Practical Work

Detection of Some Common Gases

Test for hydrogen (H_2):
Hydrogen gas is liberated when active metals such as Na, K, Mg react with dilute acids.

$$M + H_2SO_4 \longrightarrow MSO_4 + H_2$$
$$M + HCl \longrightarrow MCl + H_2$$
$$[M = Ca,\ Mg,\ Zn,\ etc.]$$

Few characteristics of this gas are as follows.

i. It is a colourless and odourless gas.

ii. When this gas is allowed to pass through a moist red or blue litmus paper, the colour of the paper does not change. This shows that hydrogen gas is neutral to litmus.

iii. A burning wooden splint, when brought near this gas, gets off and burns with a pale blue flame producing a pop sound.

$2\ H_2 + O_2 \rightarrow 2\ H_2O$

Test for oxygen (O_2):

Oxygen gas is liberated on heating metal nitrates, potassium chlorate, potassium dichromate, potassium permanganate, hydrogen peroxide, barium peroxide and oxides such as HgO, PbO_2, Pb_3O_4.

$$2\ PbO_2 \xrightarrow{\Delta} 2\ PbO + O_2$$
$$2\ HgO \xrightarrow{\Delta} 2\ Hg + O_2$$

Few characteristics of this gas are as follows.

i. It is a colourless and odourless gas.

ii. When this gas is allowed to pass through a moist red or blue litmus paper, the colour of the paper does not change. This shows that oxygen gas is neutral to litmus.

iii. A burning wooden splint when brought near this gas re-lights brightly which shows that it is a supporter of combustion.

Test for water vapour (H_2O):

Water vapour is liberated on heating salts containing water of crystallisation, metallic hydroxides and metallic hydrogen carbonates.

$$Na_2CO_3.10H_2O \xrightarrow{\Delta} Na_2CO_3 + 10\,H_2O$$

$$CuSO_4.5H_2O \xrightarrow{\Delta} CuSO_4 + 5\,H_2O$$

Few characteristics of this gas are as follows.

i. It is a colourless and odourless gas.

ii. When this gas is allowed to pass through a moist red or blue litmus paper, the colour of the paper does not change. This shows that water vapour is neutral to litmus.

iii. It turns anhydrous copper sulphate to blue.

$$CuSO_4 + 5\,H_2O \longrightarrow CuSO_4.5H_2O$$

iv. It turns blue copper chloride to pink.

$$CoCl_2 + 2\,H_2O \longrightarrow CoCl_2.2H_2O$$

Test for ammonia (NH_3):

Ammonia is liberated by heating ammonium salts with alkalies and treating metallic nitrides with warm water.

$2\,NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2\,H_2O + 2\,NH_3$

Few characteristics of this gas are as follows.

i. It is a colourless gas with a strong biting odour that brings tears to eyes.

ii. When this gas is allowed to pass through a moist red litmus paper, the colour of the paper changes to blue. This shows that ammonia is basic in nature.

iii. Dense white fumes are formed when a rod dipped in HCl is brought near this gas.

$NH_3 + HCl \rightarrow NH_4Cl$

iv. It turns Nessler's reagent (K_2HgI_4) brown.

v. It forms a pale blue precipitate when passed through copper sulphate solution. This precipitate is soluble in excess of the gas and the solution turns dark blue in colour.

Test for carbon dioxide (CO_2):

Carbon dioxide is liberated by strong heating of metallic carbonates and hydrogen carbonates. It is also liberated when dilute mineral acids are treated with carbonates and hydrogen carbonates of metals.

$$ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$$
$$CaCO_3 + 2\ HCl \longrightarrow CaCl_2 + H_2O + CO_2$$
$$NaHCO_3 + HCl \longrightarrow NaCl + H_2O + CO_2$$

Few characteristics of this gas are as follows.

i. It is a colourless and odourless gas.

ii. It turns lime water milky.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

ii. When this gas is allowed to pass through a moist blue litmus paper, the colour of the paper changes to light red. This shows that carbon dioxide is acidic in nature.

iii. A burning wooden splint when brought near this gas goes off which shows that it is not a supporter of combustion.

iv. It has no effect on filter paper dipped in acidified potassium dichromate ($K_2Cr_2O_7$) or potassium permanganate ($KMnO_4$) solution.

Test for sulphur dioxide (SO_2):

Sulphur dioxide is liberated by strong heating of metallic sulphites and hydrogen sulphites. It is also liberated when dilute mineral acids are treated with sulphites and hydrogen sulphites of metals.

$$CaSO_3 \xrightarrow{\Delta} CaO + SO_2$$
$$Na_2SO_3 + 2\ HCl \longrightarrow 2\ NaCl + H_2O + SO_2$$
$$2\ NaHSO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2\,H_2O + 2\ SO_2$$

Few characteristics of this gas are as follows.

i. It is a colourless gas having suffocating odour.

ii. It turns lime water milky.

$Ca(OH)_2 + SO_2 \rightarrow CaSO_3 + H_2O$

iii. When this gas is allowed to pass through a moist blue litmus paper, the colour of the paper changes to red. This shows that sulphur dioxide is acidic in nature.

iv. It turns potassium permanganate solution colourless.

$$2\ KMnO_4\ +\ 2\,H_2O\ +\ 5\ SO_2\ \longrightarrow\ K_2\,SO_4\ +\ 2\ MnSO_4\ +\ 2\,H_2\,SO_4$$

v. It changes the colour of acidified potassium dichromate from orange to green.

$$K_2\,Cr_2\,O_7\ +\ H_2\,SO_4\ +\ 3\ SO_2\ \longrightarrow\ Cr_2\,(SO_4)_3\ +\ K_2\,SO_4\ +\ H_2O$$

Test for hydrogen sulphide (H_2S):

Hydrogen sulphide is liberated by the action of dil. HCl or dil. H_2SO_4 on metallic sulphides.

$FeS + H_2SO_4 \rightarrow FeSO_4 + H_2S$

Few characteristics of this gas are as follows.

i. It is a colourless gas having rotten egg like smell.

ii. It turns lead acetate solution silvery black.

$$(CH_3\,COO)_2\,Pb\ +\ H_2S\ \longrightarrow\ PbS\ +\ 2\ CH_3\,COOH$$

iii. It turns moist blue litmus paper red. This shows that it is acidic in nature.

iv. It turns lead nitrate solution black in colour.

$$Pb\,(NO_3)_2\ +\ H_2S\ \longrightarrow\ PbS\ +\ 2\ HNO_3$$

Test for nitrogen dioxide (NO_2):

Nitrogen dioxide is liberated by heating metal nitrates.

$$2\ Cu(NO_3)_2 \xrightarrow{\Delta} 2\ CuO\ +\ 4\ NO_2\ +\ O_2$$

Few characteristics of this gas are as follows.

i. It is a reddish-brown in colour.

ii. It has pungent and irritating odour.

iii. It turns moist blue litmus paper red. This shows that it is acidic in nature.

iv. It turns moist potassium iodide paper brown.

$2\ KI + 2\ NO_2 \rightarrow 2\ KNO_2 + I_2$

v. It turns acidified ferrous sulphate solution from green to brown.

Test for chlorine (Cl_2):

Chlorine is liberated by the action of conc. HCl on oxidising agents like Pb_3O_4, PbO_2, MnO_2, etc.

$MnO_2 + 4\ HCl \rightarrow MnCl_2 + 2\ H_2O + Cl_2$

Few characteristics of this gas are as follows:

i. It is a greenish-yellow in colour.

ii. It has sharp pungent choking odour.

iii. It turns moist blue litmus paper red followed by bleaching it. This shows that it is acidic in nature.

iv. It turns moist starch iodide paper blue black.

$$Cl_2\ +\ 2\ KI \longrightarrow 2\ KCl\ +\ I_2$$
$$I_2\ +\ Starch \longrightarrow Blue-Black\ \ colour$$

v. It forms a white precipitate when passed through silver nitrate solution.

$$3\ Cl_2\ +\ 5\ AgNO_3\ +\ 3\,H_2O \longrightarrow 5\ AgCl\ +\ HClO_3\ +\ 5\ HNO_3$$

Test for hydrogen chloride (HCl):

Hydrogen chloride is liberated by the action of conc. H_2SO_4 on metal chloride like NaCl, KCl, etc.

$NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$

Few characteristics of this gas are as follows:

i. It is colourless.

ii. It has pungent choking odour.

iii. It turns moist blue litmus paper red.

iv. It produced dense white fumes when a rod dipped in ammonia solution is brought near the gas.

$NH_3 + HCl \rightarrow NH_4Cl$

v. It forms a white precipitate when passed through silver nitrate solution. This precipitate is soluble in excess of ammonium hydroxide solution.

$HCl + AgNO_3 \rightarrow AgCl + HNO_3$

Identification of Compounds by Dry Heating

1. Copper (II) carbonate

[$CuCO_3$]

- On strong heating:
- the light green amorphous powder of copper carbonate changes to black colour.
- It gives off a gas which is colourless and odourless that extinguishes burning wooden splint.
- The gas is acidic in nature and turns lime water milky. This shows that the gas is carbon dioxide.
- The black residue is copper (II) oxide.

Equation: $CuCO_3(s) \xrightarrow{Heat} CuO(s) + CO_2(g)$

2. Zinc Carbonate

[$ZnCO_3$]

- On strong heating:
- The light white coloured amorphous solid of zinc carbonate changes to pale yellow colour.
- It gives off a gas which is colourless and odourless, also extinguishes the burning wooden splint.
- The gas is acidic in nature and turns lime water milky. This shows that the gas is carbon dioxide.
- The pale yellow residue is zinc oxide which on cooling changes to white colour.

Equation: $ZnCO_3(s) \xrightarrow{Heat} ZnO(s) + CO_2(g)$

3. Sodium carbonate decahydrate

[$Na_2CO_3.10H_2O$]

- This salt is also known as Washing Soda.
- On strong heating, the white crystalline solid swells and then melts.
- It gives off steamy vapour which condenses on the cooler part of the test tube and forms tiny droplets of colourless liquid.
- On testing with anhydrous copper sulphate, these liquid droplets get absorbed and turn copper sulphate in blue colour.
- This colourless liquid turns blue coloured cobalt chloride paper pink. This shows that the liquid is water. The presence of water proves that the salt is a hydrated salt.
- On cooling, the white amorphous residue is left behind which is anhydrous sodium carbonate.

Equation:

$$Na_2CO_3.10H_2O \xrightarrow{Heat} Na_2CO_3(s) + 10H_2O(g)$$

(Steam)

4. Copper (II) sulphate pentahydrate

[$CuSO_4.5H_2O$]

- It is also known as Blue vitriol.
- On strong heating, the blue coloured crystalline solid crumbles to form a white amorphous powder.
- The steamy vapour condenses on the cooler parts of the test tube and forms tiny droplets of a colourless liquid.
- This liquid turns blue coloured cobalt chloride paper pink. This proves that the liquid is water. Hence, the salt is hydrated salt.

Equation:

$$CuSO_4.5H_2O \xrightarrow{Heat} CuSO_4(s) + 5H_2O(g)$$

(Steam)

5. Calcium sulphite

[$CaSO_3$]

- On addition of dilute hydrochloric acid, a gas is liberated out which turns potassium dichromate paper orange to green due to the reduction of dichromate (VI) to chromium (III).

$$CaSO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + SO_2(g) + H_2O(l)$$

- A white ppt. of barium sulphite is observed on addition of barium chloride or barium nitrate solution. This ppt. gets dissolved in the excess of hydrochloric acid and gives a colourless solution.

Equation:

$$CaSO_3 + BaCl_2 \rightarrow CaCl_2 + BaSO_3$$
$$BaSO_3(s) + 2HCl(aq) \rightarrow BaCl_2(aq) + H_2O(l) + SO_2(aq)$$

6. Lead (II) nitrate

[$Pb(NO_3)_2$]

- On strong heating, the white crystalline solid crumbles with cracking noise.

- A reddish brown gas liberates which turns moist blue litmus paper red and starch potassium iodide paper blue. This shows that the gas is nitrogen dioxide.

- The glowing wooden splint gets relighted when it is kept near the reddish brown gas. It shows that nitrogen dioxide gas is mixed with oxygen.

- On cooling, the reddish brown residue changes to yellow colour and some part of it fuses in the glass test tube and stains it yellow.

- The residue is lead (II) oxide.

Equation:

$$2Pb(NO_3)_2(s) \xrightarrow{Heat} 2PbO(s) + 4NO_2(g) + O_2(g)$$

7. **Lead oxide**

[Pb_3O_4]

- On strong heating, a reddish brown residue is obtained which on cooling changes to yellow colour and some part of it fuses in the glass test tube and stains it yellow.
- The residue is lead (II) oxide.

Equation: $2Pb_3O_4 \xrightarrow{Heat} 6PbO + O_2$

8. Ammonium chloride

[NH_4Cl]

- On strong heating, the white crystalline solid sublimes to form dense white fumes.

- These dense fumes form a white powdery mass on the cooler parts of the test tube.

Equation: $NH_4Cl(s) \xrightarrow{Heat} NH_3(g) + HCl(g)$

9. Ammonium dichromate

[$NH_4]_2Cr_2O_7$

- On strong heating, the orange red crystalline solid swells up many times its volume and liberate steamy fumes which on cooling condense on the cooler parts of the test tube and forms tiny droplets of colourless liquid.

- This colourless liquid turns cobalt chloride paper pink which shows that the liquid is water.
- It gives off a colourless and odourless gas which is neither combustible nor supports combustion. It does not turn lime water milky. So, the gas is nitrogen.
- The greenish grey residue is chromium oxide (Cr_2O_3).

Equation: $(NH_4)_2Cr_2O_7(s) \xrightarrow{Heat} Cr_2O_3(s) + N_2(g) + 4H_2O(g)$

10. Zinc nitrate hexahydrate

$Zn(NO_3)_2.6H_2O$

- On heating the white deliquescent solid forms a white sticky mass and gives out steamy vapours.
- On strong heating, the sticky mass releases reddish-brown fumes which turns moist blue litmus paper red.
- The reddish brown gas bursts a glowing wooden splinter into flames, indicating that the gas is mixed with oxygen.
- On heating the residue it turns yellow, and when cooled it changes back to white.
- This white sticky residue is zinc oxide (ZnO).

Equation:

$$Zn(NO_3)_2.6H_2O \xrightarrow{\Delta} Zn(NO_3)_2 + 6H_2O$$

$$2\ Zn(NO_3)_2 \xrightarrow{\Delta} 2\ ZnO + 4\ NO_2 + O_2$$

11. Copper (II) nitrate hexahydrate

$Cu(NO_3)_2.6H_2O$

- On heating the blue-green crystalline solid melts and forms a bluish green mass and gives out steamy vapours. The vapours convert into droplets of water after condensing on the cooler parts of the test tube.
- On strong heating, the bluish green mass converts into the black residue of copper oxide (CuO).
- The substance releases reddish brown gas.

- The glowing wooden splinter starts burning on coming in contact with the gas.

Equation:

$$Cu(NO_3)_2.6H_2O \xrightarrow{\Delta} Cu(NO_3)_2 + 6\,H_2O$$

$$2\ Cu(NO_3)_2 \xrightarrow{\Delta} 2\ CuO + 4\ NO_2 + O_2$$

12. Iodine

I_2

- On strong heating the violet crystalline solid sublimates to violet vapours. These vapour deposit back the violet crystals on the cooler part of the test tube.
- No residue is left at the bottom of the test tube.
- The violet vapours turn the filter paper dipped in starch solution blue.
- A filter paper dipped in silver nitrate solution turns yellow on coming in contact with the vapours.

Equation:

$$I_2 \xrightarrow{\Delta} 2\,I$$

Action of Dilute Sulphuric Acid on Certain Substances

Action of Dilute Sulphuric Acid

Experiment	Observation	Inference
Unknown Substance + dil H_2SO_4 + Heat	Vigorous effervescence Evolution of colourless, odourless gas The gas burns with a pop sound when a burning splint is brought near it	The gas evolved is hydrogen Given substance may be **reactive metals** like Fe, Mg, Zn
Unknown Substance + dil H_2SO_4 + Heat	Brisk effervescence Evolution of colourless and odourless gas Not support combustion Turns moist litmus red Turns lime water milky	• The gas evolved is carbon dioxide • Salt contains **carbonate** (CO_3^{2-}) or **hydrogen carbonate** (HCO_3^-)

	No effect on acidified potassium dichromate	
Unknown Substance + dil H_2SO_4 + Heat	Rotten egg smell gas Turns moist blue litmus paper red Turns moist lead acetate paper black	The gas evolved is hydrogen sulphide Salt contains **sulphide** (S^{2-})
Unknown Substance + dil H_2SO_4 + Heat	Suffocating gas Turns golden yellow or orange coloured filter paper moist with acidified potassium dichromate green	• The gas evolved is sulphur dioxide • Salt contains **sulphite** (SO_3^{2-})

Dry Tests for Salts

The Preliminary tests for the qualitative analysis of an inorganic salt involve the observation of the following physical properties:

1. Colour and Odour:

Physical property	Experiment	Observation	Inference
Colour	Observe colour of the salt	Pink	Co^{2+}
		Blue	Cu^{2+}
		Light green	Fe^{2+}
		Dark brown	Fe^{3+}
		Flesh colour	Mn^{2+}
		White	Pb^{2+}, Zn^{2+}, Ca^{2+}, Na^{+}, K^{+}, NH_4^+

Odour	Rub a pinch of salt between the fingers with a drop of water	Ammoniacal smell Vinegar like smell Rotten egg-like smell Smell of sulphur dioxide gas	NH_4^+ CH_3COO^- S^{2-} SO_3^{2-}

2. Dry heating test

In order to perform this test, a small amount of salt is heated in a dry test tube and observations are recorded.

	Observation/ Gas evolved	**Inference**
1	*CO_2 gas*:- A colourless and odourless gas which turns lime water milky.	CO_3^{2-} or $C_2O_4^{2-}$
2	*H_2S gas*:- Colourless gas with smell like a rotten egg turns lead acetate paper black.	S^{2-}
3	*SO_2 gas*:- Colourless gas with smell like burning sulphur, turns acidified potassium dichromate paper green.	SO_3^{2-}

4	*HCl gas*:- Colourless gas with a pungent smell forms white fumes with ammonia and white ppt. with silver nitrate.	Cl^-
5	Colourless gas with vinegar like smell	CH_3COO^-
6	*NH_3 gas*: Colourless gas with characteristic smell turns Nessler's reagent brown.	NH_4^+
7	*NO_2 gas*:- Reddish brown gas turns ferrous sulphate solution black.	NO_2^- or NO_3^-
8	*Br_2 gas*:- Reddish brown vapours.	Br^-
9	*I_2 gas*:- Dark violet vapours.	I^-
10	*O_2 gas*:- Supports combustion, glowing wooden splinter burns.	O^{2-}
11	*H_2O* vapours:- Droplets of water on the cooler part of the test tube	Hydrated salt

3 Flame test.

In order to perform the flame test, the paste of salt with conc.HCl is introduced into the flame with the help of platinum wire and the colour of the flame is observed.

	Colour of flame	Inference
1	Brick red	Calcium
2	Crimson red	Strontium
3	Grassy-green	Barium
4	Bright-bluish green	Copper
5	Green flashes	Zn or Mn
6	Bull bluish	Lead

4. Solubility test

The following table represents solubility of various salts in water.

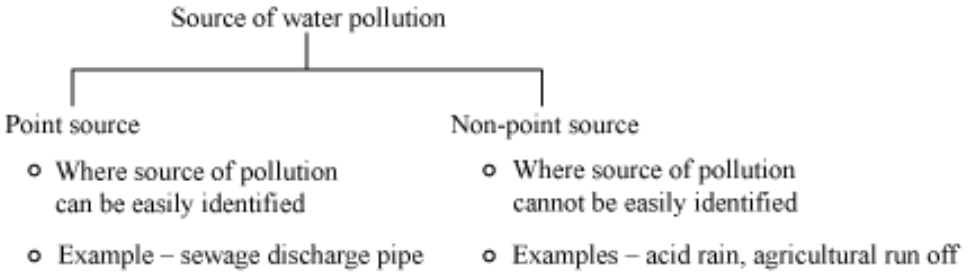
Anion→ Cation ↓	NO_3^-	CH_3COO^-	Cl^-	SO_4^{2-}	OH^-	S^{2-}	CO_3^{2-}	SO_3^{2-}	PO_4^{3-}
Al^{3+}	√	√	√	√	×	Not exist	Not exist	Not exist	×
Na^+	√	√	√	√	√	√	√	√	√
Ba^{2+}	√	√	√		√	√	×	×	×
Ca^{2+}	√	√	√	√	√	√	×	×	×
Mg^{2+}	√	√	√	√	√	√	×	×	×
K^+	√	√	√	√	√	√	√	√	√
Zn^{2+}	√	√	√	√	×	×	×	×	×
Hg^{2+}	√	√	√	√	Not exist	×	×	×	×
Fe^{3+}	√	√	√	√	×	Not exist	×	×	×
Mn^{2+}	√	√	√	√	×	×	×	×	×
Pb^{2+}	√	√	×	×	×	×	×	×	×
Cu^{2+}	√	√	√	√	×	×	×	×	×
Ag^{2+}	√	√	×	√	×	×	×	×	×
Fe^{2+}	√	√	√	√	×	×	×	Not exist	×

Water Pollution

- Introduction of unwanted substances to the water bodies that affects the natural quality of water decreasing its usability
- Ways to identify polluted water:
- Foul smell
- Bad taste

- Oil or grease floating on the surface
- Excessive algal growth
- Growth of weeds

Sources of Water Pollution



- Household detergents
- Sewage
- Domestic and industrial waste
- Oil spills
- Thermal pollution

Causes of Water Pollution

- **Pathogens** − Enter water from sewage and animal excreta

  E.Coli and *S.faecalis* cause gastrointestinal diseases.

- **Organic wastes** − Leaves, grass trash, etc. reach water with run off.

- Oxygen dissolved in water is called dissolved oxygen (DO). DO in water (10 ppm) is very less as compared to air (200,000 ppm).

- For decomposition of organic matter, oxygen is required by bacteria. Therefore, presence of organic matter in water depletes the DO of water.

- If DO reaches less than 6 ppm, then the growth of fish gets inhibited.

- If there is deficiency of oxygen in water, then anaerobic bacteria start degrading the organic matter, resulting in foul small and harmful effects on human health.

- *Biochemical Oxygen Demand* (BOD) − Amount of oxygen required by bacteria to break down organic matter present in water.

- Therefore, BOD represents the amount of organic matter present in water.

- Less polluted water has lower BOD value and vice-versa.

- **Chemical pollutants**

- Heavy metals dissolved in water are harmful as our body cannot excrete them. These metals cause damage to kidneys, CNS, liver, when accumulated beyond tolerance limit in body.

- Acids and raw salts (used to melt ice) also act as water pollutants.

- Organic chemicals such as petroleum products (from oil spills), pesticides, industrial chemicals such as PCBs, detergents also fall under category of chemical water pollutants.

- Fertilizers also cause water pollution. These fertilizers contain phosphates, which enhance algae growth (algae bloom). Algae consume a major part of dissolved oxygen, thus depriving aquatic plants and animals of it, hence killing them. This condition is called *Eutrophication*.

Parameters Used to Determine Water Quality

- **pH value**
- Presence of pollutants alters the natural pH (7) of water.
- This causes harm to aquatic plants and animals
- pH value less than 7 indicates water is acidic.
- pH value greater than 7 indicates water is basic.

- **Bacteria**
- Presence of bacteria can be detected by observing samples of water from a source under microscope at regular intervals.
- Presence of bacteria in water indicates water is polluted.

- **Hardness**
- Hard water produces less or no lather with soap.
- It is unsuitable for washing, drinking etc.
- Presence of hardness in water indicates pollution.
- **Dissolved oxygen**
- It is responsible for support of aquatic life.
- Water present in streams, rivers contains high level of dissolved oxygen than that found in lakes, ponds etc.
- Water in a river or stream is considered polluted if the level of dissolved oxygen is less that what is found in normal water.
- It is measured using an instrument known as Oxygen Flow Meter.

- **Biological Oxygen Demand**
- It is the amount of dissolved oxygen utilised by micro-organisms when oxidising organic matter.
- Polluted water has high level of biological oxygen demand.

- It is determined by comparing the amount of oxygen present in pure water and polluted water.

- **Turbidity**
- It refers to the amount of suspended particulate matter in water.
- It measures the amount of light scattered by suspended solids in water.
- Greater the amount of suspended solids, greater is the scattering of light and hence water has high turbidity.
- Turbid water is incapable to support aquatic life.
- Solids that cause turbidity in water are:
- Clay
- Insoluble waste substances
- Microorganisms

Ways to Control Water Pollution

- Proper treatment of sewage before its discharge in water bodies.
- Neutralization of chemicals released from factories.
- Gravity settlement and screening processes helps in removal of heavy floating solids.
- Oxidation of organic matter for its removal.
- Destruction of pathogens by ultraviolet radiations.

International Standards for Drinking Water

- **Fluoride**

- Concentration upto 1 ppm − Useful and recommended as it makes enamel of teeth hard by converting hydroxyapatite into fluorapatite
- Concentration above 2 ppm − Causes brown mottling of teeth
- Concentration over 10 ppm − Harmful effects on bone and teeth

- **Lead**

- It is a water pollutant.
- Should not exceed beyond 50 ppb
- Can damage kidney, liver, and reproductive system

- **Sulphate**

- Moderate − Harmless
- Excessive − Laxative effect

- **Nitrate**

- Maximum limit − 50 ppm
- Excess nitrate causes ‘Blue Baby Syndrome’.