

## Air & Noise pollution

→ pollution - It come from Latin word "polluere" that means Contamination.

It is something that Contaminates the Environment. It can be define as introduction of harmful substances or toxic substances that cause adverse effect to environment.

→ pollutants - The substances that cause pollution  
examples - harmful gases like  $CO_2$ ,  $CO$ , oxides of Sulphur, Nitrogen and plastics, garbages etc.

### Types of pollution

1. Air pollution
2. Water pollution
3. Noise pollution
4. Soil pollution
5. Radioactive pollution

1. Air pollution - It may define as the undesirable presence of one or more contaminants such as dust, fumes, gas, mist, odour, smoke or Vapour, which are harmful to human health and Environment.

2. Water pollution - change of physical, biological and chemical form of water <sup>body</sup>, due to undesirable substances or contaminated substances which makes water unsuitable for drinking or other uses.

3. Noise pollution - The unwanted or underisable substances that disturbs the well being or Environment, due to human activities or natural activities.

4. Soil pollution - Refers to any physical or chemical changes in soil condition that may adversely effect the human health, plants and animals.

5. **Radioactive pollution** - Defined as increase in the natural radiation level in the environment caused mainly by human activities. It includes nuclear power plants, TVs, computers, radio waves.

## # Natural & man-made sources of air pollution.

### Natural sources of air pollution

It is caused due to continuous and temporary natural events & cannot be prevented, there is no involvement of humans. Various natural sources of air pollution are described below:

→ **Volcano activities** - It emits a series of toxic gases including sulphur & chlorine.

→ **Wild fires or forest fires** - It emits CO, & particulate matter into the atmosphere.

→ **Microbial decaying process** - microorganisms present in the environment have a major role in natural decaying process of living organism release gases like methane which cause air pollution.

### Manmade sources of air pollution.

→ **Transportation (Automobiles/vehicles)** - It emits CO<sub>2</sub>, CO, oxides of N, S & particulate matter.

→ **mining** - Crushing of minerals emits various chemical & hazardous substance.

→ **Industrial processes** - They emit both organic & inorganic contaminants through leakages or mis-handling.

→ **Construction sites** - Usually dust particles are released & these particles pollute the environment.

→ **power plants** - Burning of various minerals produces particulate matter.



- Deforestation - This leads to release of  $\text{CO}_2$  in atmosphere.
- Refrigerants - These are mainly responsible for creating greenhouse effect in atmosphere, that raise the Earth's temperature.
- Agriculture - Various weedicides, pesticides used in agriculture fields contains toxic volatile organic compounds.
- Defence activities - Emits toxic gases through practices & training.
- IC Boilers - These are combustion devices used to heat water or to produce steam. IC Boilers creates air pollution by emitting hazardous air pollutants in environment.

### Air pollutants

Excessive concentration of unwanted or undesirable particles in air which adversely affects the well-being of the individual or cause damage to environment.

important

These are classified according to sources of emission into two groups - primary pollutants & secondary pollutants.

- (i) primary pollutants - Emitted from a source directly into the atmosphere. The sources can either be a natural processes such as sand storms, volcanic eruption or anthropogenic (by humans) such as industrial & vehicle emissions. major primary pollutants are - oxides of S, N, C,  $\text{CH}_4$ ,  $\text{NH}_3$ , CFCs,

- (ii) Secondary pollutants - These are not emitted directly. They are formed in the atmosphere when the primary pollutants react with themselves or with the other components of atmosphere. It includes acids, nitrogen dioxide,  $SO_2$ ,  $O_3$  etc.

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### Particulate pollutant

It is one of the most complicated forms of air pollution. The pollutant responsible for particulate pollution is called particulate pollutant & also known as particulate matter (PM).

PM is sub-divided into different categories based on particle size i.e PM 10, PM 2.5, & PM 0.1.

- (i) PM 10 - Coarse particles, with diameter of 10  $\mu m$  or smaller. Contains PM 2.5 & PM 0.1. These particles can pose significant health threat as it penetrate into our lungs. Once these particles get into our lungs, it irritate the lung tissue & can prompt asthma attacks, also irritates airways, ~~that~~ <sup>rise</sup> ~~on natural~~ sources - agriculture process, plant, insects, dust, natural dust storm.

- (ii) PM 2.5 - also known as fine particles with diameter of 2.5  $\mu m$  or smaller. These particulate not only enters into the lung tissue, it enters to the blood stream. It penetrates deeply & can flow to other parts of body. It contributes disease like respiratory disease, <sup>reduce</sup> immune response, congenital disabilities. sources - Vehicle exhaust, wildfires, power plant emission.



0.001mm.  
 $10^{-6}$ .

(iii) PM 0.1 - Ultrafine dust with diameter of 0.1  $\mu\text{m}$  or smaller. It is smaller than fine dust & originates from PM 2.5.

Research indicates that ultrafine dust pose a worse threat than PM 2.5 as smaller particle size can infiltrate into our body to an greater extent.

It can be removed by using various equipments like Bag filters, cyclone separators, Electrostatic precipitators.

### → Bag filters

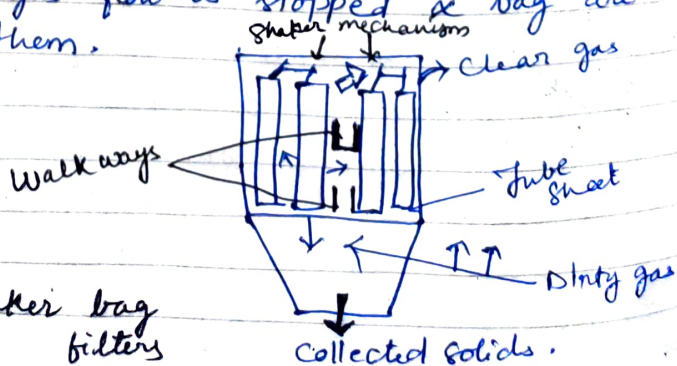
Bag filters, commonly known as baghouse or dust collector is an pollution control device used to remove particulate matter from the contaminated gas stream by depositing the particles on bag filters.

These bag filters are made up of fabric material

There are 3 types of bag filters and are different from each other in cleaning methods:-

#### 1) Shaker bag filters

The shaker bag filters consists of vertical casing made up of cylindrical bags, bottom hopper & a tube sheet between the vertical casing & the hopper. The cylindrical bags are closed at the top. At the top of the casing, a shaking mechanism is attached. The contaminated gas stream enters into the hopper, flow through the holes of vertical sheet & inside the vertical bags, leaving the dust on inside surface of bag filters. The gas flow is stopped & bag are shaken to clean them.



\* Typical shaker bag filters

## Reverse Air Bag filters

These are ~~same~~ similar to Shaker bag filters. The contaminated or toxic gas stream enters from the hopper, flows into and through the bags. The gas stream leaves out the dust ~~on~~ on the bag surface.

For cleaning the bags, the flow of contaminated gas stream is stopped and another clean gas flow is introduced which flows in reverse direction. This gas flow is usually taken from the cleaned gas stream discharged from the bag filters.

The dust, dislodged by the reverse airflow falls into the hopper and finally removed from the collector.

## Pulse Jet type Bag filters.

**Working principle** A pulse jet bag filter is a type of dust collector used to remove particulates from a gas stream.

It is a highly efficient device commonly employed in industries like cement, steel and power plants to control emission and maintain environmental standards.

The filter system uses fabric filter bags to capture the dust & a high-pressure jet of air for cleaning.

The pulse jet type bag filter features a tube sheet positioned near the top of its vertical casing from which the filter bags are suspended. Each bag is supported by a wire mesh cage inserted inside to prevent collapse. The contaminated gas stream enters through the hopper & flows into the bags moving upward through the tube sheet while leaving the dust particles on the outer surface of bags. To clean the bags, short burst of compressed air are periodically injected causing the dust on the bag surface to dislodge.



fall into the hopper. The collected dust is then removed from the hopper for disposal.

### Cyclone separators

Equipment used to remove the particulate matter from air or other gas stream.

#### # Working principle.

It works in the principle of inertia to remove particulate matter. The size of the cyclone may vary from 1.2 mt to 9 mt depending upon the volume of air or other gas stream to be filtered.

Cyclone separators are basically centrifugal separators and work much like a centrifuge.

It consists of an upper cylindrical part referred to as the barrel and a lower conical part referred to as Cone.

- The dusty or particle-laden gas enters the cyclone separator through the inlet at high velocity.
- The inlet is typically tangential to the cylindrical body, causing the gas stream to swirl around inside.
- The swirling motion creates a strong centrifugal force.
- Particles, being denser than the gas, are pushed outward toward the walls of the cyclone.
- The gas & particles move in a spiral, forming a double vortex inside the cyclone.
- The larger particles, due to the centrifugal force, lose momentum and drop down along the walls into the collection hopper.

lighter gas, free from most of the heavier particles, move inward & upward in a smaller vortex.

- The clean gas exits through a central outlet pipe located at the top of the cyclone.
- The separated dust or particulate matter is collected at the bottom in a hopper.

The cyclone separator works on the principle that particles will be separated based on their size, density & shape due to the centrifugal force created by the spinning motion of gas.

### Advantages

- Less installation & maintenance cost
- occupy very little space.
- Separated particulate matter is collected in dry condition which makes it easier to dispose off.

### Disadvantages

- Standard models are not available to remove particulate matter smaller than 10  $\mu\text{m}$
- Equipment are unable to handle sticky materials.



## Electrostatic precipitators.

Electrostatic precipitators are used to remove the fine particles like smoke and dust from the ~~fast~~ flowing gas.

It uses an electric charge & electrostatic force to remove particulate matter either in the form of solid or liquid droplets from air or other gases.

It consists of rows of thin vertical wires and a stack of large vertical metal plates. The plates are spaced from 1cm to 17cm apart depending on the type of application.

One electrode is highly negative voltage whereas second electrode charged with high positive.

The gas stream flows horizontally between the wires and through the stack of plates.

When the particulate passes through negative electrode it gets charged. Thus the  $\ominus$ -vely charged are pulled towards the +ve electrode and deposited on plates or other collection devices.

When sufficient quantity of particles are accumulated on the collector devices, they are shaken off mechanically from the collectors. The particulates which can be dry or wet, fall into a hopper at the bottom of unit and are transported to the disposal or recycling site through belt conveyor.

## Gaseous pollution control

1) Absorber - It is a process of removing gaseous pollutants by dissolving it into a solvent media.

The material that absorbs is called solvent, & the gas that is to be absorbed is called solute.

The gas stream containing the pollutant enters from the bottom of the scrubber and moves upwards towards the exhaust provided at the top of the scrubbers.

The liquid scrubbing media or solvent enters from the top of the scrubber. The liquid media absorbs the pollutants from the gas stream which are collected.

## Catalytic Converter

It was first invented by Eugene Houdry, to overcome the air pollution. The car emission contains harmful toxic by-products like Nitrogen oxides, Carbon monoxide and hydrocarbon. This catalytic converter is a simple device that uses oxidation and reduction reaction to convert the harmful fumes or gas to less harmful gas.

usually found in car. The material (catalytic converter) is coated with precious metals like platinum, rhodium, palladium. It is located near front portion of car.

~~Types~~ Types of catalytic converter → Reduction catalyst  
→ Oxidation catalyst.

→ Reduction catalyst

Reduces nitrogen oxide pollutants by removing oxygen. Oxides are break and oxygen gas is released.



→ Oxidation catalyst

Converts Carbon monoxide to Carbon dioxide hydrocarbon into Carbon dioxide & water which are less harmful.

→ Three-way type catalytic converter - where both oxidation & reduction takes place.





G.C Boilers - These are combustion devices used to heat water or to produce heat/steam.

These steam produces are highly hazardous and cause various disease & health issues. pollutants emitted are Nitrogen Oxide,  $SO_2$ ,  $CO$ ,  $HCl$ ,  $Cd$ ,  $Hg$  etc.

## NOISE POLLUTION

It is defined as unwanted or undesirable sound that affects the health and well-being of human and other organism.

The sound is typically described in terms of loudness and it is measured in dB (decibels).

### Sources of noise pollution.

→ Industrial sources -

The industries such as textile mills, engineering establishments, printing press, metal works contribute heavily towards noise pollution.

→ Transport vehicles -

In <sup>the</sup> recent past, there is an enormous growth in traffic volume due to increase in number of vehicles such as buses, train, trucks etc. resulting increase in noise pollution.

→ Household noise -

Domestic gadgets like mixer-grinders, cookers exhaust fans, washing machines are the sources of noise pollution.

→ public address system (PA System) - political rallies, strikes, election, religious events are various sources of noise pollution.

- Agriculture machines - Heavy types machinery and equipment like tractors, tube wells, harvesters create noise pollution.
- Defence equipment - Explosion, shooting practices, jet engines & Sonic boom create noise pollution.
- Miscellaneous sources - Construction site, blasting, Stone crusher etc, are various sources of noise pollution.

### Measurement of noise pollution.

Sound is measured with a sound level meter which is usually a portable, self-contained instrument incorporating a microphone, amplifier, voltmeter & attenuator (reduces the sound). This reads out sound pressure levels directly.

### Sound pressure level

$$L_p = 10 \log_{10} (P/P_r)^2$$

where  $L_p$  = Sound pressure level, dB

$P$  - sound pressure

$P_r$  = reference sound pressure.

### Effects of noise pollution.

- Hearing loss - Constant exposure to loud level of noise may result in loss of hearing.
- Change in sleeping schedule / sleeping disorder. It affects our sleeping pattern & it may lead to very uncomfortable and irritating situation.
- Cardiovascular issues - High level of noise may cause high blood pressure, cardiovascular disease, heart problems.



→ Effect on wildlife

They may suffer from hearing loss & lead to imbalance in ecosystem

→ Communication barrier - This may lead to misunderstanding and difficulty in understanding each other.

### Noise pollution (Regulation & Control)

→ Noise limit - Noise levels in any area must not exceed the ambient air quality standard for noise

→ public awareness / advertisement - This might help people to know the causes & effect of noise pollution.

→ Silence Zone

Silence zone are areas around hospitals, educational institutions, courts & religious places that are at least 100 mt in distance.