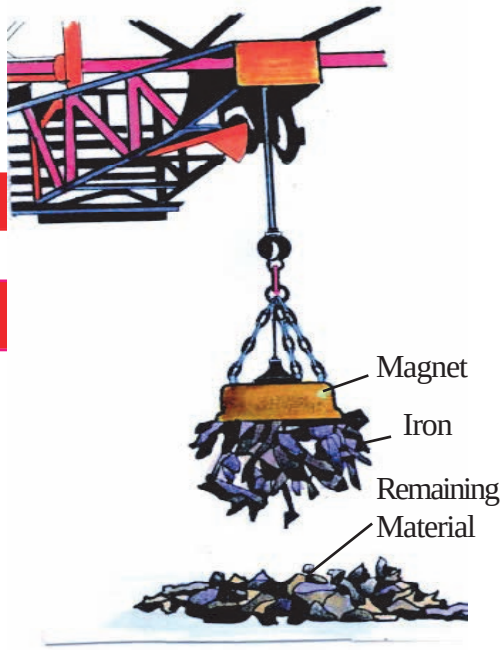


Fig.4.4 Separation of iron pieces by using electrical magnet

5. Decantation

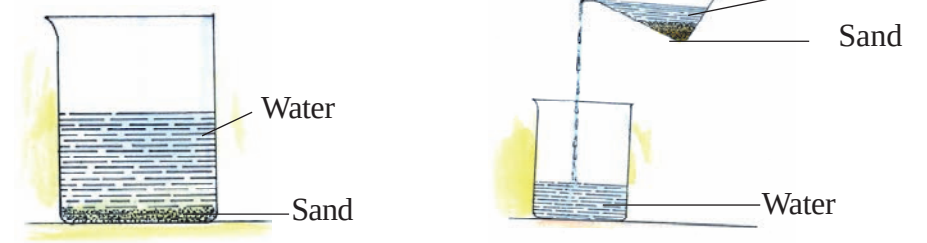
ACTIVITY 2

Materials required: Two beakers, glass rod, water, sand.

Take a mixture of water and sand in a beaker. Mix it well using a glass rod. Now leave it undisturbed for sometime. Observe. What do you see?

Sand settles down in the beaker as it is heavier. This is called **Sedimentation.**(figure 4.5A). Remove the water in the upper layer and pour it in a

beaker in such a way that the sand settled at the bottom does not move. This method is known as **Decantation.** By using this method we have separated insoluble sand (a solid) from water (liquid) (figure 4.5B)



A. Sedimentation B. Decantation

Figure 4.5

ACTIVITY 3

Materials Required- A beaker, separating funnel, stand, glass rod, oil and water

Take equal quantity of oil and water in a beaker. Mix well with a glass rod. Leave it undisturbed for sometime. Observe the beaker carefully. Do oil and water mix with each other? Both the liquids make separate layers. Can you separate the two by decanting?

To separate two immiscible liquids we use a separating funnel. Keep this mixture in a separating funnel and leave it for sometime. Water settles as the lower layer while oil settles as the upper layer. Open the stop cock at the base of the funnel and collect the heavier layer of water in a beaker. In this way two immiscible liquids can be separated. (figure 4.6)

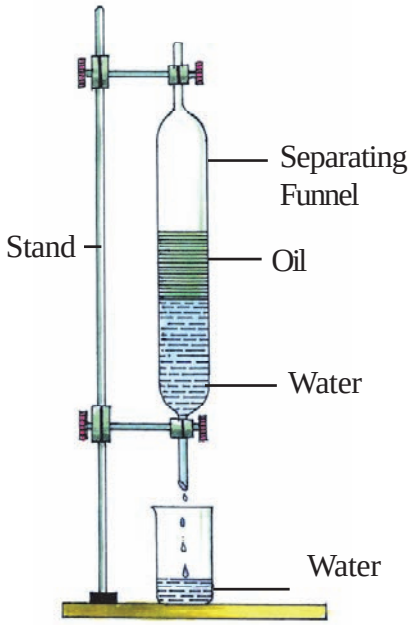


Figure 4.6 Separation by a separating funnel

6. Loading

ACTIVITY 4

Materials required- Two beakers, impure water, piece of alum

Fill half a beaker with impure water. Tie a piece of alum with a thread and put it in water while holding the other end of the thread. Now remove the alum and leave the beaker undisturbed for sometime. After 5-6 hrs you will see that impure water gets cleaned because the impure particles present in water become heavier due to alum and they settle down at the base of the beaker. This process is known as **loading**. Now decant the clean water into a beaker. (figure 4.7)

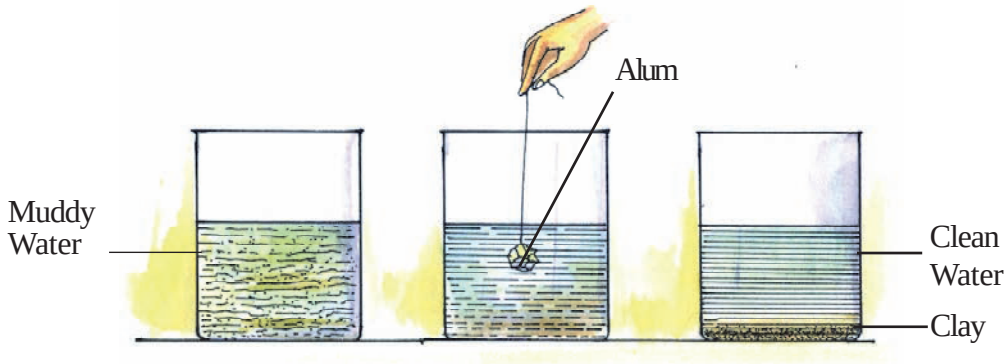


Fig. 4.7 Loading

ANSWER THESE

1. Which method is used to separate pieces of iron from coal in coal mines?
2. How will you separate kerosene oil mixed in water? Explain by giving diagrams.
3. Give two examples from your daily life where you use decantation for separating substances.
4. Name the property of the constituents which is used to separate the following mixtures.

   a) Wheat and hay b) Iron fillings and sand

   c) Coconut oil and water d) Flour and bran

7. Centrifugation

Tie a stone with a thick thread. Now hold the other end of the thread and revolve the stone fast over your head. You would feel your hand being trigged as if the stone is being pulled out of your hand towards opposite direction.

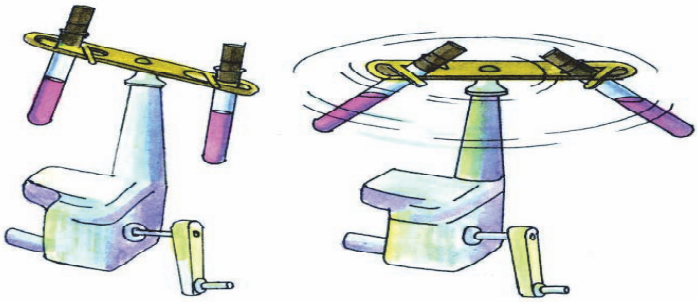


Fig 4.8 Hand driven centrifugation machine

If you leave the thread or it gets broken, what will happen? Which direction would the stone fly out? Take a small plastic bottle and fill it with muddy water. Close it with a cork so that water does not spill. Now tie the bottle with a thread and revolve it in the same way as the stone. What will happen to the mud particles? They are not attached to any thread so they would move towards the base of the bottle and settle. We can now decant the water and separate it from mud.

This process of separation is called Centrifugation. This method of sepalation is used in laboratories (fig.4.9) industries and also in separating cream from milk.

8. Filtration

ACTIVITY 5

Materials required- beaker. Glass rod, funnel, filter paper, stand, a mug and impure water.

Take a filter paper. Fold it twice to make a cone (fig 4.9A) Fix it inside the funnel as shown in fig 4.9B. Wet the filter paper and fix the funnel on the stand as shown in fig 4.9C. Pour impure water into the funnel with the help of a glass rod. Collect the filtered water in a mug. Mud particles and other insoluble impurities will remain on the filter paper. By using this method we can separate insoluble solid particles from liquids. This method is known as filtration.

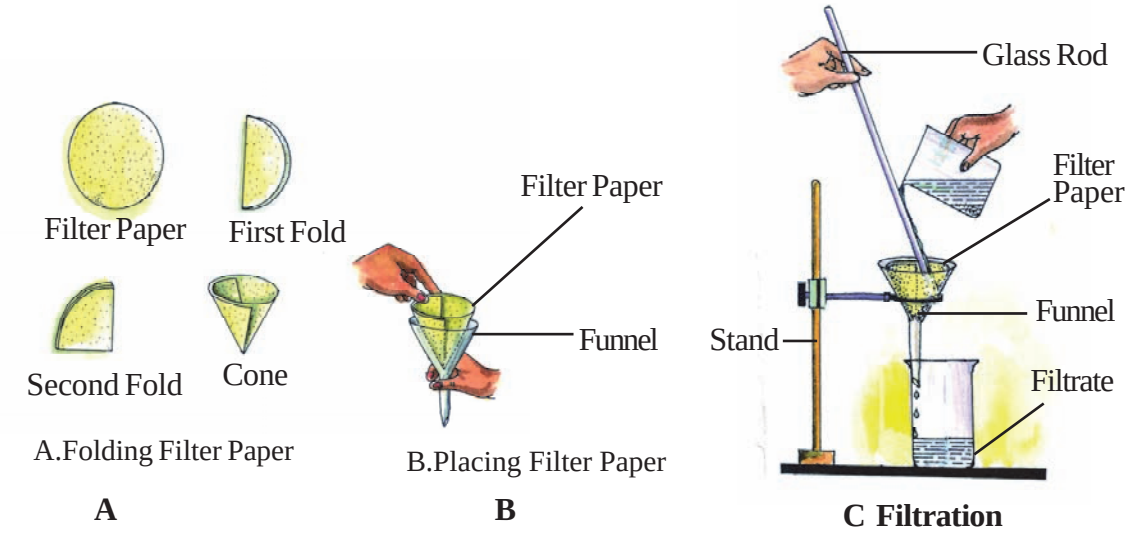


Figure 4.9

Filtration method plays an important role in industry. Generally water filters are used to clean water at home. In these filters, water is passed through a ceramic candle. In this process, solid impurities are stopped on the candle and potable water is collected in the lower part of the filter. (figure 4.10A)

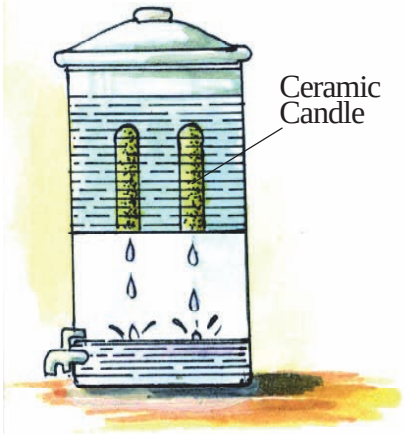


Figure 4.10 A Filter

In big cities, drinking water is distributed by water purification plants. In these plants (Fig 4.10B), impurities are separated from water by using methods of sedimentation, decantation, loading and filtration. Also harmful organisms are removed by treating the water with chlorine. Water obtained in this way is distributed as drinking water at homes.

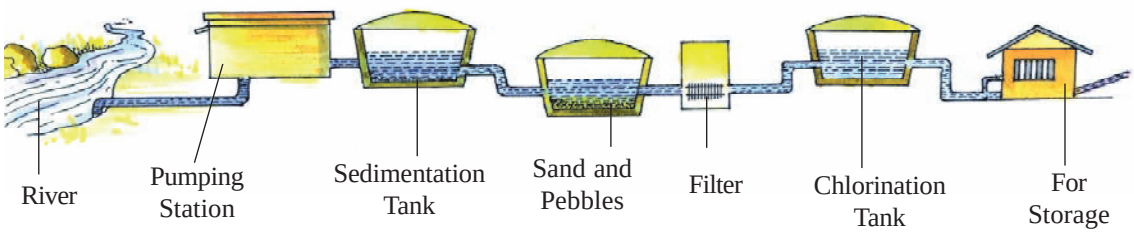


Figure 4.10(B) Method to clean water in big cities

In big cities, water coming out of drains is filtered by using large metal filters. Solid impurities are separated by this method. We should never throw polythene bags and household garbage in the drains.

9. Evaporation

ACTIVITY 6

Materials required- Porcelain bowl, tripod stand, wire gauge, spirit lamp, spoon , salt and water.

Take water in a bowl, add one spoon of salt and mix well. Put the bowl on a wire gauge over a tripod stand. Now heat it using a spirit lamp. While heating, stir the solution with the help of a spoon. Heat till all the water in the bowl disappears in the form of vapour. The substance left in the bowl is salt (fig. 4.11). To separate a miscible solute from solvent by evaporating the solvent is called evaportion.

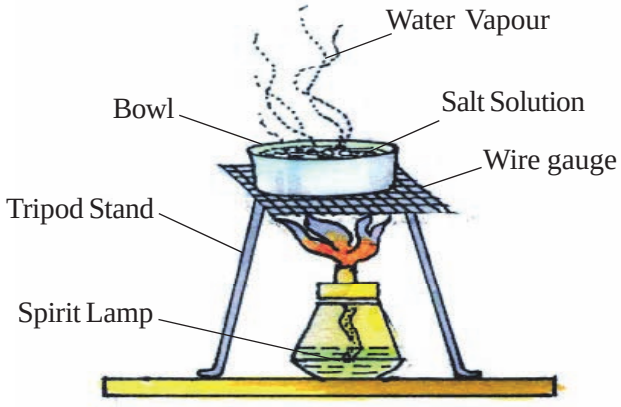


Fig 4.11 Evaporation of water to obtain common salt

Common salt is obtained from seawater in large scale by using this method. At the time of high tide, seawater gets collected in small cubicals. This water is evaporated in the sun and salt remains in the cubical.

10. Crystallization

ACTIVITY 7

Materials required: Beaker, glass rod, tripod stand, wire gauze, spirit lamp, copper sulphate (Blue vitriol), filter paper and water

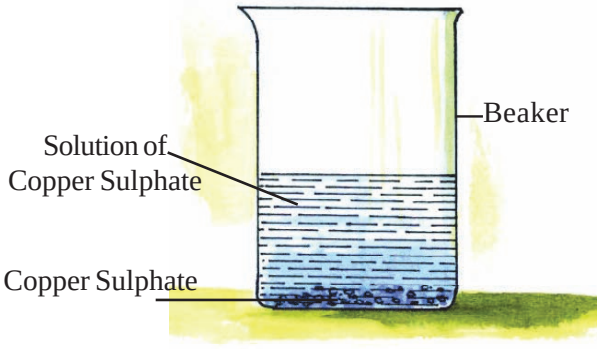


Fig. 4.12 Copper sulphate crystallization

Fill one fourth of the beaker with water. Add copper sulphate slowly and mix with a glass rod. Heat the solution and add more copper sulphate. Keep on dissolving copper sulphate till the solution becomes saturated and no more copper sulphate can be dissolved. Filter this hot solution through a filter paper to remove impurities. Now let it cool slowly. After some time you would see pure copper sulphate crystals at the base of the beaker. This process is known as Crystallization.

11. Distillation

Water is evaporated from rivers, streams, oceans, etc. This water vapour rises up as it is lighter; it gets cooled and changes into small droplets thereby forming clouds. These droplets condense and change into bigger droplets and come back to the earth in the form of rain. This is called water cycle. In this process water is distilled. Let us understand this by an activity

ACTIVITY 8

Materials required: Conical flask, glass tube bent at two right angles, cork, test tube, tripod stand, spirit lamp, beaker, salt solution, ice.

Arrange the apparatus according to fig.4.13 and put the salt solution in the conical flask and heat it. Water vapour, which come out, moves into the glass tube and is collected in a test

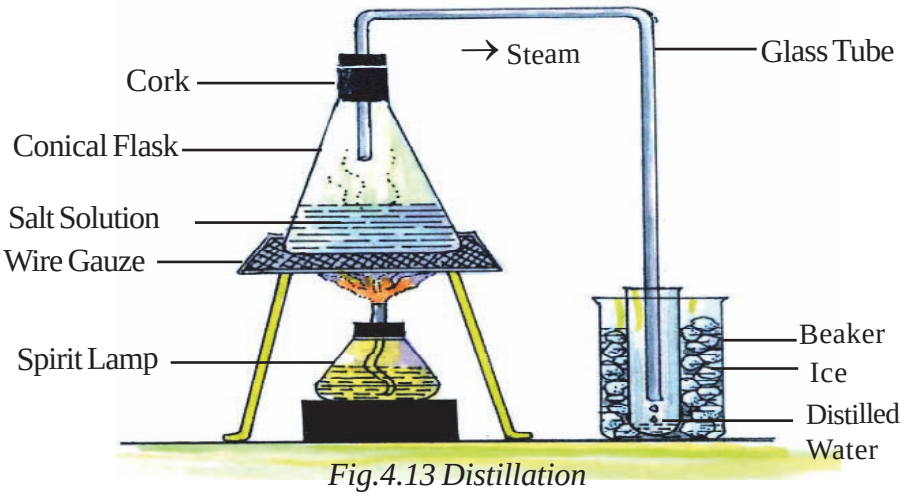


Fig.4.13 Distillation

tube kept in ice. When water vapour comes in contact with the ice-cold walls of test tube, it changes into small droplets of water. Salt is left in the conical flask. Changing of water to water vapour is called evaporation and changing of water vapour back to water is called condensation.

Thus, we can say that distillation is the result of both evaporation and condensation . By using this method we can separate solute and solvent from a solution.

12. Sublimation

ACTIVITY 9

Materials required: Porcelain bowl, spirit lamp, glass funnel, tripod stand, wire gauze, cotton, common salt, and ammonium chloride

Mix common salt and ammonium chloride in the porcelain bowl. Keep an inverted funnel over this mixture. Close the open end of the funnel with cotton and heat. White fumes will rise from the mixture.

Now stop heating. After some time vapours of ammonium chloride will settle on the inner side of the funnel on cooling and common salt will be left in the bowl (fig.4.14).

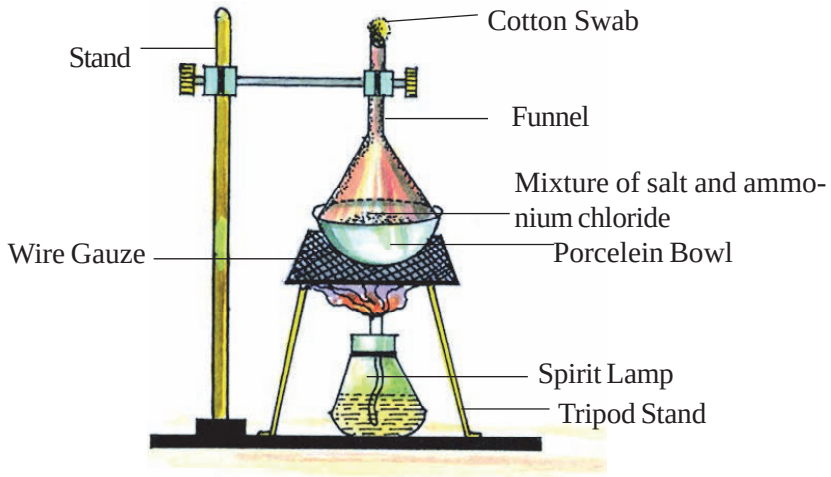


Fig.4.14 Sublimation

Normally substances like ice, wax etc. turn from solid to liquid on heating and then from liquid to gas. But in the above example, you have seen that ammonium chloride on heating turns to the gaseous state without showing the liquid state. On cooling also it again comes to solid state without showing the liquid state. This process is called sublimation. Camphor, iodine, naphthalene balls also show sublimation property

$$\text{Ammonium chloride(solid)} \underset{\text{On Cooling}}{\overset{\text{On heating}}{\rightleftharpoons}} \text{Ammonium chloride (gas)}$$

4.3 Using more than one method for separation

Till now we have separated a mixture of two substances by using any one method of separation. If a solution contains more than two substances, then more than two methods are used to separate these substances. Let us separate iron fillings, sand and salt mixture

ACTIVITY 10

Materials required: Magnet, two beakers, glass rod, paper, funnel, filter paper, iron fillings, sand, salt and water

Spread the mixture of iron fillings, sand and salt on a paper. Bring a magnet close to this mixture repeatedly. Separate the material which gets attracted to the magnet. What is this substance? Now, take rest of the mixture and dissolve it in water in a beaker. After some time filter this solution by using a filter paper on a funnel. Sand will be stopped on a filter paper. Evaporate or distill the rest of the solution to obtain salt.

Thus, we have used magnetic separation, filtration and evaporation to separate substances from a mixture.

WE HAVE LEARNT

- A mixture may have two or more than two substances in any quantity.
- A mixture has characters of its constituents, on the basis of which, they are separated.
- The separation of components of a mixture is done to remove unwanted constituents, and to obtain useful and pure substance.
- Constituents of a mixture can be separated by using one or more than one method of separation.
- To separate constituents from a mixture following methods can be used- Handpicking, sieving, winnowing, threshing, magnetic separation, decantation, loading, centrifugation, filtration, evaporation, crystallization, distillation and sublimation.

EXERCISE

1. Choose the correct answer

1. Which of the following mixtures can be separated by hand picking -

   i. Common salt and sand ii. Saw – dust and iron fillings

   iii. Rice and stone iv. Camphor and sand

2. Which method is used when we wash a pulse to clean it -

   i. Threshing ii. Hand Picking

   iii. Sieving iv. Decantation

3. Which method is used for separating a mixture of Iron and coal dust. -

   ii. Evaporation iii. Threshing

   iv. Magnetic separation v. Decantation

4. Which method is used to separate a mixture of Iodine and common salt?

   i. Threshing ii. Hand Picking

   iii. Sieving iv. Decantation

2. Match the following

a.	Separation of ammonium chloride and sand	Magnetic separation
b.	Mixing alum in muddy water	By separating funnel
c.	Revolving a mixture at high speed	Evaporation
d.	Groundnut oil and water	Loading
e.	Sand and iron fillings	Centrifugation
f.	Common salts dissolved in water.	Sublimation

3. Fill in the blanks

a. …….. method is used to separate iron filling from heap of garabage.

b. Two immiscible liquids can be separated with the help of…….. method.

c. Flour and bran can be separated by……..method.

d. ……. method is used to separate wheat from straw.

e. We can see the sky clearly after the rains because dust particles…… with the rain droplets and come to earth.

4. Answer the following question

a. How will you separate a mixture of naphthalene and sand?

b. Suggest a method to separate, a mixture of coconut oil and water.

c. How will you separate alum from alum solution?

5. In the following mixtures which property can be used for the separation of its component -

a. Salt and chalk powder

b. Rice and straw

c. Iodine and coal

d. Iron fillings and saw dust

e. Sand and rice

6. How do you obtain salt from seawater?

7. What is criterion for the selection of method to separate the components from a mixture?

8. Write four methods used to purify river water to obtain drinking water by the water purification plant.

9. Explain distillation with help of diagram.

THINGS TO DO

1. From things around you, give examples of various mixtures and try to understand how you can separate the components of these mixtures.
2. Try to know from your elders the methods that were used in their time to clean water. Write your information according to the following points,
   a. Diagram of traditional method
   b. Substances mixed in water.
   c. Reason to add the particular substance.
3. Request your principal to arrange a educational tour to a city where water treatment (purification) plant is established. Understand the working of that plant and note down the information in your notebook.