Separation of Substances

Need for Separating Substances

In our daily life, we encounter a lot of mixtures. A mixture is formed when two substances are mixed in any proportion. For example, when we mix sand and water, or salt and water, we get a mixture.

Now, many times it happens that a mixture contains a useful component and a non-useful component, or two useful components. To obtain these components, we need to separate the mixture. For example, when tea is prepared, tea leaves are separated from the tea using a strainer.

Mixtures are separated for various purposes. Before we use a substance, we need to separate the harmful or non-useful substances that may be mixed with it. Sometimes useful components are also separated if they have to be used independently. For example, milk or curd is churned to separate butter.

The substances that have to be separated may be of different sizes or materials.

A few processes of separation are given below, with the purpose of separation and the usage of the separated components also provided in different columns. **Can you match each process with its purpose and the way the separated components are used?**

Separation process	Purpose of separation	What do we do with the separated components?
(1) Tea from tea leaves (2) Stones from rice (3) Butter from milk	To remove impurities or harmful components To separate two different but useful components To remove used up components	We use both the components. We throw away the impurities. We throw away the solid component.

Handpicking, Sieving, Threshing, Winnowing and Magnetic Separation

Mixtures are substances that are formed by the physical combination of two or more substances in any proportion. Mixtures are formed by combining different solids that have different properties.

Do you know any method that can be used for separating mixtures?

Mixtures can be separated by various methods such as handpicking, winnowing, threshing, and sieving. Here, we will discuss these methods in detail.

Handpicking

The mixtures that comprise solids of different colours, shapes, or sizes can be separated by hand. This process is known as handpicking.

You may have observed your mother separating impurities such as small stones and husk from wheat, pulses, and grains by handpicking.

1. **What is the boy in the figure doing?**

2. **What is the name of the method that the boy is using to do the same?**

Winnowing

The process of separating lighter components of a mixture from the heavier ones by using wind or moving air is known as winnowing.

Threshing

The process of separating grains from stalks by beating them with sticks is called threshing.

After a harvest, wheat or paddy stalks are dried in the sun. Each stalk contains many grains. Hence, farmers make bundles of the stalks and then beat them with sticks to separate the grains.

Sieving

The process of separating smaller particles from bigger ones by passing them through a sieve is called sieving. **Sieving can only be used for separating the mixtures containing components of different sizes.**

Figure B: Sieving

A mixture of sand, pebbles, and stones can be separated by the process of sieving. Fine sand particles pass through the holes of the sieve, while bigger impurities such as stones and gravel remain on the sieve, as shown in figure B.

However, a mixture of chalk powder and flour cannot be separated by the process of sieving as the sizes of the two components of the mixture are almost the same.

Magnetic Separation

This process is used when one of the components of a mixture is iron. Iron shows magnetic properties because of which it gets attracted to a magnet. Any mixture containing iron and some other component can easily be separated by magnetic separation.

Which method can be used for separating the following mixtures?

1. A mixture of stones and rice

2. A mixture of dry sand and small pieces of paper

Separating Mixtures by Sedimentation, Decantation, Filtration, Evaporation, and Condensation

Mixtures are obtained when two or more substances combine in any proportion. Mixtures can be of many types and most mixtures can be separated easily by physical methods. Methods such as handpicking, winnowing, threshing, etc. are used to separate components of mixtures formed by solid substances having different properties.

Do you know which methods can be used to separate the components of a mixture that has an insoluble solid component present in a liquid component?

Mixtures of mud in water and chalk in water are examples of such a mixture. It is not possible to separate such mixtures by handpicking, winnowing, threshing, or sieving.

Such mixtures are separated by using methods such as sedimentation, decantation, and filtration. The definitions of these three methods are given in the following table.

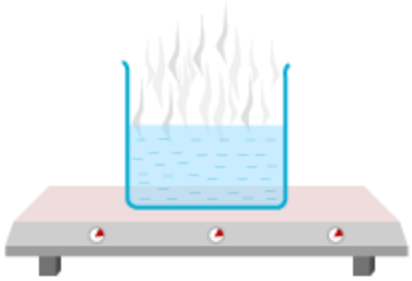
SEDIMENTATION	DECANTATION	FILTRATION
It is the process of settling down of the heavier components present in a mixture.	It is the process of transferring a liquid from one container to another without disturbing the sediments that are present at its bottom.	It is the process of separating the un-dissolved components from a mixture. It is done by passing the mixture through a material containing fine holes that will allow only one component of the mixture to pass through.
Filtration is a better method than decantation to separate mixtures as some of the solid particles also pass along with the liquid during the process of decantation, while filtration allows one to obtain a cleaner liquid. However, decantation is used in cases where recovering the solid substance from the filter paper is difficult.		

Evaporation: It is the process by which a substance present in liquid state changes into its gaseous state by forming vapours. Evaporation can take place at any temperature.

When this process is used for separating a mixture containing a soluble solid component and a liquid component, the liquid component of the mixture turns into vapours leaving behind the solid component.

The process of separation by evaporation can be easily understood by performing the following task.

Take a beaker containing 50 mL water. Add two spoons of salt to the water and keep stirring until all the salt dissolves. After this, heat the beaker using a hot plate. Continue the process until all the water present in the beaker evaporates.



What do you think is left in the beaker after the water gets evaporated?

Do you know?	Common salt is obtained from seawater by the process of evaporation. Common salt is present in seawater in dissolved form. Seawater is collected in shallow pits. The water from these pits evaporates slowly due to the heat of the sun, leaving behind the solid salt. The common salt obtained in this manner is then purified and packed.

Condensation: It is the process of conversion of a substance from its gaseous state to its liquid state. This is done by cooling the vapours of the substance.

The formation of dew, fog, and clouds is the result of the condensation of water vapours into water.

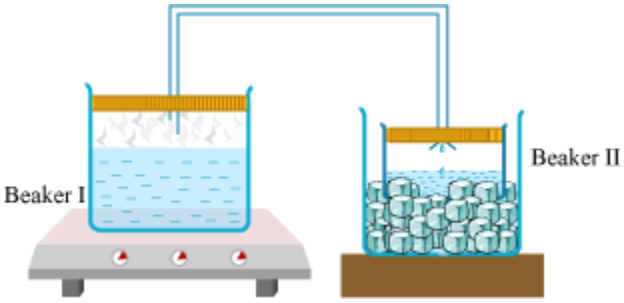
Condensation can be used for separating the liquid component of a mixture from its soluble solid component. The following experiment can be used to understand the methods of condensation and evaporation.

Step 1: Take two beakers and label them as **I** and **II**.

Step 2: Take some water in beaker **I**. Add a spoon of sugar to it and stir it well so that all the sugar dissolves.

Step 3: Put beaker **II** in another beaker containing ice. After this, seal both the beakers and connect them with the help of a glass tube, as shown in the figure.

Step 4: Start heating beaker **I** slowly. Continue heating until all the water evaporates



1. What will you call the processes taking place in beaker **I** and beaker **II**?

2. What will you obtain in beakers **I** and **II** when the experiment is over?

   Thus, we can conclude that evaporation and condensation can be used to separate the components of mixtures in which solids are dissolved in liquids.

Saturated and Unsaturated Solutions

You must have observed that there are many substances, such as salt and sugar, which dissolve in water readily and there are substances, such as plastic and glass, which do not. The substances that dissolve in water are known as water-soluble substances.

Can a substance that is soluble in water be dissolved in water in any quantity?

Or,

Can water dissolve any amount of a substance that is soluble in it?

Or,

What will happen if we keep adding more and more of a soluble substance to water?

If a substance that is soluble in water is added to water, then a solution will be obtained. Depending on how much solute is added to water, two types of solutions are obtained.

1. **Saturated solution**
2. **Unsaturated solution**

Saturated solution:

When a solution can dissolve no more of a substance than it already contains and the added substance settles at the bottom of the container, the solution is called a saturated solution.

Unsaturated solution:

A solution in which more of the same substance can be dissolved than it already contains is called an unsaturated solution.

Let us perform an activity to understand more about these solutions.

Can the solubility of a substance in water be increased?

Yes, the solubility of a substance increases as the temperature of the solution is increased. The given fact can be understood by performing the following task.

Take 50 mL of water in a beaker and add salt to it to prepare a saturated solution. Now, add some more salt to it so that it settles at the bottom of the beaker. After this, heat the solution slowly and stir it constantly.

What happens to the un-dissolved salt present at the bottom of the container?

Are the solubilities of different substances same or different?

The solubilities of different substances are different, i.e., water dissolves different substances in different amounts.

Take two containers, **I** and **II**, and take 50 mL of water in each. Prepare a saturated solution of sugar in container **I** and a saturated solution of salt in container **II**. Record the amounts of salt and sugar that were added to prepare the respective saturated solutions.

Were equal amounts of salt and sugar used to prepare the respective saturated solutions?