Chapter – 5: Separation of Substances

- Observe some sugar and soil
    - All particles of sugar – same size, shape, colours – **pure** substance
    - Particles of sand – different shape, size, colours – clay, grass, even dead animals – **impure** substance (mixture)
- Mixture – made of 2 or more pure substance – components (constituents)
- Mixture – show properties of all the components
- Air – mixture of oxygen, nitrogen, carbon dioxide, water vapour – oxygen supports burning – air also supports burning
- Daily life – most things – mixture
- Sea-water – mixture of water, common salt, other salts dissolved in it
- Cup of tea – mixture of water, tea leaves extract, sugar, milk
- Mixture can be solid (sand), liquid (milk), gas (air)
- Some cases – different substance – observed easily
    - Pulses purchased from market – contain stone mixed with pulses – stones spotted easily
- Most cases – different substance – cannot be observed easily
    - Sea-water – salts dissolved in water – cannot spot easily

Reasons for Separating Mixtures into their Components

- To remove undesired component
    - Make tea – boil tea leaves in water – add sugar and milk – remove tea leaves – unwanted substance
- To remove a harmful component
    - Buy wheat, rice, pulses from market – may contain small stones – removed from grains – harmful for us
- To obtain pure substance
    - Tap water – dissolved salts – need to remove salts – make it pure – use in medicines
- To obtain useful component
    - Petroleum oil – mixture – cannot be used as fuel – separate it – obtain kerosene, petrol diesel

Methods of Separation or Mixtures

- Many materials – mixture – may not be useful in its current form
- Sometimes we may require – separate substances – need separation
- Different components – different properties – used to separate them
    - **Threshing –**
        - Crops like wheat, rice – harvested close to ground – dried up under sun
        - Get bundles of stalk (stem) – grains attached to them
        - Grains covered in thin layer – chaff – separated from stalks by threshing
        - Stalks – beaten up – stalks and chaff – soft – breaks down to ‘hay’ – grains – hard – remains as it is
    - **Winnowing –**
        - After threshing – mixture of grains and husk (hay)

        - Separated by winnowing – using wind
        - Mixture – dropped from height – with a background wind
        - Grains – heavier – drops down at the place where it is dropped from – husk – lighter – blown away
    - **Hand-picking –**
        - One component – small quantity – taken out by hand
        - Food grains – wheat, rice – contain small stones – picked by hand
        - Generally done at homes
    - **Sieving –**
        - Sieve – shallow vessel – small holes at bottom
        - Separate solid substances – components – different sizes
        - Bigger particles – cannot pass through small holes – smaller particles pass through it
            - Wheat flour – separated by sieving – larger coarse particles – remain on the sieve – smaller finer particles – pass through them
            - Flour mill – impurities removed before grinding
            - Cement mixing – need fine sand – obtained by sieving
            - Some cashew nuts – smaller – some – bigger – separated by sieving
    - **Magnetic separation –**
        - Some substance – attracted by magnet – separated using a magnet
        - Scrap yard – large magnet – separates scrap iron from other scrap (plastic, sand, other materials)
    - **Decantation –**
        - Some mixture – components insoluble in water
        - Mixture of sand and water – separated using decantation
        - Take a beaker – fill it with water – pour some sand – suspended in water (sediments) – let it settle (sedimentation)
        - Take a glass rod – place it in empty beaker – pour water from 1st beaker using glass road – 1 water droplet pulls another – sand remain inside 1st beaker
        - Daily life – pulses and rice – washed with water – water separated using decantation
        - Only used when solids – insoluble in water
        - Also used when liquids are immiscible – do not mix
            - Water and oil – immiscible – separated using decantation
        - Cannot be used when liquids are miscible – mix with each other
            - Water and alcohol – miscible – cannot be separated using this method
    - **Loading –**
        - Muddy water – contain suspended clay particles – takes a long time to settle
        - Speed of settling down – increased by loading
        - Alum particles – deposit on clay particles – make them heavy – settle down easily
        - Take a beaker – fill it with muddy water – suspend a piece of alum – some alum dissolves in water – deposits on clay particles – make them heavy – settle down faster – clear water – decanted into another beaker

    - **Filter paper** – circular piece – millions of tiny holes in it – can be seen with microscope only – liquids (water, oil, salt solution) pass through it – other particles – larger – cannot pass through

- **Folding of filter paper** – need to be folded properly – make a hollow cone
  - Filter paper – folded in half
  - Folded in half again
  - Opened to form a cone
  - Cone placed inside funnel

- **Filtration –**
  - Separate insoluble substances – by filtration
  - Mixture of insoluble solid in water – separated using this method
  - Mixture of chalk and water – poured onto funnel with filter paper – water passes through it – chalk powder remains inside filter paper
  - Daily life – many filters – wire mash (sieve), piece of cotton, muslin cloth, strainer (*chhalni*), layer of sand
  - Tea leaves – filtered using tea-strainer
  - Fresh fruit juice – filtered using strainer
  - Cream separated from milk – using piece of cloth
  - Drinking water – filtered using special filters – made of porcelain
  - Water treatment plants – filtered using sand filters
  - Drain water – filtered using metal filters
  - Mixture of 2 liquids cannot be separated using this method
  - Solid dissolved in liquids cannot be separated using this method
- **Evaporation –**
  - Liquid to vapours (gas) – evaporation
  - Dissolved solids – separated by evaporation
  - Liquids – vaporize easily – solids – do not vaporize easily
  - Solids – remained as residue – water evaporates
  - Solution of salt and water – heated – water evaporates – solid salt remained as residue
  - Used on large scale – obtain common salt from sea
    - Sea water collected in shallow lakes – left to evaporate – water evaporates – mixture of salts obtained – common salt obtained by further purification
  - Sugar separated from sugar solution
  - Copper sulphate separated from its solution
  - Potash alum, potash nitrate separated from its solution
  - Water – evaporates into atmosphere – cannot be recovered
- **Distillation –**
  - Water cannot be recovered by evaporation
  - To obtain both – use distillation
  - Water to gas – evaporation
  - Gas to water – condensation
  - Water – forms vapour – salt – do not form vapour – property used for separation of salt and water
  - Take a kettle – fill it with water – boil it – steam comes out of kettle – place a pan filled with ice over steam – steam cools down to water – collected in another water

- Some substances – separated using more than one method
  - Mixture of sand and salt
    - Sand – insoluble – salt – soluble

- Pour mixture on water – salt – dissolves in it – sand – suspended – settle down
- Obtain salt solution by decantation
- Obtain salt and water by evaporation and distillation

Saturated Solutions

- Water – dissolves many substance – dissolves limited amount
- Keep on dissolving same substance in water – after a limit no more of it dissolves in water – remains suspended
- Saturated solution – no more substance can be dissolved
- 36 grams of salt – dissolved in 100 grams of water – maximum limit – 20^0 C

Solubility

- Maximum limit of substance – dissolved in 100 grams of water – solubility of that substance at given temperature
- 36 gram salt – dissolved in 100 gram water – solubility of salt in water at 20^0 C
- Copper sulphate – 21 gram
- Potassium nitrate – 32 gram
- Sugar – 204 gram

Effect of temperature on solubility

- Saturated solution – heated to higher temperatures – solubility increases – more substance can be dissolved
- Saturated solution – cooled down to lower temperatures – solubility decreases – some of the dissolved substance separate out as crystals