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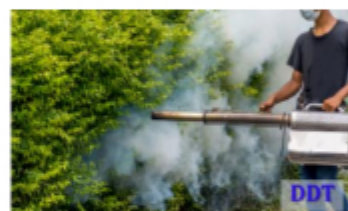
Environmental Issues

1. Introduction :

- "Any undesirable change in physical, chemical or biological characteristic of air, water and land which is harmful to the man directly or indirectly through his animals, plants, industrial units or raw materials is called **pollution**".
- **Pollutants** :- "Any material or act on the part of man, or nature which leads to pollution is called pollutants."

Some categories of pollutants:

- **Nonbiodegradable pollutants** :- Many of such pollutants are usually not degraded or degraded partially in environment. Such as aluminium packs, Mercury compounds, Iron, Compounds of phenols, Glass, D.D.T. benzene, BHC pesticides, etc.
- They are collected in the environment and cause pollution. These pollutants are harmful even in low concentration and harm increases with their increasing concentration. No treatment is found in the nature for their recycling. There are two methods by which we can stop the pollution caused by pollutants
- Such type of substances should be banned by law.
- Use their alternative substances.
- **Biodegradable pollutants** - If much of domestic sewage papers, woods, garbage, live stock wastes, etc. are easily degraded completely by microorganisms, it becomes useful. But if these materials enter the environment in such large quantities, that they cannot be degraded completely then addition of these materials causes pollution in environment.
- **Primary pollutants** - These persist in the form in which they are added to the environment. *e.g.* DDT, CO etc.



- **Secondary pollutants** – These are formed by chemical reaction among primary pollutants
e.g. Photochemical smog, London smog, PAN, O₃ etc.



- Process of formation of secondary pollutants is known as **synergism**. secondary pollutants are more toxic than primary pollutants.
- **Quantitative pollutants** – These are the substances which occur in nature but become pollutant when their concentration reaches beyond a threshold value in the environment
e.g. CO₂, Nitrogen Oxide etc.
- **Qualitative pollutants** – These are the substances which do not occur in the environment but are passed in through human activity
e.g. fungicides, herbicides, D.D.T., etc.

Other type of pollution :

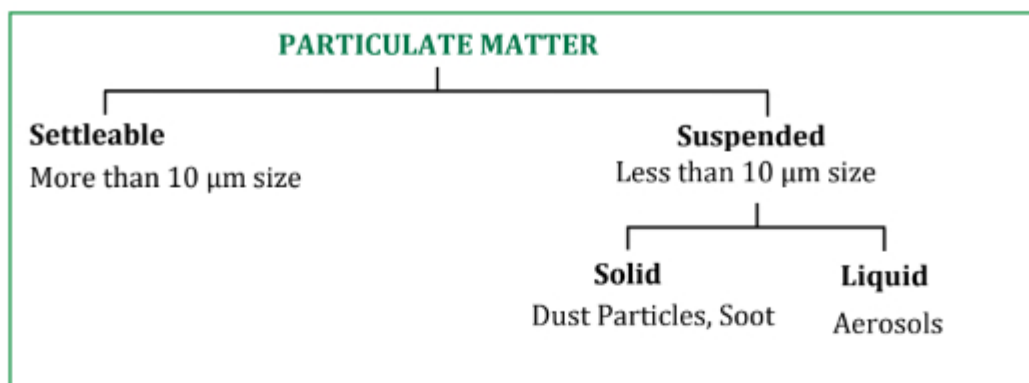
- **Natural pollution** – Caused by natural sources like, CH₄ from paddy fields and cattle, marsh, forest fire.
- **Anthropogenic pollution** – Caused by human activities.
- **Negative pollution** – Loss of soil productivity. *e.g.*, Overgrazing, Soil erosion.
- Removal or absence of desirable substances at right place which results in loss of soil productivity.
- **Positive pollution** – Presence or addition of undesirable substances at wrong place which results in reduction of soil fertility *e.g.* more use of fertilizer, Land filling by wastes.

2. Air Pollution :

The air pollution is caused due to addition of unwanted substances or gases. The atmospheric pollution is mainly caused by the activities of man and concentrated to the inhabited and the industrial complexes in cities. There are two main categories of air pollutants

Gases : The gaseous materials include various gases and vapours of volatile substances or the compound with a boiling point below 200°C.

Particulates : According to **central pollution control board (CPCB)**, particulate size **2.5 micrometers** or less in diameter are responsible for causing the greatest harm to human health. These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory problems, irritation, inflammation and damage to the lungs and premature deaths.

**(A) Major Air Pollutants and their Effects :-**

S.N.	Pollutant	Source	Effect
1.	Carbon monoxide (CO)	smoke of automobile and burning of fossil fuels (Petrol, diesel, coal)	it impairs respiration and it causes death due to asphyxiation when inhaled in large amount.
2.	Unburnt Hydrocarbons (3,4 Benzopyrine, Benzene)	automobiles and burning of fossil fuel (petrol, diesel, coal). Methane (CH ₄) is the most abundant hydrocarbon in atmosphere and its main source is marshy area and paddy field .	Hydrocarbons causes lung cancer .
3.	Ethylene	Ethylene released in air during fruits ripening .	Falling of leaves without particular reason, falling of flowering bud before time.
4.	Nitrogen oxide - (NO, NO₂)	Burning (combustion) of fossil fuel in automobiles.	These nitrogen oxides form photochemical smog in atmosphere and release ozone. Nitrogen oxide also responsible for acid rain . Entry of these nitrogen oxide causes respiratory trouble such as emphysema, bronchitis, swelling of lungs and lung cancer etc.
5.	Sulphur oxide - (SO₂, SO₃)	Main source of Sulphur oxides are coal burning, smelters, oil refineries.	Lichen and mosses do not grow in SO₂ polluted areas . Lichen and mosses are indicator of SO ₂ pollution. Sulphur oxides causes chlorophyll destruction. Taj Mahal also get affected.

Smoke – (SO₂, SO₃, NO₂, NO, CO, CO₂)

(B) Secondary Pollutants :**(i) Smog (Smoke + Fog) –**

This word was given by Desvoeux. Smog/Smoke is measured by **Ringelmann method**.

o types

(a) Los Angeles Smog or Photo Chemical smog or Oxidising smog –

It was first observed in Los Angeles. In this process smoke, fog, nitrogen oxide, hydrocarbons, oxygen, UV light and high temperature are essential. These components react with each other and form reddish brown smog ($\text{PAN} + \text{O}_3 + \text{Nitrogen oxides}$) or brown haze/brown air. Los angles smog is light induced smog.

Effect –

- Photochemical smog causes irritation in eyes and harms the lungs. Due to smog elastic substances (rubber/tyers) also affected.
- Ozone causes harm to mucous membrane.
- During smog peroxyacetyl nitrate (PAN) is formed. PAN stops or inhibits the photolysis of water in hill reaction of photosynthesis and affect or inhibit the photosystem-II. PAN also inhibit the chlorophyll formation in plants.

(b) London smog or sulphur smog or Classical smog or Reducing smog –

It was first observed in London. In this process coal, smoke, fog, sulphur oxide and low temperature are essential. These components react with each other and form vapour (fog) of H_2SO_4 which is known as London smog.

Effect – Due to inhalation of H_2SO_4 vapour with fog 4000 people died in London in 1952.

(ii) Acid rain – This word was given by Robert August. NO_2 and SO_2 released from different sources in form of smoke and dissolved in atmospheric water vapour to form acid ($\text{H}_2\text{SO}_4 + \text{HNO}_3$). These acids come down on earth with rain water this is called acid rain.

(a) Wet deposition :- If acid comes down on earth with rain, fog and smog, it is known as wet deposition.

(b) Dry depositon :- If acid settled on earth surface through solid dust particles with nitrate or sulphate, this is called dry deposition.

Note : The pH of acid rain is lesser than < 5.6

In acid rain the ratio of H_2SO_4 and HNO_3 is 7: 3 (**70% H_2SO_4 + 30% HNO_3**)

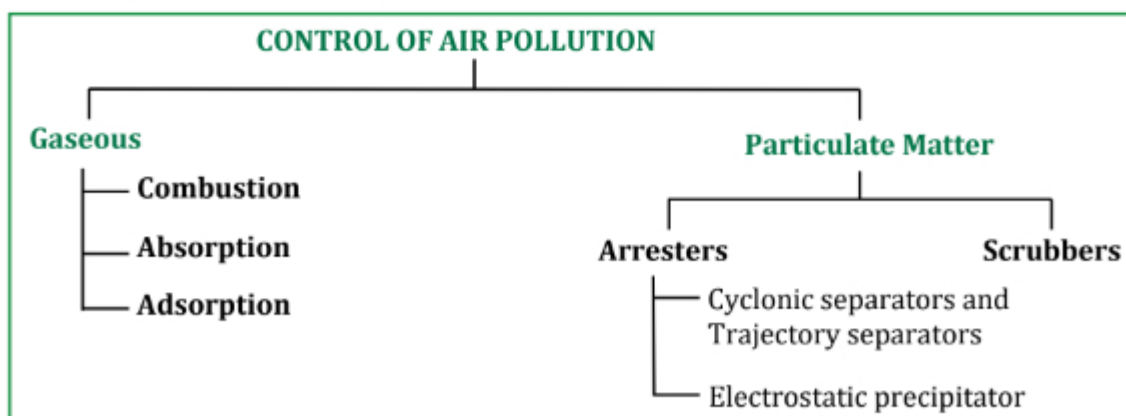
Effects –

Due to acid rain acidity of soil and water increases.

Acid rain also causes damages historical monuments. e.g. Taj Mahal, Red Fort.

Stone leprosy is caused due to acid rain because due to acid rain outer surface of metals, marbles, and stone destroyed.

(C) Control of Air Pollution :



- (i) **Control of particulate matter** – Two devices used to remove particulate air pollutants are **Arresters & Scrubbers**.

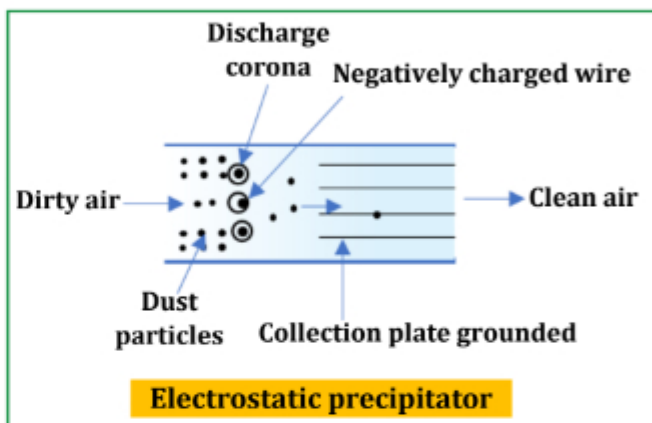
- (a) **Arresters** : These are used to separate particulate matters from contaminated air.

Arresters are of different types :

Cyclonic separators and Trajectory separators :- These are commonly used to separate out particulate matters from industrial emissions with minimum moisture content. These separators work on the principle of dust separation by centrifugal force.

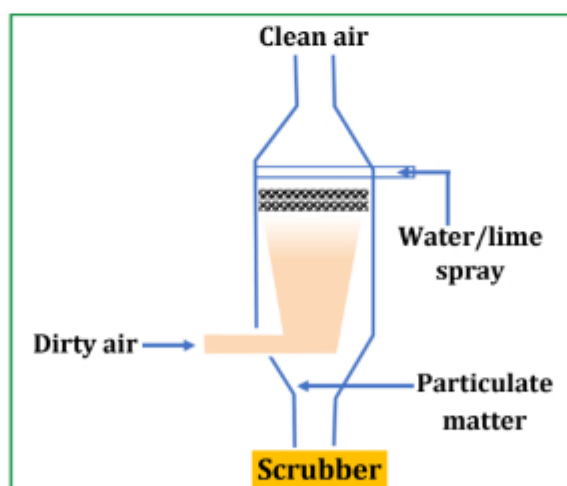
Electrostatic precipitator :- It is the most efficient device to remove fine particulate pollutants. Electrostatic precipitation device work on the principle of electrical charging of the dust particles and collecting it on a differently charged platform.

There are several ways of removing **particulate** matter; the most widely used of which is the **electrostatic precipitator**, which can remove over 99 per cent particulate matter present in the exhaust from a thermal power plant.



It has electrode wires that are maintained at several thousand volts, which produce a corona that releases electrons. These electrons attach to dust particles giving them a net negative charge. The collecting plates attract the charged dust particles. The velocity of air between the plates must be low enough to allow the dust to fall.

- (b) **Scrubbers** : A scrubber can remove gases like sulphurdioxide. In a scrubber, the exhaust is passed through a spray of water or lime.



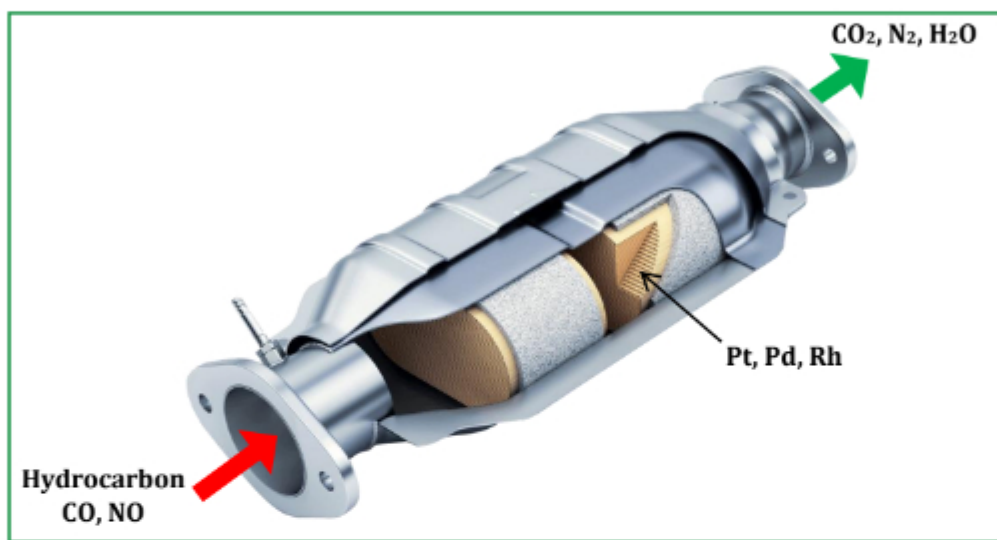
- (ii) **Control of Gaseous pollutants** – Combustion, absorption and adsorption technique are used to control gaseous pollutants.

- (a) **Combustion** – In combustion process, oxidisable gaseous pollutants are completely burnt at a high temperature. Petrochemical, fertilizer, paints and varnish industries used combustion control of gaseous pollutants.

- (b) **Absorption** : Suitable solvents are used to absorbed toxic gaseous pollutants.

(c) Adsorption :

Catalytic converters : Automobiles are a major cause for atmospheric pollution in the metro cities. Proper maintenance of automobiles along with use of lead-free petrol or diesel can reduce the pollutants they emit. Catalytic converters, having expensive metals namely **platinum**, **palladium** and **rhodium** as the catalysts, are fitted into automobiles for reducing emission of poisonous gases. As the exhaust passes the catalytic converter, unburnt hydrocarbons are converted into CO_2 and water, and CO and nitric oxide are changed into CO_2 and nitrogen gas respectively. Motor vehicles equipped with catalytic converter should use unleaded petrol because lead in the petrol inactivates the catalyst.



(iii) A Case study of Delhi –

(a) CNG (compressed natural gas):

In the 1990s, Delhi ranked fourth among the 41 most polluted cities of the world.

All the buses of Delhi were converted to run on CNG by the end of 2002.

CNG is the better than diesel because CNG burn most efficiently as compared to diesel or petrol in the automobiles and very little of it is left unburnt. CNG is cheaper than petrol or diesel.

(b) Euro norms: The government of India through a new auto fuel policy has laid out a roadmap to cut down vehicular pollution in Indian cities. More stringent norms for fuels means steadily reducing the sulphur and aromatics content in petrol and diesel fuels.

Bharat stage Norms (Euro norms)	Type of Vehicles	Cities	Date of Implementation	Amount of Sulphur in petrol	Amount of Sulphur in diesel	% of hydrocarbon content in fuels
Euro (III)	2,3,4, wheelers	All over India	October 2010	150 ppm	350 ppm	42%
Euro (IV)	4 wheelers	13 Mega cities	April 2010	50 ppm	50 ppm	35%
Euro (IV)	2,3,4 wheelers	All over India	April 2017	50 ppm	50 ppm	35%
Euro (VI)	2,3,4 wheelers	All over India	April 2020	10 ppm	10 ppm	35%

