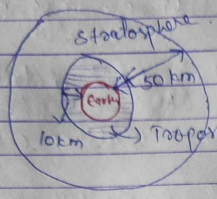
Environmental Chemistry



* Atmospheric Pollution

↳ Tropospheric pollution.

Gaseous
↳ SO_2, NO_2, CO_2, H_2S, Hydrocarbons, Ozone, and other oxidants.

Particulate pollutants:
→ dust, mist, fumes, smoke, fog, etc.

Gaseous pollutants:-

(A) Oxides of Sulphur

$SO_2 + O_2 \rightarrow SO_3$

$SO_2 + O_3 \rightarrow SO_3 + O_2$

$SO_2 + H_2O_2 \rightarrow H_2SO_4$

(B) Oxides of Nitrogen

$N_2 + O_2 \rightarrow NO$

$NO + O_2 \rightarrow NO_2$

$NO + O_3 \rightarrow NO_2 + O_2$ (tartar)

(C) Hydrocarbons: Produced by incomplete combustion of fuel.
↳ Carcinogenic (cause of cancer)

(D) Oxides of Carbon
↳ CO → colourless, odourless, tasteless poisonous gas.

↳ forms Carboxyhaemoglobin in Blood (which causes in death.

↳ CO_2 used in photosynthesis.

Global Warming.

Green house Gases:
CO_2, CH_4, CFC_l, O_3, N_2O, H_2O vapour.

Acid Rain.

pH of rain water is near about 5.6.

$H_2O + CO_2 \rightarrow H_2CO_3$

$H_2CO_3 \rightarrow H^+ + HCO_3^-$

$SO_2 + O_2 + H_2O \rightarrow H_2SO_4$

$NO_2 + O_2 + H_2O \rightarrow HNO_3$

Particulate Pollutants.

SMOG

Classical	Photochemical
(1) Occurs in cool humid climate	(1) occurs in warm, dry and sunny climate
(2) smoke + fog + SO_2	(2) smoke + fog + H.C + Nitrogen hydrocarbon oxides
(3) Reducing Smog	(3) Oxidising Smog

Photochemical smog

$NO_2 \xrightarrow{h\nu} NO + O$

$O + O_2 \longrightarrow O_3$

$NO + O_3 \longrightarrow NO_2 + O_2$

$CH_4 + O_3 \rightarrow HCHO + CH_2=CHCHO + CH_3COOONO_2 + H_2O$

$CH_2 = CH - \overset{O}{\overset{\|}{C}} - H$ → Acrolein/Acrylaldehyde

$CH_3 - \overset{O}{\overset{\|}{C}} - O - O - NO_2$ → PAN = Peroxy acetyl nitrate.

X Stratospheric Pollutant

→ Formation and breakdown of Ozone.

$O_2 \xrightarrow{UV} O + O$

$O + O_2 \underset{UV}{\rightleftharpoons} O_3$

→ Free Radical:-

Chain Reaction

$CF_2Cl_2 \xrightarrow{UV} \dot{Cl} + \dot{C}F_2Cl$

$\dot{Cl} + O_3 \longrightarrow ClO\dot{} + O_2$

$ClO\dot{} + O \longrightarrow \dot{Cl} + O_2$

The Ozone hole

$ClO\dot{} + \dot{N}O_2 \longrightarrow ClONO_2 \xrightarrow{H_2O} HOCl + HNO_3$

$\dot{Cl} + CH_4$ ↓ $CH_3 + HCl$

$ClONO_2$ —HCl→ $Cl_2 + HNO_3$

HNO_3 —hν→ $\dot{Cl} + \dot{O}H$

Cl_2 —hν→ $\dot{Cl}$

* Water Pollution

→ Pathogens → disease causing agent
↳ Human excreta → contains bacteria
→ Escherichia coli & Streptococcus faecalis which cause gastrointestinal disease

→ Organic Waste : leaves, grass, trash, etc.
↳ Excessive growth of phytoplankton.
↳ Biodegradable Waste.

→ If dissolved oxygen is below 6 ppm, growth of fish inhibited.

→ D.O in cold water = 10 ppm | air = 2 lakh ppm

* **BOD** = Biochemical oxygen Demand. ⇒ Amt. of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water.

Clean water → BOD - less than 5 ppm
Polluted water → BOD → more than 17 ppm

* → PCB → Polychlorinated biphenyls
  # cleansing agent
  # Carcinogenic
* Eutrophication → Decrease in conc^n of oxygen in water due to pollutant.

* Drinking water
  * Flouride → needed = 1 ppm.
    deficiency → tooth decay.
    over 2 ppm → brown mottling of teeth
    over 10 ppm → harmful for bones and teeth.
  * Lead :- upper limit = 50 ppb (per billion).
    Can damage : kidney, liver, reproductive system.
  * Sulphate : limit = <500 ppm.
    excessive → cause laxative effect (loose motion)
  * Nitrate → max limit = 50 ppm
    Excess → cause → methemoglobinemia ('blue baby' syndrom)

		limit
Kaddy	Cd	= 0.005 ppm
Main	Mn	= 0.05 ppm
Fe	Fe	= 0.2 ppm
Al	Al	= 0.2 ppm
Tum	Cu	= 3 ppm
Zano	Zn	= 5 ppm

Soil pollution

* Pesticides → DDT
  Organic toxin
  ↳ Aldrin
  ↳ Dieldrin
  → water insoluble
  → Non-biodegradable.

Herbicides :- $NaClO_3$ and Na_3AsO_3
  ↳ toxic to mammals
  ↳ biodegradable.

* Bleaching of Paper :
  → Chlorine gas was used earlier → Now; Replaced by H_2O_2.

* Synthesis of chemicals
  Ethanal (CH_3CHO) : Commercial preparation =

$$CH_2=CH_2 + O_2 \xrightarrow[\text{in Water}]{\text{catalyst } Pd(II)/Cu(II)} CH_3CHO \text{ (upto 90\%)}.$$

* Powder of kernel of tamarind seeds used to clean waste waters. → non-toxic, biodegradable
  present practice → alum is used at its place.
  Cause Alz toxic
  disease.