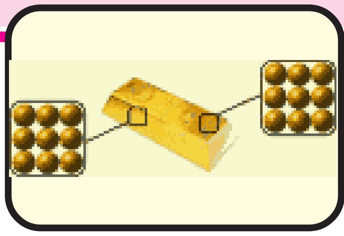
Chapter 4

IS MATTER PURE?



You might have gone to the market many times with your parents to purchase rice, salt, milk, ghee and other provisions. You must have tried to ensure that you got the purest possible milk and pure ghee etc. In our day to day language, 'pure' means something with no adulteration. But in chemistry pure means something different.

Let us find out what is pure in chemistry?

Activity-1

Is full cream pure?

Take some milk in a vessel. Spin it with a milk churner for some time. See figure 1

Fig-1 Churning of milk

After some time, you observe separation of a paste like solid out of the milk. This paste like solid called cream contains more than one component in it. It is therefore a mixture. We have already studied about mixtures in previous classes, let us learn more about them.

As per the principle of churning, the lighter components stay at the top when a mixture of liquids are spun rapidly. Commercially for separating the cream from milk, a machine called centrifuge is used. It follows the same principle. Centrifugation is also used in a diagnostic laboratory, to test blood and urine samples. The sample is taken in a test tube and the test tube is placed in a centrifugation machine. The heavier particles settle to the bottom and the lighter particles stay at the top of the test tube.

Think and discuss

How does a washing machine squeezes out water from wet clothes?

What is a mixture?

Many things that we call pure are actually mixtures of different substances. Juice is mixture of water, sugar and fruit pulp. Even water contains some salts and minerals. All the matter around us can be classified into two groups – pure substances and mixtures.

When a scientist says that something is pure, he means that the substance is homogeneous i.e.,the composition doesn't change, no matter which part of the substance you take for examination.

For example, whichever part of a pure gold biscuit is taken as a sample, the composition is found to be same throughout. (See figure.2)

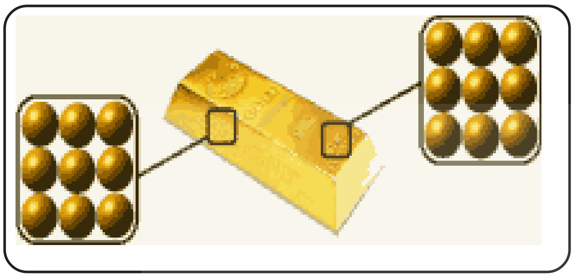


Fig-2 Pure gold biscuit

But, mixtures are not always homogeneous. The composition in some mixtures change, depending on the part you have taken as a sample.

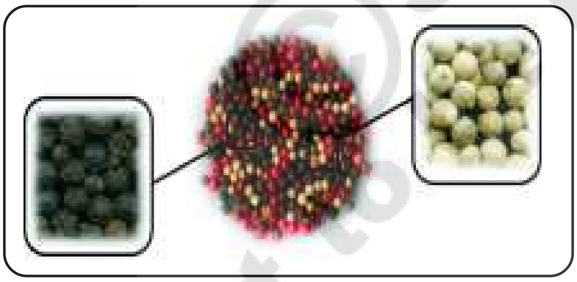


Fig-3 Mixture

A mixture is generally made of two or more components that are not chemically combined. The substances in a mixture retain their own properties, and they can be physically separated.

What would you notice from the figure 4?

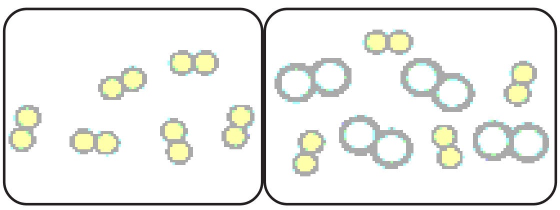


Fig-4 (a) Pure substance 4(b) Mixture

Types of mixtures

You have learnt what a mixture is. Do you know the types of mixtures? What are they? Let's find out.

Mixtures can be in solid, in liquid or in gaseous states or the combination of these three states.

Activity-2

Finding out homogeneous and heterogeneous mixtures

Take two test tubes. Fill one test tube with water and other with kerosene. Now add one tea spoon of salt in both the test tubes and stir them.

What do you notice ?

In the first test tube you can observe that the salt dissolves completely. Such types of mixtures are called **homogeneous mixtures**. In other test tube salt is not dissolved. What do you conclude from this? Think!

In a homogeneous mixture the components mixture are uniformly distributed throughout it. The components of a homogeneous mixture are too intimately combined that it will be difficult to distinguish them from one another by visual observation. For example air is a homogeneous mixture of many gases.

We all prepare a drink 'lemonade' and enjoy its taste. It is a mixture of water, sugar, lemon juice and salt. Is it homogeneous or not? If you taste a spoonful of lemonade, it tastes the same throughout. The particles of sugar lemon juice and salt are evenly distributed in this solution and we cannot see the components separately. We call such mixtures as homogeneous mixtures.

- Can you give few more examples of this kind?

You have observed in the above activity that the salt added to kerosene does not dissolve in it. It is a **heterogeneous mixture**. A heterogeneous mixture is a mixture made up of different substances, or the same substance in different states which are not uniformly distributed in it.

For example the mixtures "oil and water", "naphthalene and water" are heterogeneous mixtures.

Thus we can conclude that mixtures are of two types homogeneous and heterogeneous. Do you know that these can again be classified into different kinds? Let us find out.

Solutions

All of us enjoy drinking soda water and lemonade. We know that they are examples of homogeneous mixtures. The homogeneous mixture of two or more substances from which we can not seperate its components by the process of filteration is called a **solution**. Solutions can be in the form of solids, liquids, or gases. A solution has two components, a solvent and a solute.The component of the solution that dissolve the other component in it (usually the component present in larger quantity) is called **solvent.** The component of solution that is dissolved in the solvent (usually the component present in lesser quantity) is called **solute**.

A solution of sugar is prepared by dissolving the sugar in water. In this solution sugar (solid) is the solute and water (liquid) is the solvent. In the solution of iodine in alcohol (tincture of iodine) iodine (solid) is the solute and alcohol (liquid) is the solvent. All the aerated drinks are liquid solutions containing carbon dioxide (gas) as solute and water as solvent.

Can you give some more examples for solutions and tell what the solute and solvent present in those solutions?

Think and discuss

- "All the solutions are mixtures, but not all mixtures are solutions". Discuss about the validity of the statement and give reasons to support your argument.
- Usually we think of a solution as a liquid that contains either a solid, liquid or a gas dissolved in it. But, we can have solid solutions. Can you give some examples?

Properties of a solution

In a solution the particles are so small in size that we cannot see them with our naked eyes. They do not scatter a beam of light passing through the solution and hence the path of light is not visible in a solution.

- Can you prove this with an expariment?
- If the solution is diluted, can the path of light be visible?

One more interesting property of solution is that, the solute particles do not settle down when left undisturbed. Can you give a reason? If the solute particles are settling down in a solution can we call it as a homogeneous mixture?

- What would happen if you add a little more solute to a solvent?
- How do you determine the percentage of the solute present in a solution?

Concentration of a solution

Can we dissolve as much solute as we want in a given solution? How can you deside how much solute is allowed to dissolve in a solvent.

The amount of solute present in a saturated solution at a certain temperature is called its **solubility** at that temperature.

For example, take one gram of sugar and add 50ml of water to it. Also take 30gm of sugar and add the same amount of water to it in another beaker. Which of the solutions can be called as dilute and which one as concentrated?

Activity-3

Preparation of saturated and unsaturated solutions

Take 50 ml of water in an empty cup. Add one spoon of sugar to the water in the cup and stir it till it get dissolved. Keep on adding sugar to the cup and stir till no more sugar can be dissolved in it. How many spoons of sugar is added ?

Fig.5 Adding Sugar to water

When no more solute can be dissolved in the solution at a certain temperature, it is said to be a **saturated solution.** A saturated solution cannot hold any more solute at a certain temperature. If the amount of solute present in a solution is less than the saturation level, it is called an **unsaturated solution**.

Can you tell what saturation level is?

Now take the solution prepared by you into a beaker and heat it slowly. (do not boil) Add some more sugar to this solution. You notice that the solution allows to dissolve more sugar in it easily when it is heated.

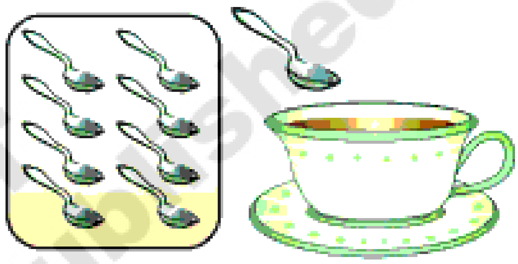


Fig.6 Adding more sugar to water

Find out whether this is true for the salt solution also?

Activity-4

Factors affecting the rate of dissolving

Take three glass beakers and fill each of them with 100 ml of water. Add two spoons of salt to each beaker. Place the first beaker undisturbed, stir the solution in the second beaker and warm the third beaker.

What will you observe from the above three activities? Which method allows the solute to dissolve in the solvent easily? If you increase the temperature of the third beaker, what will happen? Repeat the activity by using salt crystals instead of salt powder. What change can you observe?

What are the factors that affect the solubility of a solute?

From this activity we can conclude that the temperature of the water, size of the salt particles, and stiring of the solutions are some of the factors that affect the rate of solubility of solute in a solvent.

You know that solubility is the measurement of amount of solute that dissolves in a solvent. If the amount of solute present is little, the solution is said to be **dilute**, and if the amount of solute present is more, the solution is said to be **concentrated.**

The concentration of a solution can be defined as the amount (mass) of solute present in a given amount (mass) of solution or the amount (mass) of solute dissolved in a given volume of the solution.

There are many ways of expressing the concentration of a solution, but here we learn only about two of those.

(i) Mass by mass percentage of a

$$\text{solution} = \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

(ii) Mass by volume percentage of a

$$\text{solution} = \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$$

Example

A solution contains 50g of common salt in 200g of water. Calculate the concentration in terms of mass by mass percentage of the solution?

Solution

Mass of solute (salt) = 50g

Mass of solvent (water) = 200g

Mass of solution = Mass of solute + Mass of solvent

= 50g + 200g = 250g

Mass percentage of a solution =

$$\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$$

$$= \frac{50}{250} \times 100 = 20\%$$

Suspensions and Colloidal Solutions

Activity-5

Finding of heterogeneous mixtures- suspensions and colloids

Take some chalk powder in a test tube. Take a few drops of milk in another test tube. Add water to these samples and stir with a glass rod. Observe whether the particles in the mixtures are visible. Can you call these mixtures as solutions? (Hint: Are your samples heterogeneous or homogeneous?)

Now do the following steps and write your observations in the table 1.

- Direct a beam of light from a torch or a laser beam on the test tubes. Is the path of the light beam visible in the liquid?
- Leave the mixture undisturbed for some time. What changes do you observe? Does the solute settle down after some time?

- Filter the mixtures. Did you find any residue on the filter papers?

Record your observations in the table-1

Table-1

Mixture	Is the path of the light beam visible?	Did solute settle down?	Residue is seen on the filter paper (Yes/No)
Chalk mixture			
Milk mixture			

We find that the particles of chalk don't dissolve but remained suspended throughout the volume of the water. So the mixture we got is a heterogeneous mixture because the solute particles didn't dissolve and the particles are visible to naked eye. Such heterogeneous mixtures are called ***suspensions.*** Suspensions are the heterogeneous mixtures of a solid and a liquid, in which the solids do not dissolve, like mixtures of soil and water.

Let us consider the mixtures of oil in water and kerosene in water. These are special kinds of suspensions, called **emulstions**. These mixtures consist of two liquids that do not mix and the settle into layers when they left undisturbed.

Give some more examples of emulations which you see in your daily life.

Think and discuss

Have you ever observed carefully the syrup that you take for cough? Why do you shake them before consuming?

- It is a suspension (or) emulstion?

In activity-5, particles of milk in the second test tube are uniformly spread throughout the mixture. Due to smaller size of milk particles it appears to be homogeneous but it is a heterogeneous mixture. These particles easily scatter a beam of visible light. Such mixtures are called a ***colloids or colloidal solutions***. These mixtures possess the characteristics in between a solution and a suspension. They are also called as colloidal dispersions. Colloidal dispersions may appear homogeneous but are actually heterogeneous.

A large number of substances such as milk, butter, cheese, creams, gels, boot polish, and clouds in the sky etc. are some more examples of colloids.

Colloidal solutions are heterogeneous in nature and always consist of at least two phases; **the disperse phase and the dispersion medium.** Disperse phase is the substance that present in small proportion and consists of particles of colloidal size (1 to 100mm). Dispersion medium is the medium in which the colloidal particles are dispersed. These two phases can be in the form of solid, liquid or a gas. Thus, different types of colloidal solutions are possible depending upon the physical state of the two phases.

Here are some common examples of colloids from our daily life. (See table 2) Don't try to memorize this table-2, it has given only for your information.

Table-2: Examples of dispersing medium and disersed phase

Dispersing Medium	Dispersed Phase	Colloid type	Examples
Gas	Liquid	aerosol	Fog, clouds, mist
Gas	solid	Aerosol	Smoke, automobile exhaust
Liquid	Gas	Foam	Shaving cream
Liquid	Liquid	Emulsion	Milk, face cream
Liquid	solid	Sol	Mud, milk of magnesia
Solid	Gas	Foam	Foam, rubber, sponge, pumice stone
Solid	liquid	Gel	Jelly, cheese, butter
Solid	solid	Solid sol	Coloured gem stone, milky glass

We studied that the particles in a colloidal solution can easily scatter a beam of visible light. This scattering of a beam of light is called the **Tyndall effect** named after the scientist who discovered it. You may observe this effect in your day-today life when a fine beam of light enters a room through a small hole or slit. You can try to see Tyndall effect at your home.

Select a room where the sunlight falls directly through a window. Close the windows in such a way that a slit is left open between the windows. (Don't close completely). What do you see?

You can also observe this phenomenon while walking on a road having a lot of trees on both sides. When the sunlight passes through branches and leaves you see the path of dust particles.

Try to observe the Tyndall effect in the kitchen, the smoke from the stove is exposed to sun light.

- Did you ever observe this phenomenon in the cinema halls?
- Have you ever get an opportunity of going through deep forests? If you go through deep forest you can experience this effect.

Fig.7 Tyndall effect in the forest

When sunlight passes through the canopy of a dense forest; mist contains tiny droplets of water, which act as particles of colloid dispersed in air.

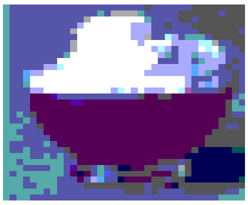
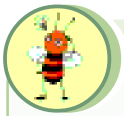


Fig. 8

Is ice-cream a colloid ?

Ice cream is made by churning a mixture of milk, sugar and flavours. This mixture is slowly chilled to form ice cream. The churning process disperses air bubbles into the mixture by foaming and breakup the large ice crystals in to tiny particles. The result is a complex substance which contains solids (milk fats and milk proteins), liquids (water) and gases (air bubbles). Now can you guess whether ice cream a colloid or not?



Think and discuss

Is there any difference between a true solution and colloidal solution? If you find the differences, what are those differences?

Can you explain now in a comparative way about suspensions and colloids? Let us see.

Table 3 Properties of suspension and colloids

Suspensions	Colloids
Suspensions are heterogeneous mixtures.	Colloid is a heterogeneous mixture.
The particles of suspensions can be seen with naked eyes.	The size of particles of a colloid is too small to be individually seen by naked eyes..
The particles of a suspension scatter a beam of light passing through it and make its path visible	Colloids are big enough to scatter a beam of of light passing through it which makes its path visible.
The solute particles settle down when a kept undisturbed. When the particles settle down the suspension breaks and it does not scatter light any more.	They don't settle down when the suspension is left undisturbed. i.e., colloid is quite stable.
Suspension is unstable. The components can be separated from the mixture by the process of the filtration or decantation.	The components cannot be separated from the mixture by process of filtration. Centrifugation technique is used in separation.

Separating the components of a mixture

Till now we have discussed the types of mixtures. Do you know techniques to separate these mixtures in to their respective constituents?

Usually heterogeneous mixtures can be separated into their respective constituents by simple physical methods like handpicking, sieving, filtration etc., as we use in our day to day life.

Sometimes special techniques have to be used for the separation of the components of mixture. We have learnt in class VI how to separate mixtures in various ways like, flotation, filtration, crystallization, chromatography etc. Let us see more.

Sublimation

Activity-6

Separation of mixtures by sublimation

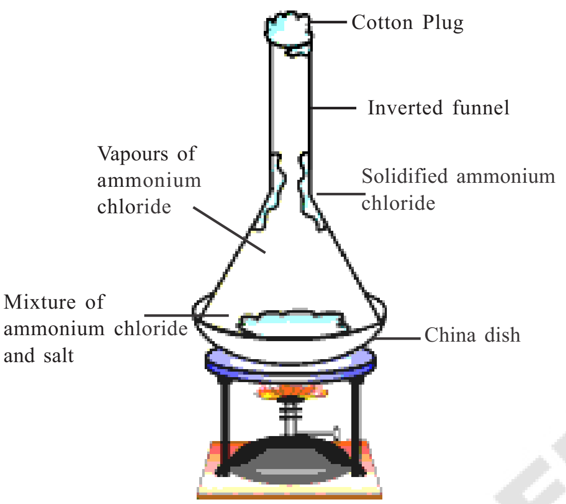


Fig- 9 Separating ammonium chloride and salt

Take one tablespoon of common salt one tablespoon of ammonium chloride and mix them.

- Is the mixture heterogeneous? Give reasons.
- How do we separate the salt and ammonium chloride?

Take the mixture in a china dish. Take a glass funnel which is big enough to cover the dish. Plug the mouth of the funnel with cotton and invert it over the dish as shown in figure 9. Keep the dish on the stand of stove and heat for some time and observe the walls of the funnel. Initially you find vapours of ammonium chloride and then solidified ammonium chloride on the walls of the funnel.

Try it for mixtures that have camphor or naphthalene.

Think and discuss

Why do we use different separation techniques for mixtures like grain and husk as well as ammonium chloride and salt though both of them are heterogeneous mixtures?

- What is the basis for choosing a separation technique to seperate mixtures?

Evaporation

Activity-7

Process of evaporation of water

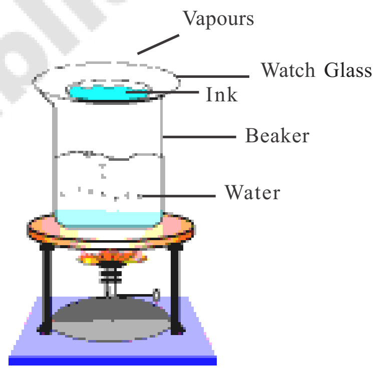


Fig-10 Evaporation of water

Take a beaker and fill it to half its volume with water. Keep a watch glass on the mouth of the beaker as shown in figure-10. Put few drops of ink on the watch glass. Heat the beaker and observe the watch glass. Continue heating till you do not observe any further change on the watch glass.

What is evaporated from the watch glass? Is there any residue on the watch glass?

We know that ink is a mixture of a dye in water. We can separate the components in the ink using evaporation.

Think and discuss

Is it possible to find out adulteration of Kerosene in petrol with this technique?

In activity-7 we saw that ink is a mixture of solute and solvent. Is the dye in ink a single colour? How many solutes are there in ink? How can we find out those? Is there any technique to separate the different components of dye in the ink? That is where chromatography would help?

Chromatography is a laboratory technique for the separation of mixtures into its individual components. We can use chromatography to separate components of dyes in ink. The process can also be used to separate the coloured pigments in plants and flowers or used to determine the chemical composition of many substances.

Paper Chromatography

Lab Activity

Aim: Separating the components of ink using paper chromatography.

Material required: Beaker, rectangular shaped filter papers, black marker (non-permanent), water, pencil and cello tape.

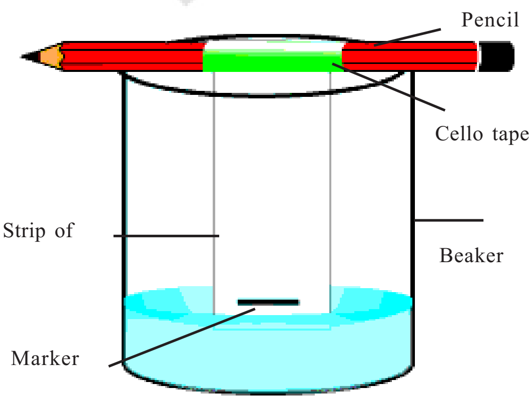


Fig.11 Separating the components of ink

Procedure : Draw a thick line just above the bottom of the filter paper using the marker. Pour a small amount of water in the beaker and hang the paper strip with help of a pencil and tape in such a way that it should just touch the surface of water as shown in figure 11.

Make sure that the ink line or mark does not touch the water.

Allow the water to move up the paper for 5 minutes and then remove the strip from water. Let it dry.

What colours did you observe in the black ink sample?

Take two more paper strips and markers as samples and do the experiment. Do the colours occur in the same order and in the same location on all the samples?

Instead of non permanent marker use a permanent marker. What will you observe?

Now touch the marker line to water. What will you notice?

Instead of thick line, draw a thin line on the paper strip with non- permanent marker? Do your results change in each case?

- Is chromatography used only to seperate components of coloured liquids?

Separation of immiscible and miscible liquids

A liquid is said to be miscible if it dissolve completely in another liquid. For example alcohol is miscible in water. Can you give some more examples for miscible liquids.

An immiscible liquid is one which doesn't dissolve but forms a layer over another liquid and can be separated easily like oil is immiscible in water. Can you name any such liquids from your daily observation?

Do you know how to separate immiscible liquids?

Activity-8

Separation of immiscible liquids

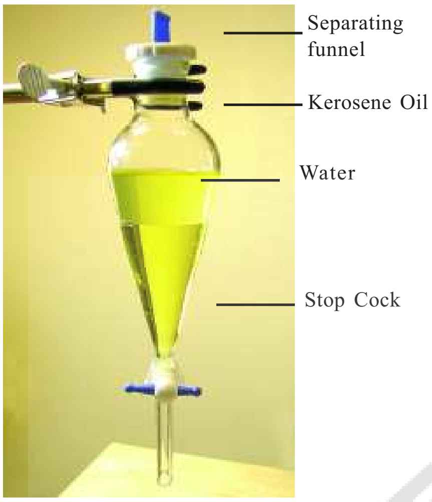


Fig.12 Separating funnel

You must have seen a mixture of oil and water. How many layers can be observed? How can you separate the two components?

Take a separating funnel and pour the mixture of kerosene oil / caster oil and water in it. Let it stand undisturbed for some time. So that separate layers of oil and water are formed. Open the stopcock of the separating funnel and pour out the lower layer of water carefully. Close the stopcock of the separating funnel as the oil reaches the stop-cock.

The underlying principle is that the immiscible liquids separate out in to layers depending on their densities. Did you observe in your village how caster oil is prepare by boiling castor seeds? If not ask your parents and teachers.

Diesel is immiscible in water. The bright rainbow patterns seen often during rainy season when the diesel drops falls on the road, are the result of thin film of diesel on water.

Fig.13 Drops of diesel on wet road

Separation of a mixture of two miscible liquids

Sometimes a homogeneous solution is formed by the mixing of liquids. Some liquids have the property of mixing in all proportions, forming a homogeneous solution. This is known as miscibility. Water and ethanol, for example, are miscible because they mix in all proportions. How can we separate such mixtures?

Distillation

Activity-9

Separation of two miscible liquids bv distilation

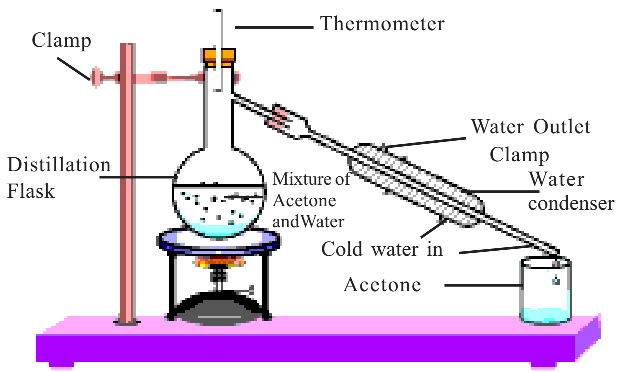


Fig-14 Separating the mixture of Acetone and water by distillation

Acetone and water are also miscible. Take a mixture of acetone and water in a distillation flask. Fit it with a thermometer and arrange to stand. Attach the condenser of the flask on one side and other side keep a beaker to collect. Heat the mixture slowly keeping a close watch on the thermometer. The acetone vaporizes and condenses in the condenser. Acetone can be collected from the condenser outlet. Water remains in the distillation flask.

The separation technique used above is called ***distillation***. Distillation is used in the separation of components of a mixture containing two miscible liquids. But there should be a large difference in the boiling points of the two liquids.

What if the boiling points of the two liquids are close to each other?

To separate two or more miscible liquids when the difference in their boiling points is less than 25°C, fractional distillation process is used. If the difference in boiling points is greater than 25°C, a simple distillation is used.

Do you know what process of fractional distillation is?

The apparatus is similar to that for simple distillation except that a fractionating column is fitted in between the distillation flask and the condenser. A simple fractionation column is a tube packed with glass beads. The beads provide maximum possible surface area for the vapours to cool and condense repeatedly as shown in Fig.15

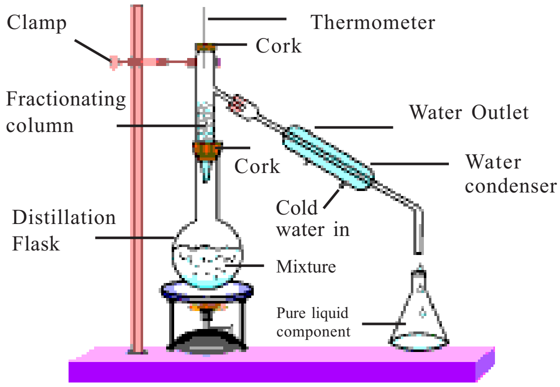


Fig-15 Fractional distillation

- Can you give any examples where we use this technique?
- How can we obtain different gases from air ?

We have learnt that air is a homogeneous mixture. Can it be separated into its components?

Let's see the flow chart which gives the steps of the process.

Air

↓

Compress and cool by increasing pressure and decreasing temperature

↓

Liquid air

Allow to warm up slowly in fractional distillation column

Gases get separated at different heights

↓

Points	Oxygen	Argon	Nitrogen
Boiling points (°C)	-183	-186	-196
% air by volume	20.9	0.9	78.1

Fig. 16 Flow diagram shows the process of obtaining gases from air

If we want oxygen gas from air (figure-17), we have to separate out all the other gases present in the air. The air is compressed by increasing the pressure and is then cooled by decreasing the temperature to get liquid air. This liquid air is allowed to warm up slowly in a fractional distillation column where gases separated at different temperatures depending upon their boiling points.

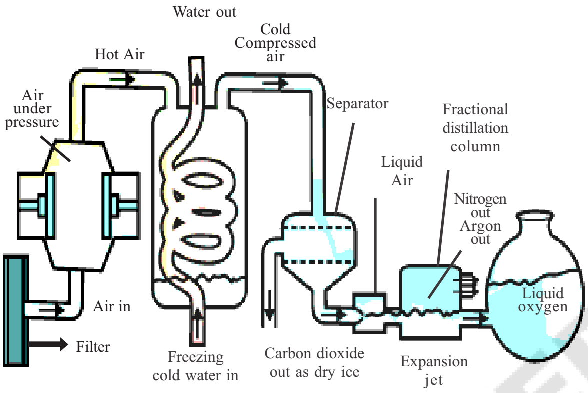
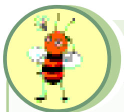


Fig.17 Separation of componants of air



Think and discuss

- Arrange the gases present in air in increasing order of their boilling points. What do you observe?
- Which gas forms the liquid first as the air is cooled?

Types of pure substances

So far we have studied about mixtures viz – substances whose components can be separated by physical methods. What about substances that cannot be separated further by any of the methods of separation? We call these as pure substances. Let us explore further about them.

Activity-10

Can we separate mixture of Copper sulphate and Aluminum

Take a concentrated solution of copper sulphate in to beaker and drop a piece of aluminum foil in it. After some time you will observe a layer of copper deposited on the aluminum foil. The solution becomes colorless. Why did this happen? **(recall activities of the chapter on Metals and Non-metals)**

We know that a chemical reaction takes place among the copper ions present in the solution with aluminum and copper metal is separated. Does it mean that copper sulphate is a mixture? No it is not.

Here copper cannot be separated from sulpher and oxygen by any physical process. It can be separated only by a chemical reaction. Substances such as copper sulphate are called **compounds**.

Table-4 : Mixtures and compounds

Mixtures	Compounds
1. Elements or compounds just mix together to form a mixture and no new compound is formed.	1. Elements react to form new compounds.
2. A mixture has a variable composition.	2. The composition of each new substance is always fixed.
3. A mixture shows the properties of the constituent substances.	3. The new substance has totally different properties.
4. The constituents can be separated fairly easily by physical methods.	4. The constituents can be separated only by chemical or electrochemical reactions.

We can define compounds as pure substances that can be separated into two or more components only by means of a chemical reaction.

We now have two types of pure substances - compounds and elements.

Elements can be divided into metals, non-metals and metalloids. We have already studied properties of metals and non-metals. Write down the names of some elements that you know.

Elements have been used since the early days of civilisation viz – metals such as iron, lead, copper, helped in the development of civilizations. For thousands of years, alchemists – up to and including Isaac Newton – attempted to unearth new elements, and study their properties. Hennig Brand, a German alchemist, boiled down urine to discover phosphorus in 1669. But it was not until the late 1700s that our knowledge of the elements really took off, as chemists developed new ways to purify and isolate elements.

Sir Humphry Davy, was extremely successful in discovering many elements - sodium, magnesium, boron, chlorine and many more. Robert Boyle used the term element and Lavoisier was the first to establish a useful definition of element. He defined an element as a basic form of matter that cannot be broken down in to simpler substances by chemical reactions.

If any substance can be separated into two or more constituent parts by a chemical reaction, that substance is definitely a compound.

What do we get when two or more elements are combined? We can understand through an activity.

Activity-11

Understanding the nature of elements, compounds and mixtures

Divide the class into two groups. Give 5g of iron fillings and 3g of sulphur powder in a china dish to both the groups.

Activity for group-1:

Mix and crush iron fillings and sulphur powder. Check for magnetism in the material obtained. Bring a magnet near the material and check if the material is attracted towards the magnet.

Activity for group-2:

Mix and crush iron fillings and sulphur powder. Heat this mixture strongly till it becomes red hot. Remove it from flame and let the mixture cool. Check for magnetism in the material obtained. Compare the texture and colour of the material obtained by the two groups.

The next part can be done if you have a lab set up in the school.

Each group should divide the material obtained into two parts. Add carbon disulphide to one part. Stir well and filter.

Add dilute sulphuric acid or dilute hydrochloric acid to the other part.

Do the same reactions separately with sulphur and iron. Observe the changes.

Now answer the following

- Did the material obtained by the two groups look the same?
- Which group has obtained a material with magnetic property?
- Can we separate the components of the material obtained?
- On adding dilute sulphuric acid or dilute hydrochloric acid did both the groups obtain a gas?
- Did the gas in both the cases smell the same or different?

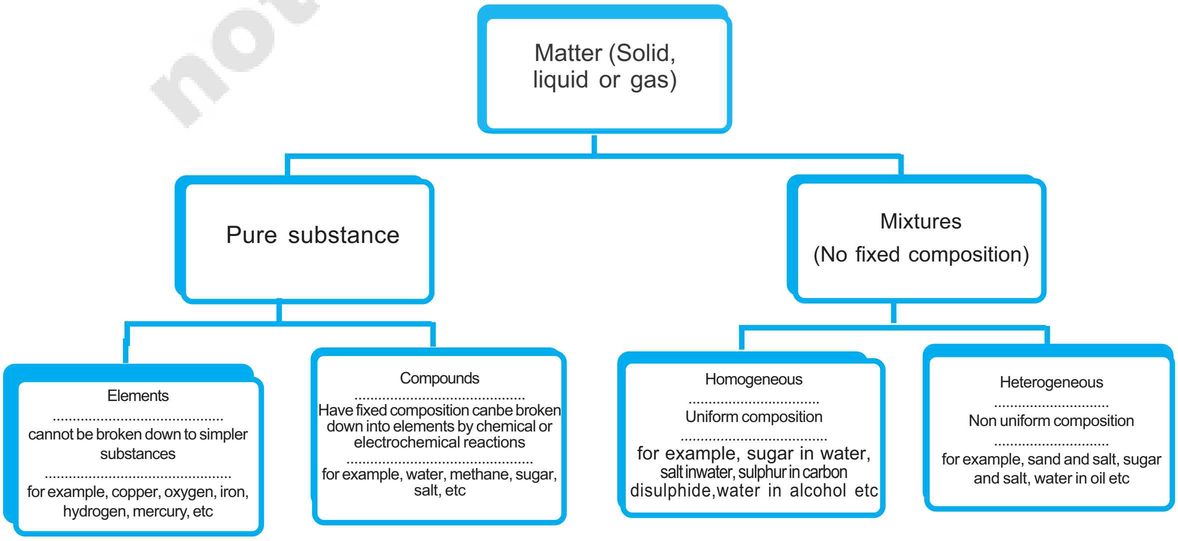
The gas obtained by group 1 due to reaction of material with dilute HCl (or) H_2SO_4 solution is hydrogen. It is colourless, odorless and combustible.

The gas obtained by group 2 due to reaction of material with dilute HCl (or) H_2SO_4 solution is hydrogen sulphide. It is a colourless gas with the smell of rotten eggs. You must have observed that the product of the both groups shows different properties though the starting material was same.

Group 1 has carried out the activity involving a physical change. Where as group examined a chemical change. The material obtained by group 1 is a mixture of two substances. i.e. iron and sulphur, which are elements.

The properties of mixture are the same as that of its constituents'. The material obtained by the group 2 is a compound. On heating the two elements strongly we get compound, which has totally different properties, compared to the properties of the combining elements. The composition of a compound is the same throughout. We can also observe that the texture and colour of the compound are the same throughout its volume.

The chemical and Physical nature of the matter is better understood by the following flow chart.



Key words

Pure substances, Mixture, Heterogeneous mixture, Homogeneous mixture, Solution, Suspension, emulsions, colloidal dispersions, solvent, solute, concentration of solution, Tyndall effect, Evaporation, Centrifuge, Immiscible liquids, Miscible liquids, Cromatography, distillation, Fractional distillation, Elements Compounds.

What we have learnt

- A mixture contains more than one substance (element and/or compound) mixed in any proportion.
- Mixtures can be separated into pure substances using appropriate separation techniques.
- A solution is a homogeneous mixture of two or more substances. The major component of a solution is called the solvent, and the minor, the solute.
- The concentration of a solution is the amount of solute present per unit volume or per unit mass of the solution.
- Materials that are insoluble in a solvent and have particles that are visible to naked eyes, form a suspension. A suspension is a heterogeneous mixture.
- Colloids are heterogeneous mixtures in which the particle size is too small to be seen with the naked eye, but is big enough to scatter light. Colloids are useful in industry and daily life. The colloid has the dispersed phase and the medium in which they are distributed is called the dispersion medium.
- Pure substances can be elements or compounds. An element is a form of matter that cannot be broken down by chemical reactions into simpler substances. A compound is a substance composed of two or more different types of elements, chemically combined in a fixed proportion.
- Properties of a compound are different from its constituent elements, whereas a mixture shows the properties of its constituting elements or compounds.

Improve your learning

1. Which separation techniques will you apply for the separation of the following? (AS_1)

   (a) Sodium chloride from its solution in water.

   (b) Ammonium chloride from a mixture containing sodium chloride and ammonium chloride.

   (c) Small pieces of metal in the engine oil of a car.

   (d) Different pigments from an extract of flower petals.

   (e) Butter from curd.

   (f) Oil from water.

   (g) Tea leaves from tea.

   (h) Iron pins from sand.

   (i) Wheat grains from husk.

   (j) Fine mud particles suspended in water.

2. Write the steps you would use for making tea. Use the words given below and write the steps for making tea? (AS_7)

   Solution, solvent, solute, dissolve, soluble, insoluble, filtrate and residue.

3. Explain the following giving examples.(AS_1)

   (a) Saturated solution (b)Pure substance (c) colloid (d) Suspension

4. Classify each of the following as a homogeneous or heterogeneous mixture. Give reasons.(AS_1)

   Soda water, wood, air, soil, vinegar, filtered tea.

5. How would you confirm that a colourless liquid given to you is pure water? (AS_1)

6. Which of the following materials fall in the category of a "pure substance"? Give reasons (AS_1)

   (a) Ice (b) Milk (c) Iron (d) Hydrochloric acid (e) Calcium oxide
   (f) Mercury (g) Brick (h) Wood (i) Air.

7. Identify the solutions among the following mixtures. (AS_1)

(a) Soil (b) Sea water (c) Air (d) Coal (e) Soda water.

8. Which of the following will show "Tyndall effect"? How can you demonstrate Tyndall effect in them? (AS_1 AS_3)

(a) Salt solution (b) Milk (c) Copper sulphate solution (d) Starch solution.

9. Classify the following into elements, compounds and mixtures. (AS_1)

(a) Sodium (b) Soil (c) Sugar solution (d) Silver
(e) Calcium carbonate (f) Tin (g) Silicon (h) Coal
(i) Air (j) Soap (k) Methane (l) Carbon dioxide
(m) Blood

10. Classify the following substances in the below given table. (AS_1)

Ink, soda water, brass, fog, blood, aerosol sprays, fruit salad, black coffee, oil and water, boot polish, air, nail polish, starch solution, milk.

Solution	Suspension	Emulsion	Colloidal dispersion

11. Take a solution, a suspension, a colloidal dispersion in different beakers. Test whether each of these mixtures shows the Tyndall effect by focusing a light at the side of the container.(AS_3)

12. Draw the figures of arrangement of apparatus for distillation and fractional distillation. What do you find the major difference in these apparatus? (AS_5)

13. Determine the mass by mass percentage concentration of a 100g salt solution which contains 20g salt? (AS_1)

Ans: (20%)

14. Calculate the concentration interms of mass by volume percentage of the solution containing. 2.5g potassium chloride in 50ml of potassium chloride (KCl)solution? (AS_1) Ans: (5%)