

## Lesson at a Glance

- **Pure Substances:** Substances which contain only one type of constituent particles either of an element or a compound are known as *pure substances*. All the constituents have similar properties. For example, copper, iron, water, common salt and sugar.
- **Impure Substances:** Substances that contain two or more than two types of elements or compounds in no fixed ratio are called *impure substances*. For example, Air—the constituents of air are oxygen, nitrogen, carbon dioxide, dust, water vapour. These constituents are not having any fixed ratio.
- **Mixture:** A *mixture* is a material made by mixing two or more substances which can be easily separated.  
Characteristics of a mixture:
  - The components of a mixture have no fixed ratio by weight.
  - The components of a mixture retain their original characteristics.
  - The components of a mixture can be separated easily.
- **Solute:** Substance that dissolves in another substance, e.g. salt, sugar.
- **Solvent:** Substance in which solute dissolves, e.g. water.
- **Solution:** Mixture of solute and solvent is called *solution*.
- **Saturated Solution:** A *saturated solution* is one in which no more of that substance (solute) can be dissolved at room temperature or at a given temperature in a given volume of the solvent.

### • Purposes of Separation of Substances:

- To remove an undesirable thing, e.g. removing pebbles from wheat and peeling banana skin.
- To obtain a desirable component, e.g. purifying water to make it free from germs by boiling.
- To obtain a useful component, e.g. separation of healthy eggs from a lot.
- To obtain a pure product, e.g. sugar from sugarcane juice.

• **Principle of Separation:** The constituents of a mixture do not lose their original properties such as particle size, density, melting point, boiling point, etc.

• **Methods of Separation:** There are several methods of separation. The choice of the method used depends upon the nature or the properties of the constituent substances present in the mixture. However, various methods used in separating materials are handpicking, winnowing, sieving, magnetic separation, sedimentation, decantation, loading, filtration, evaporation, sublimation, distillation, churning, etc.

**Separation of Solids from Solids:** Solids are separated from solids, according to the size, weight and magnetic properties of their particles. Following are some common methods:

- **Handpicking:** This is the simplest of all methods. Small pebbles are picked up from rice or wheat. Cotton is separated from its seeds by hands. Flowers and fruit are plucked from plants. Hand picking is very slow and has a limited use.
- **Winnowing:** This is used by farmers for separating lighter husk particles (*bhoosa*) from heavier grains of wheat. The farmer takes the mixture in a winnow (*chhaj*) and drops it from a height. He also shakes the winnow (Fig. 5.1). The husk being lighter flies away with the wind and the wheat being heavier falls near his feet.

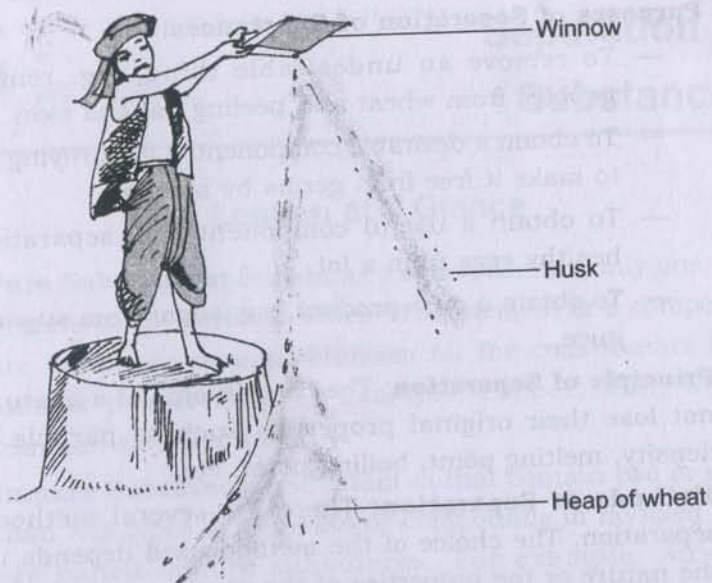


Fig. 5.1 Winnowing

The separation of grains and husk is more conveniently and quickly done by a *farm combine-harvester* (Fig. 5.2). It automatically harvests the crop, threshes it and then separates the husk from the grains.

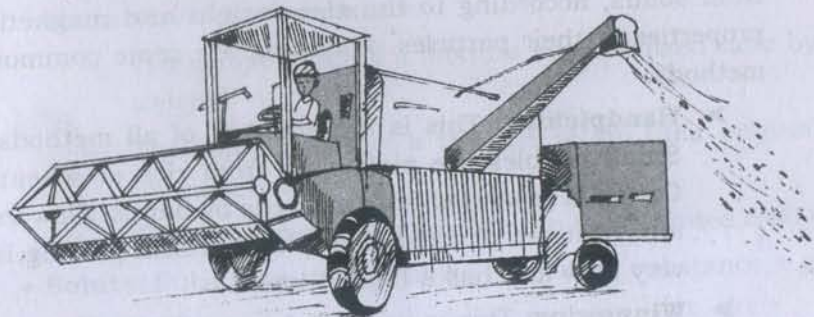


Fig. 5.2 A farm combine-harvester

- **Threshing:** The process used to separate grains from stalks is called *threshing*. In the process of threshing, the stalks are beaten to free grain seeds. This process of threshing can be done with the help of bullock. Machines are generally used to thresh large quantities of grain.

- **Sieving:** A sieve (*chhalni*) has a fine net or gauze fixed on a wooden or metal frame. It is used for separating fine particles from the bigger ones. The mixture is put in the sieve and shaken by hand or by machine. The finer particles pass through the sieve and drop down. The bigger ones remain behind.



Fig. 5.3 Sieving of wheat flour

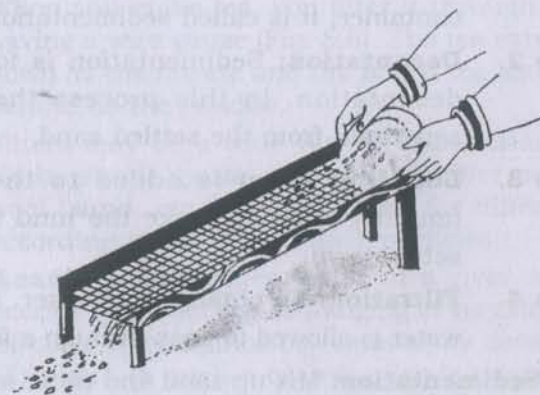


Fig. 5.4 Grating used for grading of cashew nuts, pebbles

- **Magnetic Separation:** In this method a magnet is used for picking up iron pieces, nails, pins, etc., from grains or any other commodity. On a larger scale, a powerful magnet is employed for separating scrap iron from non-magnetic waste materials (Fig. 5.5).

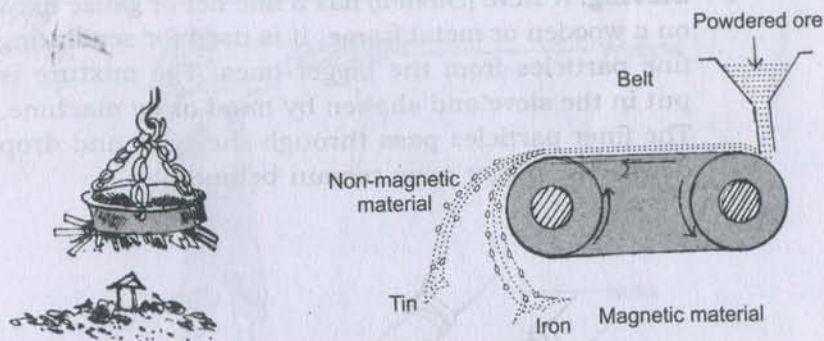


Fig. 5.5 Separation of iron pieces using a magnet

Fig. 5.6 Magnetic separation of tin-iron ore

**Separation of Solids from Liquids:** Solids which do not dissolve in a liquid can be separated by the following methods:

- Step 1. Sedimentation:** When the heavier components of a mixture settle down in the container, it is called sedimentation.
  - Step 2. Decantation:** Sedimentation is followed by decantation. In this process the water is separated from the settled sand.
  - Step 3. Loading:** Alum is added to the unclear (muddy) water to make the mud heavy and settle down.
  - Step 4. Filtration:** To obtain clear water, the loaded water is allowed to pass through a filter paper.
- **Sedimentation:** Mix up sand and water in a beaker. Stir it with your pencil and wait for some time. What do you see? You will see that the sand lies at the bottom and clear water stands on it. This process is called *sedimentation*. The solid below is termed as *sediment* and the clear liquid above it is known as *supernatant layer*.

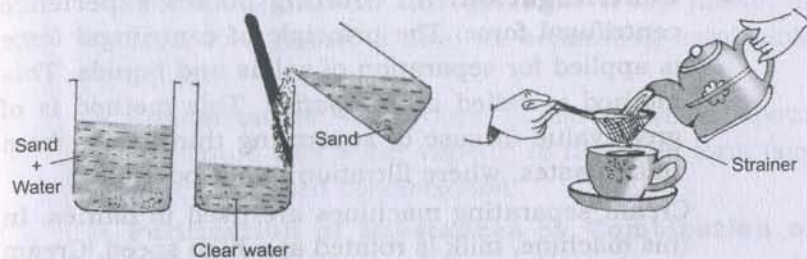


Fig. 5.7 Decantation

Fig. 5.8 Filtration of tea through strainer

Decantation is used for purifying river water containing sand. This is also used for the separation of mud or sludge from sewage (waste water of cities).

- **Filtration:** Decantation is not enough for complete separation of a solid-liquid mixture. This can be done better by *filtration*, in which the mixture is dropped on a porous material known as *filter*. The liquid passes through the filter and comes down as *filtrate*. The insoluble solid left behind is known as *residue*.

When you make tea, you filter it through a strainer having a wire gauze (Fig. 5.8). The tea extract comes down as the filtrate and the boiled tea leaves are left behind as the residue.

Filters may be a wide variety of materials like fine cloth, plastic gauze, cotton wool, filter paper, glass wool, sand, etc. They are used for different solids according to the size of their particles.

- **Loading:** Sometimes water of a river or canal is muddy or turbid due to hanging of very fine particles of clay. They cannot be removed by decantation or filtration. In such a case *loading* is useful.

A piece of alum (*phitkari*) tied with a thread is moved in the turbid water. The alum dissolves in water and the water begins to clarify. The clay particles become bigger and heavier and settle down. Now they can be removed using decantation or filtration.

The alum, in a way, *loads* (make heavy) the clay particles. Hence, the process is called *loading*. Instead of alum, many other soluble salts can also be used for loading.

- **Centrifugation:** All rotating bodies experience centrifugal force. The principle of centrifugal force is applied for separation of solids and liquids. This method is called *centrifugation*. This method is of great value in case of separating thin pastes from thick pastes, where filtration is not possible.

Cream separating machines are used in dairies. In this machine, milk is rotated at a high speed. Cream being lighter, collects towards the centre. The milk being heavier settles down below the cream layer. The two are then taken out from two separate taps.

Based on the same process, our villagers take out butter by churning milk or curd. Drying machine is used in laundries and by dry cleaners. In this machine wet clothes are centrifuged. The water runs out through the sides and clothes are left dry.

- **Evaporation:** The process of conversion of water into vapour form is called *evaporation*.

Evaporation can also take place at the ordinary temperature in the open. Thus, common salt is made from sea water or the water from salt lakes (such as Sambhar lake in Rajasthan), by evaporation in large shallow fields. The sun's heat helps in accelerating the process.

**Separation of Liquids from Liquids:** Add any quantity of water to milk, they mix up very thoroughly and become one. Similarly kerosene and petrol also mix up thoroughly. Such liquids which mix up thoroughly are called *miscible*.

Now, if you add water to kerosene, they do not mix up thoroughly. The droplets of the oil can be seen hanging in water. Such liquids which do not mix up thoroughly are called *immiscible*.

It is very difficult to separate out miscible liquids. Immiscible liquids can easily be separated. One of the immiscible liquids may be heavier than the other. Therefore, when they are present together, they soon separate out in two distinct layers. The upper layer is of the lighter liquid, while the lower layer is of the

heavier liquid. On this principle a *tap funnel* or *separating funnel* is used for separating immiscible liquids.

- **Condensation:** The process of conversion of vapour of a liquid (say water vapour) to its liquid form (say water) is called *condensation*.
- **Purification of Substances by Combination of Different Methods of Separation:** A substance is said to be *pure*, when it is all alone. If other things are mixed with it, the substance is called *impure*. The undesirable materials present are called *impurities*. The process of removing impurities and obtaining a pure substance is called *purification* or *refining*.

Suppose you are given a mixture of sand, iron filings, common salt, solid salt and naphthalene. You can separate its components as follows:

Iron filings—by magnetic separation

Naphthalene—by sublimation

Common salt and sand are dissolved in water. Salt is soluble but sand being insoluble, settles and can be separated by sedimentation, decantation followed by evaporation of salt water.

## ■ TEXTBOOK QUESTIONS SOLVED ■

- Q.1.** Why do we need to separate different components of a mixture? Give two examples.

**Ans.** Among different components of mixture there are many substances which are harmful or not useful for us. To remove these harmful or unuseful components we need to separate them. For example:

- (a) Tea leaves are separated from the liquid with a strainer while preparing tea.
- (b) Stone pieces from wheat, rice or pulses are picked out by hand.

**Q.2.** What is winnowing? Where is it used?

**Ans.** Winnowing is used to separate heavier and lighter components of a mixture by wind or by blowing air. This process is used by farmers to separate lighter husk particles from heavier seeds of grain.



**Fig. 5.9** Winnowing

**Q.3.** How will you separate husk or dirt particles from a given sample of pulses before cooking?

**Ans.** Husk or dirt particles can be separated by winnowing, being lighter they will fly away from pulses.

**Q.4.** What is sieving? Where can it be used?

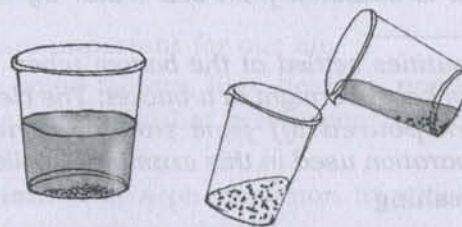
**Ans.** Sieving is a process by which fine particles are separated from bigger particles by using a sieve. It is used in flour mill or at construction sites. In flour mill, impurities like husks and stones are removed from wheat. Pebbles and stones are removed from sand by sieving.



**Fig. 5.10** Sieving

**Q.5.** How will you separate sand and water from their mixture?

**Ans.** We will separate sand and water by sedimentation and decantation method. First we leave this mixture for some time. After some time, the sand which is heavier is settled down at the bottom. After that we will pour water into another container and the mixture will be separated.



**Fig. 5.11** Separating two components of a mixture by sedimentation and decantation.

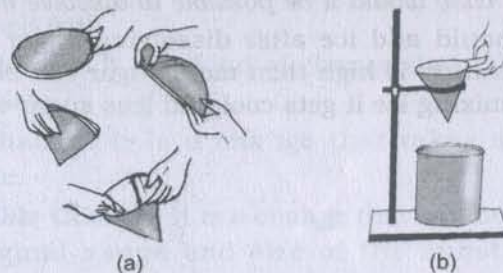
**Q.6.** Is it possible to separate sugar mixed with wheat flour? If yes, how will you do it?

**Ans.** 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.

**Q.7.** How would you obtain clear water from a sample of muddy water?

**Ans.** We will obtain clear water from a sample of muddy water by the process of filtration.

A filter paper is one such filter that has very fine pores in it. Figure 5.12(a, b) shows the steps involved in using a filter paper. A filter paper folded in the form of a cone is fixed in 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.



**Fig. 5.12** (a) Folding a filter paper to make a cone  
(b) Filtration using a filter paper

**Q.8.** Fill in the blanks:

- (a) The method of separating seeds of paddy from its stalks is called \_\_\_\_\_.
- (b) When milk, cooled after boiling, is poured onto a piece of cloth the cream (malai) is left behind on it. This process of separating cream from milk is an example of \_\_\_\_\_.
- (c) Salt is obtained from sea water by the process of \_\_\_\_\_.
- (d) Impurities settled at the bottom when muddy water was kept overnight in a bucket. The clear water was then poured off from the top. The process of separation used in this example is called \_\_\_\_\_.

- Ans.** (a) threshing  
 (b) filtration  
 (c) evaporation  
 (d) sedimentation and decantation

**Q.9.** True or false?

- (a) A mixture of milk and water can be separated by filtration.
- (b) A mixture of powdered salt and sugar can be separated by the process of winnowing.
- (c) Separation of sugar from tea can be done with filtration.
- (d) Grain and husk can be separated with the process of decantation.

- Ans.** (a) False (b) False (c) False (d) False

**Q.10.** Lemonade is prepared by mixing lemon juice and sugar in water. You wish to add ice to cool it. Should you add ice to the lemonade before or after dissolving sugar? In which case would it be possible to dissolve more sugar?

**Ans.** We should add ice after dissolving sugar. When the temperature is high then more sugar can be dissolved. After mixing ice it gets cool and less sugar will dissolve in it.