

Air pollution

→ Air pollution:

Air pollution is defined as the presence of any solid liquid or gaseous present in the atmosphere in such concentrations that may tend to be injurious to human beings or other living substances.

→ The solid, liquid, or gaseous substances which are present in air cause harmful effects on the abiotic components and biotic components of our environment are eventually called the air pollutants.

- Natural Air pollution - Remain in the atmosphere for a short period.

Man Made pollution - stay in atmosphere for a longer periods and may lead to change in atm permanently.

Primary pollutants: pollutants which releases directly from the identifiable sources called as Primary pollutants.

Eg: H_2SO_4 , O_3 , SO_2 , CO , CO_2 , NO , NO_2 , SPM

Secondary Pollutants: Primary pollutants often react with one another or with water vapour to form a new set of pollutants known as Secondary pollutants.

Eg: H_2SO_4 , O_3 , PAN

effects of Air pollution

1. Producing objectionable odour, taste.
2. Corrosive and chemical effects on objects.
3. Spoiling the fabric and leather dresses.
4. Skin damages to the exposed body parts.
5. Damage the monuments.

Dispersing of Air pollutants into the Atmosphere.

→ Adiabatic lapse rate

→ Environmental lapse rate.

Based on spatial distribution of source

Point source: An industry at a place

Areal source: A grp of industries at a place

Based on position of source with time and space

Stationary source: An industry.

Mobile source: An trucks on highway.

Based on nature.

Organic Air pollutant - Hydrocarbon

Inorganic Air pollutant - CO, SO_x, NO_x etc.

Based on ~~nature~~ State of nature

Particulates $\left\{ \begin{array}{l} \text{Solid} - \text{Dust} \\ \text{Liquid} - \text{Mist} \end{array} \right.$

Gas ———— SO_x, NO_x, CO etc.

Indoor pollution:

Indoor air pollution results from the burning of solid fuels such as crop waste, dung, charcoal and coal for cooking and heating in households. Burning these fuels produce particulate matter.

Outdoor pollution:

Outdoor pollution result from emissions caused by combustion processes from motor vehicles, solid fuel burning and industry. * other pollution sources include smoke from bushfires, windblown dust and biogenic emissions from vegetation.

Particulates! These are also called aerosols.

These are the dispersion of Minute sized solid and liquid particles in gaseous Media. These includes dust, smoke, and ~~dust~~ Mist.

→ Dust is produced by grinding of various materials eg - cement, foundry, dust, fly ash etc.

Smoke is due to combustion of coal

Mist is the concentration of minute water droplets dispersed in the atmosphere.

→ Particulates in atmosphere in high concentrations cause Respiratory diseases such as Bronchitis and asthma

→ Particulate matter in atmosphere measured by "High Volume air Sample".

Gases

SO_x: Among all oxides of Sulphur dangerous air contaminants is SO₂. large amount of SO₂ was released into the atmosphere by Thermal power stations, oil refineries, combustion of coal.

→ SO₂ is an irritant gas. when inhaled, it affects the upper respiratory tract causing bronchial problems, nose and throat irritation

→ SO₃ is a stronger irritant and even low concentration can lead to severe bronchospasm.

→ SO_x in atmosphere measured by West and Gack Method.

NO_x: Among all oxides of Nitrogen dangerous air contaminants are NO and NO₂.

* NO_x mostly emitted into atmosphere from industries and automobile

* Alveoli of human lungs are sensitive to NO_x

* NO_x in atmosphere measured by 'Jacob-Ochieser Method'

Carbonmonoxide

Carbonmonoxide is mostly releases from the automobiles.

* CO if present in small amounts only cause irritation and head ache, but if it is present in large amounts it causes 'Asphyxia' (Breathlessness)



* COHb is a Asphyxiant.

* CO in atmosphere measured by 'NDIR Analyses.'

Non dispersive Infra red analyses

Hydrocarbons:

Hydrocarbons causes lung cancer. HC in atmosphere measured by 'Gas chromatography'

Control Measures

- 1) Smoke abatement Measures
- 2) Preventive measures which are used in industries
- 3) Pollution control Equipments.

Smoke Abatement Measures:

Smoke can be reduced by doing proper combustion of coal. These proper combustion can be achieved by choosing correct Method of firing, admitting correct quantities of air and Maintaining high temperatures.

→ In the firing Methods, the fuel should be feed continuously and uniformly, Instead of Intermittently.

* To maintain this automatic staker is provided

* By doing the continuous supply of fuel, it will regulate

temperature within the combustion chamber.

→ If the supply of air is very less, then evolution of smoke happens. So, to avoid evolution of smoke, a ratio of 1 to 12 (by wt) of coal and air may be considered sufficient for complete combustion. Efficient combustion requires maintenance of high temp.

→ Smoke standards are based upon smoke density which are obtained from charts.

Ringlemann chart is most commonly used as the standard chart.

Smoke inspectors use this chart, making observations of the smoke coming out of the chimney for a half minute over a duration of an hour.

The chart is kept line with chimney such that the chart and smoke have a similar background.

→ The dense smoke should not be emitted for more than 6 min in an hour for industrial plants and there shall be no more than one minute continuous dense smoke from locomotives.

Preventive measures

a) shutting down of industry contributing maximum pollution of air.

This can be only done in case of emergency. However, as this may eventually result in an economic loss, so, it may not be advisable.

b) Dilution through the use of tall stacks or chimneys helps in the dispersion of the pollutants over a wider atmospheric area. But, in this the pollutants may transport into another area and therefore not mitigate the pollution problems.

c) By introducing air zoning with a view to locate industry, power plants etc. away from the residential areas keeping weather and wind conditions in view.

d) Process change:

Process change can be done in 4 Methods.

(i) By substituting of raw materials or fuels.

By using low volatile coal in the place of high volatile coal, so that smoke can be effectively eliminated.

(ii) By Modification of the process.

Instead of using combustible refuse, incineration may be replaced by the process of sanitary landfill.

(iii) By Replacement of process equipment.

(iv) By changes in Operational practices.

Using low Sulphur coal for high Sulphur coal in a thermal plant.

e) use of propane as a fuel:

Propane has been found that to be cleaner and more efficient fuel during combustion, because it emits low SO₂ and toxic air. It is 30-40% cheaper than petrol.

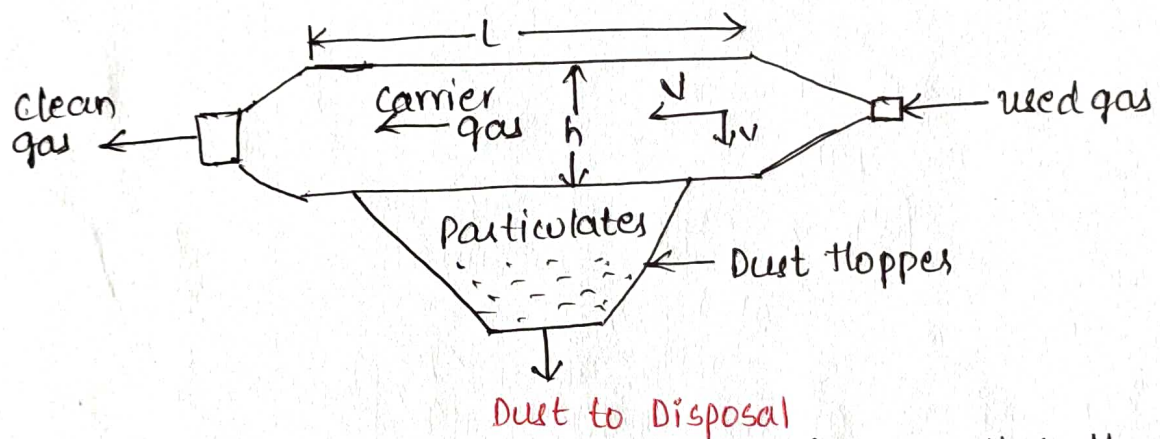
Pollution Control Equipments:

These are enable to trap and collect the pollutants before they are emitted into the atmosphere. While some of these devices enable to control only suspended particulates, while others control gaseous pollutants.

(i) Settling chambers:

Settling chamber

- * Settling chamber is known as gravity settling chamber.
- * It is a simple device which collects the settleable particulates at the source.
- * In this enlarged compartment is there in order to reduce the velocity of the carrier gas.
- * The solid particulates having higher density than the surrounding gas, settle under influence of gravity on the base of the chamber from where they are removed through dust hopper.



- * The settling chamber is based on the principle that the solids move along the chamber with the velocity of the gas and settle according to Stokes' law.
- * As a particle entering the chamber at the top would collect in the chamber if the settling time is equal to or less than the time taken for the gas to pass through the chamber.

$$\frac{h}{v_s} = \frac{L}{V}$$

$$v_s = \frac{hV}{L}$$

h = height

v_s = settling velocity of particulates

L = length

V = horizontal velocity

Also by Stokes law

$$v_s = \frac{g(s-1)d^2}{18\mu}$$

$$d = \left[\frac{18\mu v_s}{g(s-1)} \right]^{1/2}$$

Inertia Separators

There are two types

1. Impact Separators
2. Cyclone dust separators

Note:

The settling chamber is simple to construct, low in cost and is suitable for coarse particulates of size $\geq 10\mu$.

Inertial Separator

- These are two types:
- i) Impact Separators
 - ii) Cyclone dust separators

Impact Separator

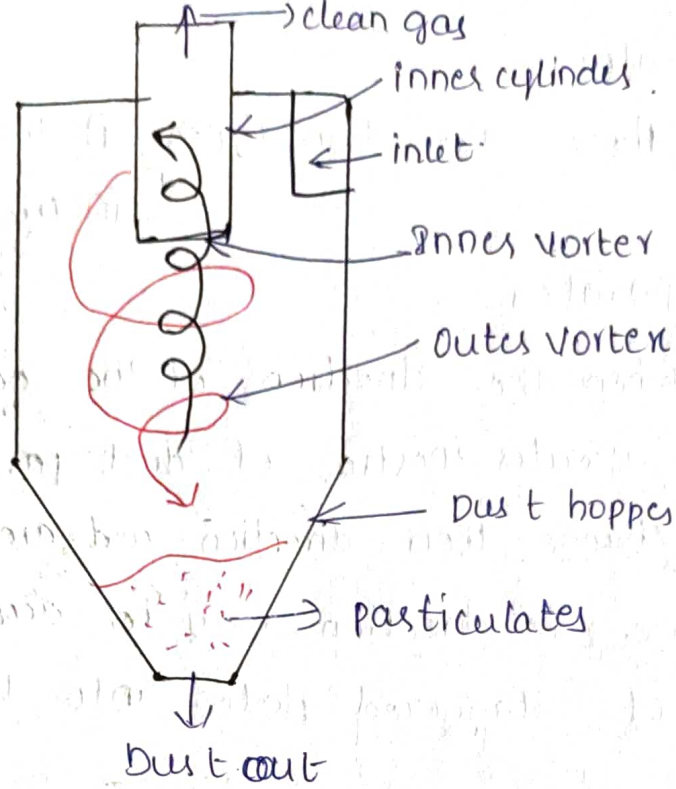
When the direction of the gas suddenly changes, because of greater inertia of dust particles, they cannot suddenly change their direction and are separated out.

- * The change of direction may be accomplished by the insertion of staggered plates into the path of gas stream.
- * The plates are set to force a quick sharp change of direction of gas stream, for a large portion.
- * At the point of sharp change of direction of gas stream, the dust particles are separated out and collected in the bed of the collector's bottom.
- * Particulates of the size 20-30 μ can be removed.

Cyclone dust Separator

Cyclone dust separator uses the principle of centrifugal action.

- * The carrier gas enters at the outer wall of the device to form a vortex. As it swirls around inside a cylindrical conical shell.
- * The particulates are forced against the wall by centrifugal force and are slowed down by friction, when they slide down a dust hopper.
- * The clean gas spirals out through an inner cylinder.
- * These are more efficient in removing particulates of size 10-20 μ .



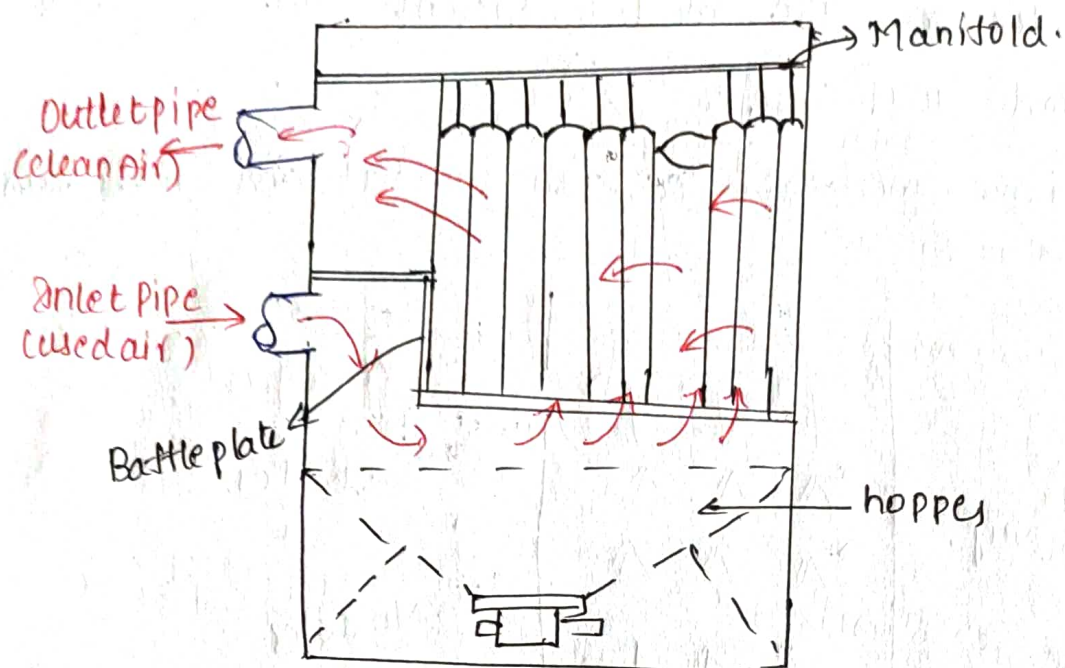
Filters

filters are of two types (i) fabric filters
(ii) Deep bed filters

1) fabric filters / Bag filters.

The filter is in the form fabric tubular bags placed vertically in a chamber and kept suspended having open ends attached to a manifold.

- * The used gas on entering the chamber is made to strike a baffle plate and this causes the larger particles to fall into the hopper
- * The carrier gas flow upwards into the tubes and then outwards through the fabric leaving behind the smaller particles in the form of pre cake called cake.
- * The dust cake initially helps in entrapping more particles, but as it becomes larger in size obstructs the gas flows and has to be removed by Shakes Mechanism.



Bag house filter.

Deep bed filters

In deep-bed filters, a fibrous medium in the form of mat of wool, asbestos, cellulose acts as a separator and the collection takes place in the pore spaces of the filter bed. They are most suitable for removal of light dust load.

Wet Scrubbers.

In this, water ~~for this~~ is used for the removal of particulates from the carrier gas.

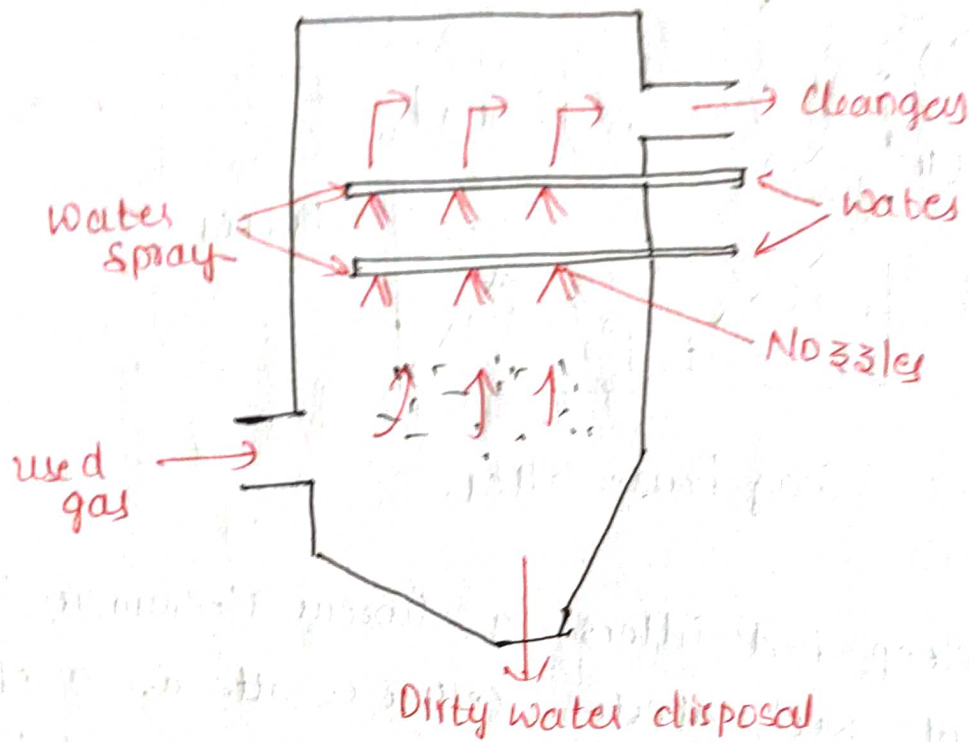
→ Spray tower.

In this, the upward flowing carrier gas is washed by the water sprayed downward from a series of nozzles, the removal is by the process of

Impingement and Interception

* As the gas containing dust is swept through an area containing water droplets, the dust particles impinge upon the droplets adsorb and are collected.

- * Spray towers are most efficient for removing particulates of around 10-4 size.
- * They have moderate cost to instal and maintain

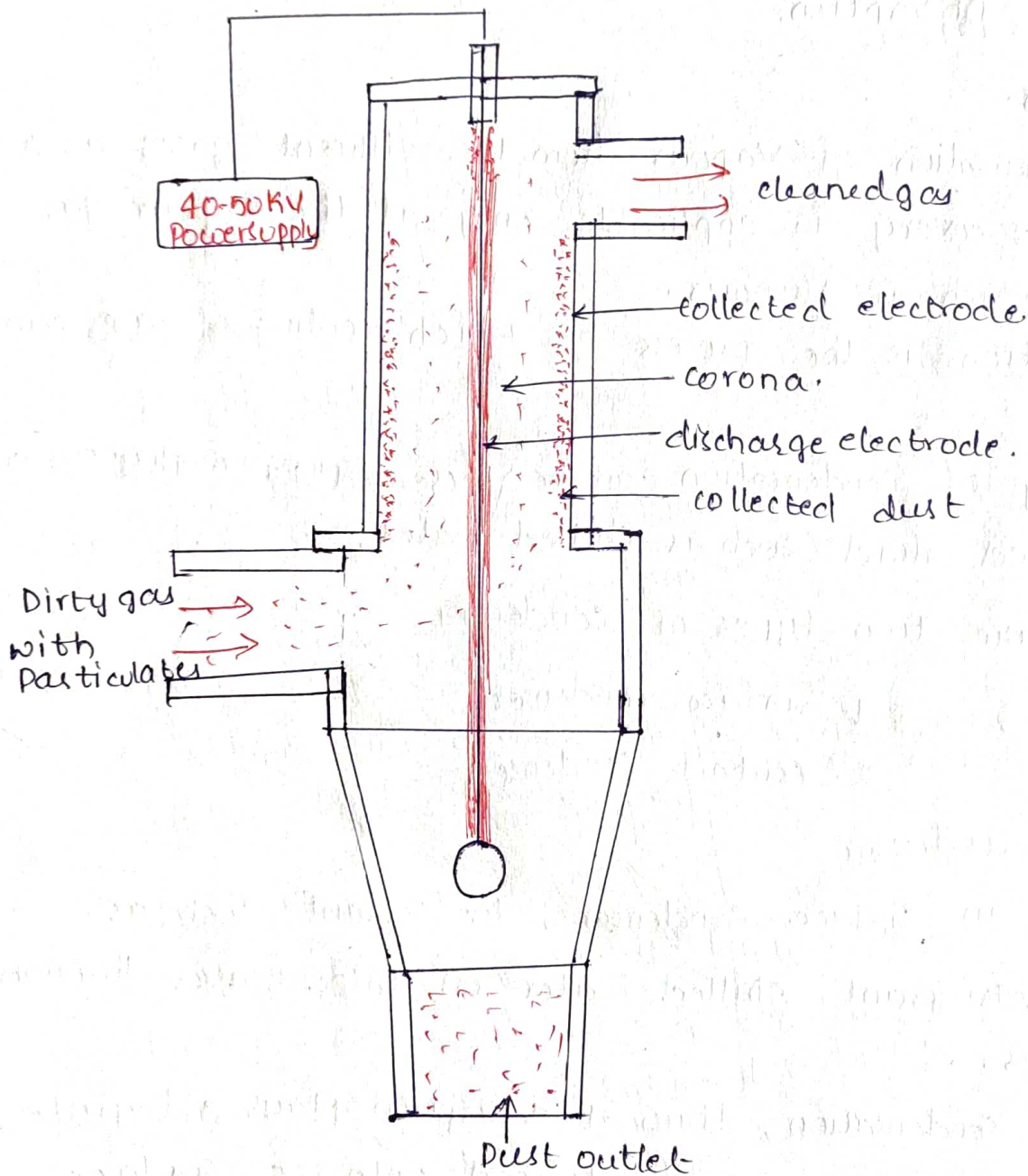


Spray tower

Electrostatic Precipitator

- Electrostatic Precipitation is a physical process by which particles can be removed from the gaseous medium.
- The gas stream is passed between a pair of electrodes, across which high potential difference is maintained.
 - The electrodes are discharge electrode at a high potential and an electrically grounded collecting electrode.
 - Due to the high potential difference, a powerful ionising field is formed called as corona.
 - Under the action of electrical field, gas ions formed in the corona move rapidly towards the collecting electrode and transfer their charge to the particles by collision with them.

- The Electrical field interacting with the charge on the particles then causes them to drift towards, and be deposited on the collecting electrode.
- The particles deposited on the collecting electrode lose their charge and then are removed mechanically by rapping or vibration to a hopper below the electrical treatment zone and are collected for disposal.



Single Stage Cylindrical Electrostatic Precipitator

Control of Gaseous pollutants.

There are four Mechanisms involved in the removal of Gaseous pollutants.

1. Condensation
2. Combustion
3. Adsorption
4. Absorption.

Condensation.

Condensation of vapour from the effluent gases as a method of recovery is applicable only if the vapour gas mixture is rich in vapour.

- Condensation is the process by which cooling of gases can be done.
- Efficiency of condensation can be increased by employing a refrigerated fluid such as chilled water.

There are two types of condenser

1. Surface condenser
2. Contact Condensers.

i) Surface condenser

In surface condensers, the coolant such as water, refrigerant, chilled water or brine passes through the tubes.

- In this condensation, Physical adsorption plays a key role, since contaminants are adsorbed onto a surface as gaseous component condenses.
- In the shell and tube condenser, as the cooling medium flows through the tubes, the vapour condenses on the surface of the tubes.

Combustion

In the Combustion Process, Organic compounds released from different Manufacturing operations are converted to innocuous CO_2 and Water.

- The combustion equipment used to control air pollution emissions are designed to push oxidation reactions as close as possible to completion.

There are three Methods

- 1) Direct flame combustion

- 2) Thermal combustion

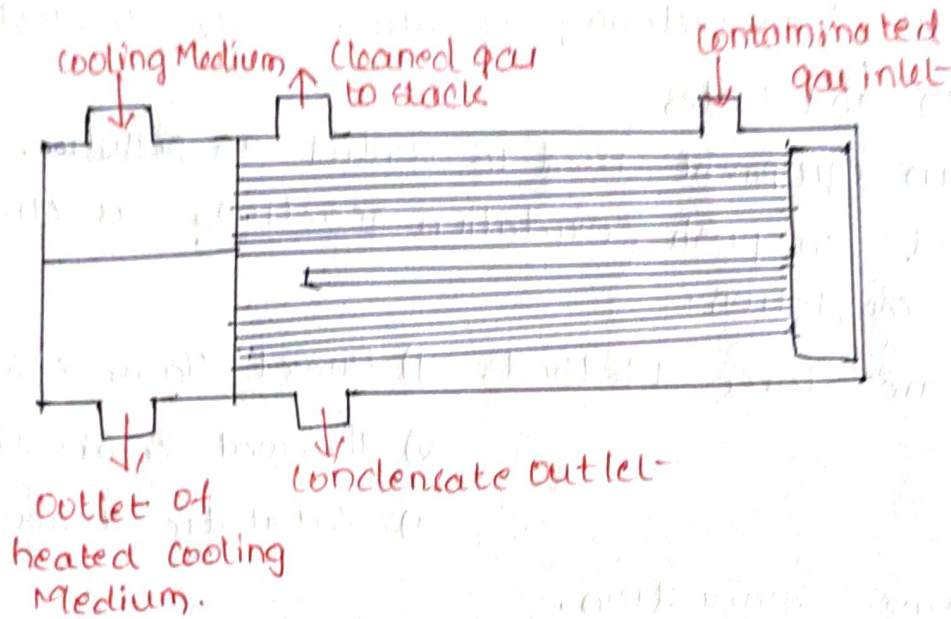
- 3) Catalytic combustion.

Direct flame combustion.

Direct flame combustion, as the name implies, is a Method by which waste gases are burned directly in a combustor with or without the aid of additional fuel such as natural gas.

- In some cases the waste gas itself may be combustible mixture without the addition of air.
- In other cases, introducing air and or adding a small amount of supplemental fuel will bring the gaseous mixture to its combustion point.
- flares are usually open ended combustion units maintained at the end of a stack or chimney discharging the waste gas stream.
- They are equipped with pilots to ensure continuous burning of gases.
- The combustion process should be designed in such a way that the flames burns at any wind speed, any gas flow.
- It is relatively safe Method to disposal of large quantities of highly combustible gases.

- The condensed vapour collects as a film of liquid and the liquid drains off to storage.



Surface Condenser

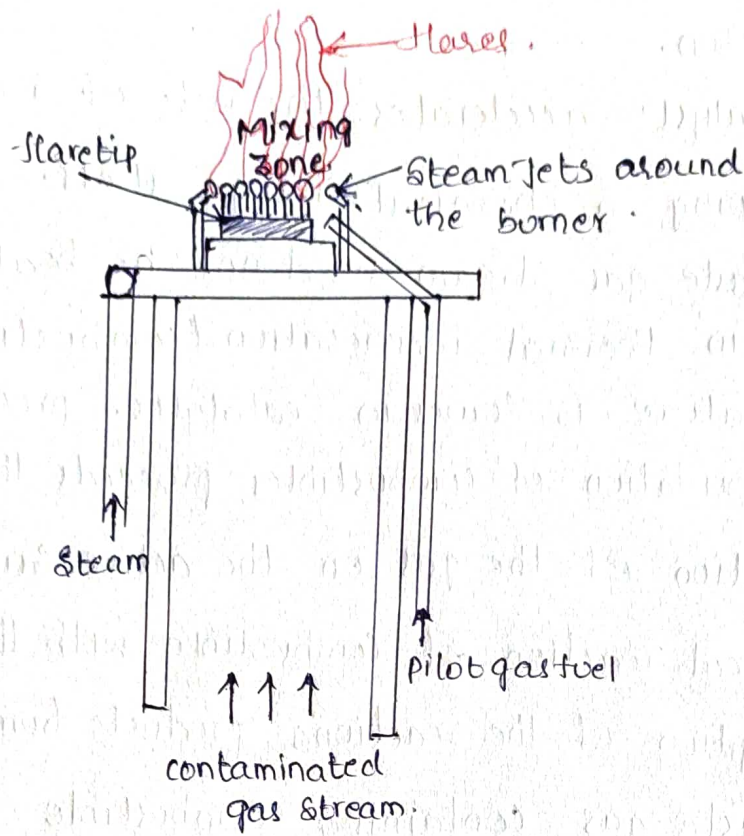
ii) Contact Condenser

The vapour and cooling Medium are brought into direct contact.

- The cooled vapour condenses and the water and condensate mixtures are removed, treated and disposed off;
- The chief advantages of contact condensers are that they are less expensive and more flexible than surface condenser and they are more efficient in removing organic vapour.

→ The specific application of the process of condensation depends upon the amount and type of coolant used, the liquid waste disposal problems and the amount of compound to be recovered.

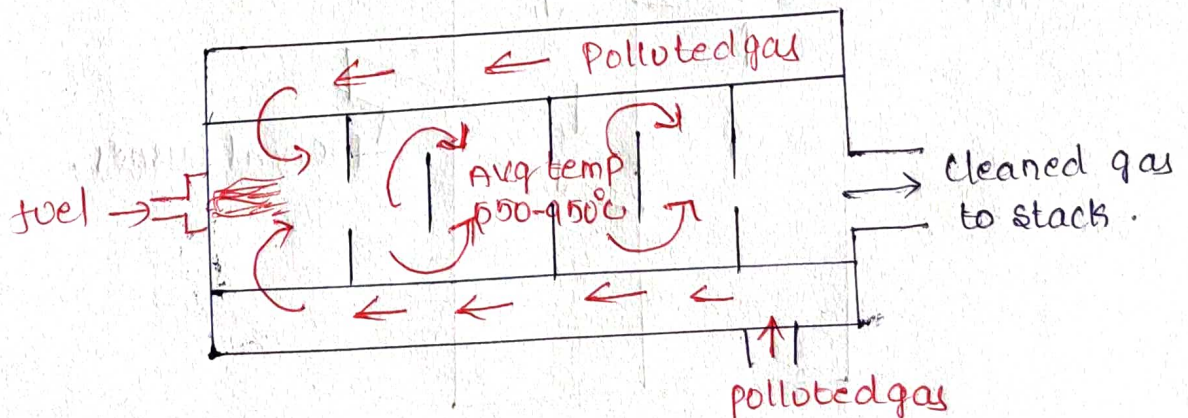
The Method of condensation is widely used as in air pollution control device in petroleum refining, petrochemical manufacturing.



Thermal Combustion.

When the concentration of combustible pollutants is below the lower explosive limit, thermal combustion is one of the choice for combustion.

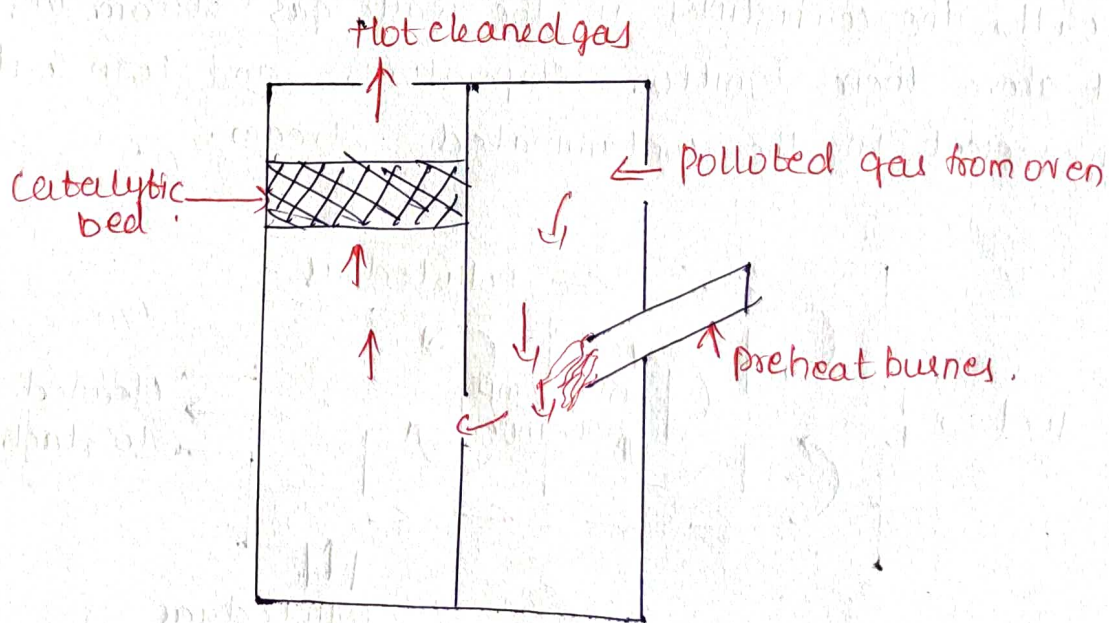
- The waste gas stream is preheated in a heat exchanger and then passed through the combustion zone of a burner, supplied with supplemental fuel.
- As a result, the combustibles in the waste gas stream are brought above their ignition temperatures and burn with the oxygen present in the contaminated stream.



Thermal combustion.

Catalytic combustion.

- A catalyst accelerates the rate of a chemical reaction without undergoing a chemical change itself.
- In this, the waste gas stream need not be heated to high temperatures as in thermal incineration (combustion) because ignition temperature is lower in catalytic processes.
 - The catalytic oxidation of combustibles proceeds through.
 1. Adsorption of the gas on the active surface.
 2. Chemical reaction of combustible with the Oxygen
 3. Desorption of the reactions products from the surface.
 - Most of the waste gas containing combustible pollutants from industrial processes are at low temperature, so preheating burner is used to bring the waste gas upto the temperature at which the catalyst will be effective.
 - The effluent gases from the catalytic conversion are CO_2 , water vapour and Nitrogen only.
 - The catalysts used for effective pollution control are the Precious Metals Platinum and palladium.



Adsorption.

The forces which hold atoms, molecules or ions together in the solid state exist throughout the body of a solid and its surface.

- Any gas, vapour or liquid will adhere to some degree to any solid surface. This phenomenon is called Adsorption.
- The adsorbing solid is called the adsorbent (or) sorbent and the adsorbed material is called adsorbate (or) sorbate.

Physical adsorption

The gas molecules adhere to the surface of the solid adsorbent as a result of intermolecular attractive forces between them. It is a reversible process.

Chemical adsorption.

Chemical Adsorption results from chemical interaction between the adsorbate and the adsorbing medium. It is an irreversible process.

Adsorbents.

Activated Carbon consisting largely of Neutral atoms of a single species, presents a surface with a relatively homogenous distribution of electric charge. Therefore Activated carbon is effective in adsorbing molecules of organic substances.

Adsorption Equipment.

Adsorbers are the devices that physically contain the adsorbent solid through which the effluent gas passes.

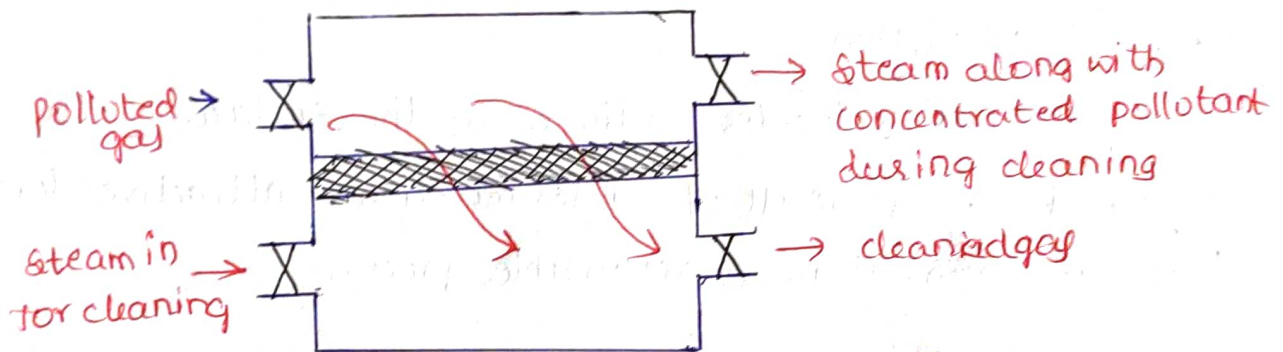
Adsorption reactors (i) fixed Bed unit

(ii) Moving bed Adsorbers.

fixed bed unit

In this type of containers are of vertical or horizontal cylindrical shell. Activated carbon, often used as the adsorbent, is arranged as bed or tray in thin layer of 1-5cm thickness.

- These thin bed adsorbers are most oftenly used in purification of air containing very low concentration of pollutants.

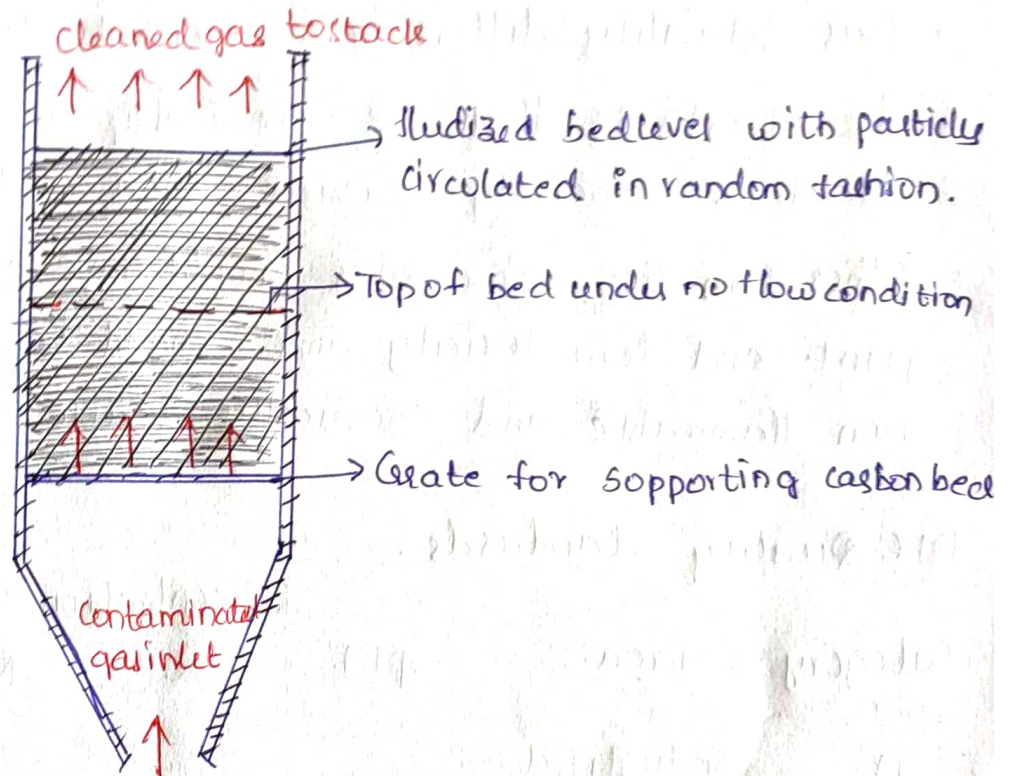


Moving Bed Adsorbers:

Activated carbon contained a rotating drum acts as the adsorption bed. The effluent gas contaminant is moved into the rotating drum.

- It contains a shallow floating bed of adsorbent and when gas passes upward through the bed, it expands and fluidises the adsorbent.
- The expanding and fluidising of the adsorbent provides intimate contact between the contaminated gas and the adsorbent and prevent channeling problems.
- Most of the adsorption units are highly efficient unit a break point occurs, when the adsorbent becomes saturated with adsorbate, At that adsorber should be regenerated.
- Depending upon the collected gas-desorption, adsorbers can be classified as Generative or regenerative.

- The non regenerative process is more costly because the adsorbent must be disposed after exhaustion and replaced with new material.
- The regenerative systems provide for the periodic recovery. In systems which rely on physical adsorption, regeneration of an adsorbent can be accomplished by use of superheated steam or circulating hot air.
- The bed must be cooled before use.



Absorption:

The principle of gas absorption is a gas-liquid contacting process for a gas separation that utilizes the preferential solubility or chemical reactivity of a pollutant gas in the liquid phase.

- Liquid Absorbents may utilize either chemical (reactive) or physical (non reactive) changes to remove pollutants.
- Liquid Absorbents may be act as reactive if the absorbent utilizes chemical change to remove pollutants.
- For Instance, SO_2 may be removed from the gases by injecting water and limestone. which reacts to form

calcium hydroxide.

- Calcium hydroxide then reacts with sulfur dioxide to calcium sulphate salt, which can be scrubbed from the gas stream by moving water.
- If gases are removed by simply dissolving the gas without chemical change, the absorbent is termed as non reactive absorbent.
- Gas solubility differs from absorbent to absorbent.
- The absorbents that are chemically similar to the absorbate generally provide good solubility.
- Other than this, absorbates should have a low freezing point and low toxicity and should be non volatile, non flammable and chemically stable.

Air Quality Standards.

Category	Area	SPM	Concentration ($\mu\text{g}/\text{m}^3$)		
			SO ₂	NO ₂	CO
A.	Industrial and Mixed use	500	120	120	5000
B	Residential and rural	200	80	80	2000
C.	Sensitive	100	30	30	1000.

Noise pollution

A sound is produced when part of the environment atmosphere is compressed suddenly, when the air is elastic, the particles originally disturbed in turn disturbing the neighbouring particles. Ultimately, the compression is propagated or spread away from the source. The sound travels in the form of waves and wave come near our ear drums, and felt the sensation of hearing.

- When the sound waves are periodic, regular and long duration and pleasant to hear, such sound is known as "Musical sound"
- When the sound waves are ^{non} periodic, irregular and of short duration and not pleasant to hear, such sound is known as noise.

Sources of Noise

Indoor noise

The sources of indoor noises are moving people, crying of babies, playing of radios, banging of doors, traffic on staircase, movement of furniture, conversation of occupants, operation of cistern etc.

Outdoor noise

These noises are created from nearby streets and the largest source of outdoor noise is generally the automobile traffic on the road. The other sources of outdoor noises are railways, aeroplanes, loudspeakers etc.

Effects of Noise pollution.

These are two types

- i) Auditory effects.
- ii) Non-Auditory effects.

Auditory effects

i) Auditory fatigue:

It appears in the 90dB region. It may be associated with the phenomena of whistling and buzzing in the ears.

ii) Deafness.

It is the most serious pathological effect or the hearing loss.

- The hearing loss can be temporary or permanent.
- Temporary hearing loss occurs in the frequency range between 4000 to 6000 Hz.
- The disability generally disappears after a period of about 24 hrs.
- Permanent hearing loss occurs when there is repeated or continued exposure to noise at the level of 160 decibels.

Nonauditory effects

i) Interference with speech.

Noise interferes with speech communication at the frequencies of 300-5000 Hz. Such frequencies are common present in the noise produced by air and road traffic.

ii) Annoyance

It is primarily a psychological response.

People suffering from neurosis (a mental disorder) are more sensitive than the balanced people.

iii) Efficiency:

A low level noise is always desirable where mental concentration is to be undertaken. Reduction in noise tends to increase work output.

iv) Psychological changes.

A number of temporary psychological changes occur in the human body as a direct result of noise exposure. These include a rise in blood pressure, increase in heart rate, and breathing and increase in sweating.

Control of Noise pollution.

Following measures may be taken to have an effective control on the noise pollution.

Ear protection Aids.

For noisy industries, the workers should be provided with the protection aids like soft plastics and rubber earplugs, etc.

Design of Doors and Windows.

For reducing noise, it is necessary to design carefully the doors and windows of the room. The sound travels through very thin cracks between the door and wall. The walls and frames are packed with sound absorbed material.

Enclosures:

A practical and efficient method of reducing noise in a system is to provide enclosures, shields and barriers so that some of the sound waves are cut off from propagating.

Planting of Trees.

A new concept gaining acceptance is the planting of trees like Neem, tamarind, coconut etc. This also will cut off or propagating of sound waves.

use of silencers or filters.

The Method is applicable to the control of noise from ducts, exhausts, vehicles etc..)

Vibration damping

This arrangement is attempted to reduce vibrations. A layer of damping material in the form of resilient pads made of rubber, neoprene, cork etc.. for high frequency vibrations.

Selection of Machinery.

If the operational processes in a factory may be fixed and may have no quieter alternative, careful selection of the machine tools and equipment to be used to obtain lower noise levels in the machine shop.

Reducing Noise from potential sources.

Noise from handling and dropping of materials on hard surfaces may be reduced by using soft resilient materials on containers, fixing rubber tyres on trucks etc..

use of acoustic Material.

Acoustic Material is used to reduce the noise pollution. These absorb the sound waves and will not allow to propagate.

Industrial waste water Management.

Strategies for pollution control.

Volume Reduction

Classification of wastes: Concentrated waste waters of Manufacturing Process are segregated from dilute wastes as cooling waters, thereby reducing the intensive treated required.

- Sometimes it is possible to classify and separate the process waters themselves so that only the most polluted ones are treated and relatively uncontaminated ones are discharged without treatment.

Changing production to decrease waste.

Changing production to decrease wastes is an effective method of controlling the volume of wastes but is difficult to put into practice.

Several measures that can be used.

1. Improve process control
2. Changing raw materials
3. Improve Equipment design.

Reusing both industrial and Municipal effluents for Raw water supplies.

- This is mainly used in the areas, where the water is scarce or expensive.
- In this, the waste which is coming from the industries and from municipal waste was treated and let it use reuse for the manufacturing or cooling purposes as a Raw water.

Elimination of Batch or Slug discharges of process wastes

In "wet" Manufacturing of a product, one or more steps are sometimes repeated, which results in production of a significantly higher volume and strength of waste during that period.

- If this waste is discharged in a short period, it is usually referred to as 'slug discharge'.

Strength Reduction.

Process change: Industry can modify manufacturing process so that fewer wastes are created.

Equipment Modifications: Changing the equipment can affect a reduction in the strength of the waste, usually by reducing the amounts of contaminants entering the waste stream.

Segregation of wastes: It reduces the strength eliminating the difficulty of treating the final waste from an industrial plant.

- In this, waste is segregated depends upon the concentration. Strong waste having small volume is segregated from weak waste having large volume.

Proportioning of wastes.

It is the discharge of industrial wastes in proportion to the flow of municipal sewage in the sewers or to the stream flow.

Monitoring waste streams.

Accidental spills and controlling malfunctioning of treatment plants.

Neutralisation:

Excessively acidic or alkaline wastes should not be discharged without treatment into a receiving stream.

- Neutralisation is reducing the impacts of acids or alkalis by mixing them each other.
- Any industry that discharges any sort of effluent into sewers, systems, lakes, streams is required to neutralise before discharge.

pH Neutralisation Systems:

A simple pH neutralisation system consists of four basic components.

1. Instrumentation for Monitoring, controlling, recording etc.
2. Effluent holding tank.
3. Chemical reagent storage tanks and addition pumps.
4. Agitators.

In such a system, effluent flows into the holding tank where a pH sensor measures the pH of the solution. If the pH value is not satisfied, chemical pumps operate to inject acid or caustic solutions as required to bring the effluent in the holding tank to correct level. The agitator keeps the contents of the holding tank adequately mixed so that the pH probe is always measuring a representative sample of the effluent.

pH Neutralisation process:

pH neutralisation can be done in a batch or continuous mode. Batch systems operate by filling an effluent holding tank and carefully treating the contents with a variety of chemicals to remove metals and contaminants before finally setting the pH level before discharge.

Continuous Systems operate by flowing effluent through a series of tanks or basins where measurements are taken and treatment chemical are added.

Whichever treatment mode is used, it is of primary importance that measurements can be depend upon chemical addition equipment is in good condition if the final effluent is to be safe the discharge.

After the neutralisation process is completed, the effluent is discharged to waste. At the point of discharge, a pH sensor should be installed dedicated to monitoring and recording the effluent pH level.

Common Problems for pH Neutralisation Systems.

Many of the operational problems encountered in a pH Neutralisation System are related to pH sensor performance, with incorrect choice of electrode technology and placement being common sources of the problems.

→ Common Effluent Treatment Plant: (CETP)

Effluent treatment plants need land for construction, capital cost, power and specialised man power for their operation and maintenance.

- Because of these constraints, small scale industries cannot afford to have their own effluent treatment facilities and therefore, combined effluent from all Tanneries are to be brought to a common place for ~~the~~ treatment.
- This facility is called Common Effluent Treatment plant.
- the expenses for operation and maintenance of CETP are being shared by participating industries.

Factors affecting

- Categories of effluent generating member industries
- Pretreatment requirements.
- Segregation of effluent streams at individual member industries
- Collection and Monitoring Mechanism.
- Mode of disposal.
- Qualitative and Quantitative fluctuations of effluent.

Advantages of CETPS.

- It is Economical.
- Homogenisation of waste water.
- Professional control over treatment can be affordable.
- Eliminate Multiple discharges in the area, provides opportunities for better enforcement i.e., proper treatment and disposal.
- Provide opportunity to improve the recycling and reuse possibilities.

Disadvantages.

- No separate treatment for hazardous and toxic effluents
- Operating on 'one size fits all basis'
- No provision to tackle fluctuations in the pollution load and quantities at individual member industries.
- Improper Management of treatment units.

Conveyance System.

Prevailing Modes of collection of Effluents from individual industries. to CETP.

- Tankers
- Pipes
- Open channels
- Combination of above.

The choice of the conveyance system shall be based on topography of the area, nature of the effluent to be conveyed, location of treatment plant.

Treatability.

In this studies have been conducted. to know the characterising the physical, chemical and biological nature of the liquid waste water.

- In that way, they can choose the economical ways to treat and Manage such wastewaters to meet the regulatory criteria for safe disposal and for reuse.

Objectives of Treatability.

- To understand the nature of Effluent.
- To Select the possible treatment Schemes by conducting lab scale studies.

Choice of Technology.

Based on the treatability process, the appropriate technologies can be identified. to treat the waste water.

for example, if the waste containing high TDS and high COD, it means it is not biodegradable but toxic. So, that type of waste is treated. Thermal decomposition, chemical oxidation etc..

Solid waste Management

Solid wastes are defined as those wastes from human and animal activities. In the domestic environment, the solid wastes include paper, plastics, food wastes, ash etc.

Improper Management of Solid wastes has direct adverse effects on health. Insects, rodents and bird species acts as passive vectors in the transmission of some infectious diseases.

Importance of Solid waste Management

- Reduce the contamination of water, soil and air.
- Many workers who handle waste and individuals who live near or on disposal area are infected with worms, and other related organisms.
- Reduce toxicity of food and water.
- Reduce resource depletion.
- Prevent the household from experiencing the hazardous outcomes of solid waste material.
- Reducing and eliminating adverse impacts of waste materials on human health and the environment to support economic development and superior quality of life.

Hierarchy of Solid waste Management. [Draw the flowchart that given in notes].

Separation:

Separation can be either at source in the household (or industry) or at the transfer station or at final destination where Mechanical separation or sorting is possible. If Municipal waste is separated at source,

it eliminates the need for expensive and difficult manual and/or ~~elirino~~ Mechanical Sorting.

Manual and Mechanical Sorting / Separation

Manual Sorting can only be carried out either manually or Mechanically at the final destination. Manual sorting can only be recommended for clean, dry and more or less presorted waste.

Mechanical Sorting is more commonly used. Magnetic Separators are used to separate the ferrous and non ferrous components. Vibrating Screens or rotating screens are used to separate fractions by particle size. Air screening and ballistic screens are used to separate light from heavy materials.

Storage

Generally Storage containers range from small plastic or Paper bags of 25L capacity to large containers with capacity upto 40,000L. The most commonly used for household waste from 120L to 390L for apartment buildings 600L to 1000L. Storage used depends upon collection system. like

- Doorstep collection
- Regular kerb collection
- Vacuum trucks
- Community recycle bins.

Transfer Stations

Transportation costs can be significant if distances are large. A transfer station should be placed or situated between the waste source and its final destination is used.

The objectives of transfer station.

- Reduction in Transport costs
- Reduction of traffic of smaller vehicles at the treatment site
- Reduction the waiting time for vehicles in transit.

Methods involved in MSW management.

Waste Minimisation.

Waste minimisation as regards MSW means of reducing the amount that is generated at source.

Some of the sources as follows.

- Production units for food and household products.
- Shopping outlets
- Households.

for eg., in households, food wastes can be minimised. In office or other institution paper can be printed on both sides.

Reuse and Recycling

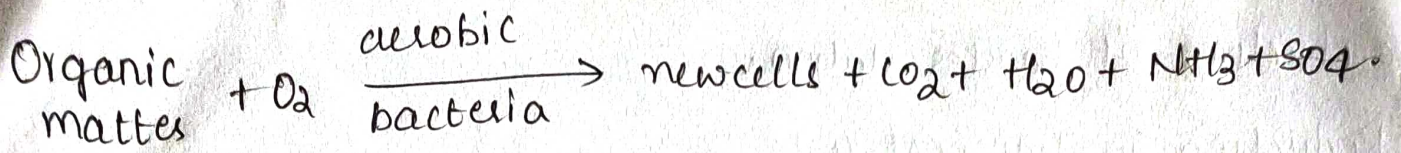
Recycling and Reuse one of the important technique for the sustainability.

- Some of the Reuse and Recycling materials are Aluminium cans, Paper and cardboard, glass, Plastics. etc..)

Biological treatment.

(i) Aerobic (or) Composting.

Composting is an aerobic process where microorganisms, in an oxygen environment, and decompose the organic waste



Composting depends on

a) Temperature: The composting process is exothermic and goes through temperature variations throughout its development

Psychrophilic — 15 to 20°C

Mesophilic — 25 to 35°C

Thermophilic — 50 to 60°C

In thermophilic stage, the biological activity is more

b) Moisture content: Moisture content should be in range of 50 to 60%. If the moisture content less than the optimum the biological activity reduces and if it more than the optimum, the more voids filled with the water, which leads to foul smell and undergoes anaerobic decomposition.

c) Oxygen content: The oxygen content should be in range of 15 to 20%. If the oxygen is less, it slows down the biological activity.

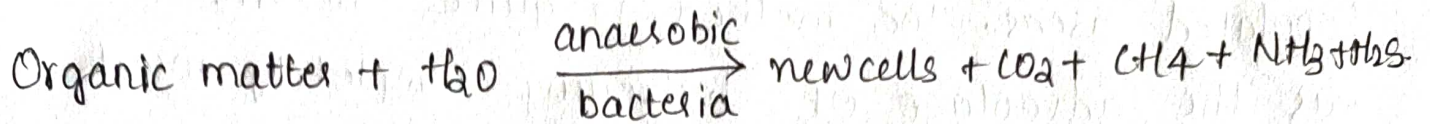
d) pH: The pH should be in range 6 to 8.

e) Biochemical composition and texture.

The biological activity also depends on the biochemical composition. The texture influences the process of retaining of moisture content and oxygen.

Anaerobic (or) Biogas.

Anaerobic digestion is described by.



• The Byproduct Methane used as a Biogas.

• To produce Methane, it undergoes three stages.

(i) Hydrolysis — Breakdown of high molecular compounds to lower molecular compounds like lipids to fatty acids, polysaccharides to Monosaccharide

ii) Acidogenesis — lower molecular components to lower molecular intermediate compounds like butyrate, formalin, acetate

iii) Methanogenesis — Intermediate compounds to final products Methane and CO_2 .

Thermal Treatment

• If thermal degradation takes place with a deficit of oxygen is called gasification.

• If it happens, heating without access of air is called pyrolysis.

• Thermal degradation with excess oxygen is called

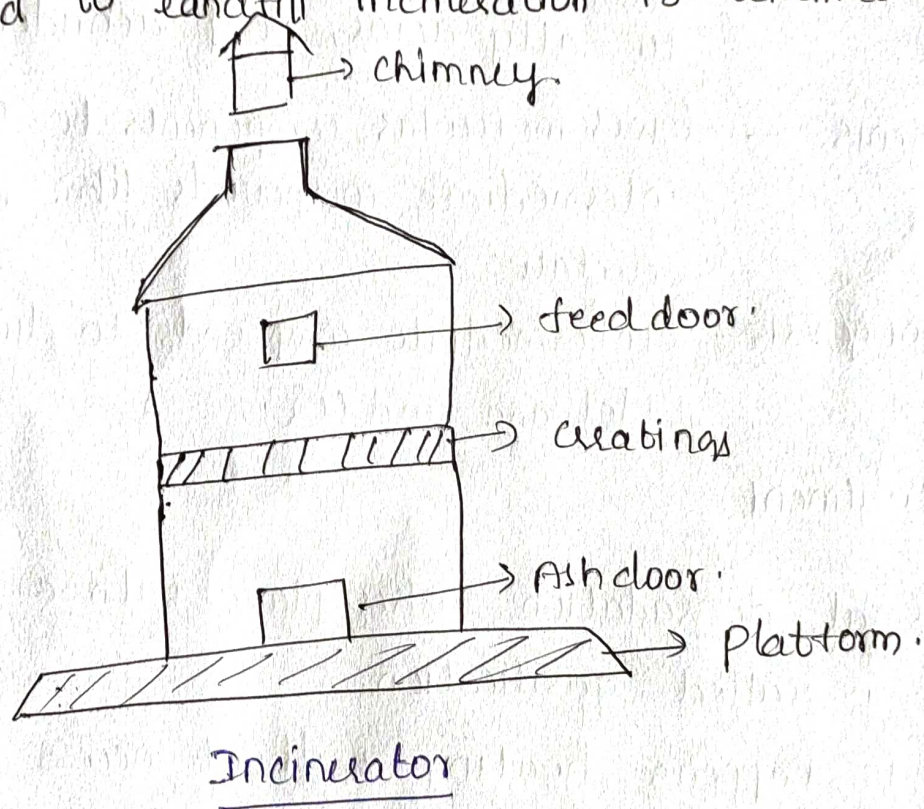
combustion, if added in the presence of air is called Incineration.

→ Incineration.

Incineration involves the burning of solid waste in an incinerator. The incinerator in its simple form, consists of a furnace provided with grating and chimney. charging doors are provided for feeding solid waste into the furnace. The burnt ash

is removed through ash door.

- Generally, it is adopted in crowded cities and populated areas. The method is quite effective and has the advantage of destroying completely insects and pathogenic bacteria.
- However, because of the large amount of smoke and gases emitted in the process.
- It also damage the buildings facework and vegetation.
- As compared to landfill incineration is tentimes costlier.

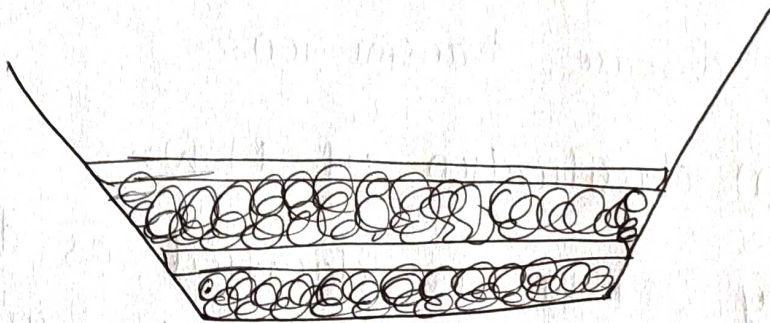


Land filling.

It requires the solid waste material to be placed in a trench or other prepared area. It is adequately compacted and covered up with a 15cm layer of earth spread at the end of each working day. When the solid waste is compacted to a height generally not more than 2.5m, it is covered with 60cm of earth on the top and on the sides. The earth cover, when properly compacted, ensures that rats and other animals.

are prevented from burrowing and further odours and volatile gases do not escape through cracks.

- The action in the fill is the Organic decomposition as a result of which the fill area settles till it is finally stabilised in the soil in a period of 2 to 3 years.



landfill

Unit 4 Environmental Sanitation.

Sanitation:

Sanitation is the hygienic means of Promoting health through prevention of human contact with the hazards of wastes, as well as the treatment and proper disposal of Sewage or wastewaters.

Environmental Sanitation:

'Environmental Sanitation' means the art and science of applying Sanitary, biological and physical science principles and Knowledge to improve and control the environment and factors therein for the protection of the health and welfare of the public.

Environmental Sanitation Methods for Hostels.

Five Essential food safety and hygiene Practices which Must be Kept in Mind.

1. Wear Proper clothing and footwear:

Wearing Proper clothing and footwear for food ~~use~~ Processing is the best way to maintain cleanliness of food which is particularly important when working in an industry such as a hostel where standards need to be kept high.

- Any employees in a hotel which deals with processing food should wear impervious gloves and should be kept clean and sanitised and Jewellery must be removed.
- Wearing Proper footwear is a standard followed by any food manufacturing company. Wearing the correct footwear which is sturdy, clean and comfortable is must.
- The proper clothing includes wearing an apron, coat, hairnet and gloves.
- Finally, you must also ensure that you have hair and facial hair protection on at all times.

2. Keep your hands clean.

Keeping your hands clean in any industry is must and daily process for us all, as it prevent the spread of diseases.

if you work in the food processing industry then you must ensure that you wash your hands before working, after lunch, after a toilet break or any time that your hands touch food or cigarettes. In other words, all workers in the industry must wash their hands before revisiting their workstation in the kitchen. All persons wash their hands properly with soap and warm water.

3. Ensure that the tools and equipment are clean and sanitised.

Another practice which must be kept in mind is ensuring that the tools and equipment used within food processing in hotels are cleaned and sanitised. Not only Bacteria present in tools and equipment that are used on a daily basis, but are also present in the carts, hoses and other supplementary materials which are used inside the food industry.

So, the best way to keep all these objects clean is by regularly sanitising them with an Antibacterial agent.

4. Make use of food safety equipment and Metal detectable equipment.

Making use of metal detectable and food safety equipment in the kitchens of hotels are standard measures followed by food Manufacturing industries to make sure there are no contaminants being brought into the workplace.

5. Step on the footbath

Lastly, one of the best ways to make sure you do not bring bacteria and contaminants into the kitchen of hotels is by stepping in the footbath.

Just ensure that the footbath present in workplace should have enough sanitising agents so that it will not become ground to bacteria to form.

Effects

1. food contamination
2. Spread of sickness and disease in the workplace

2) Environmental Sanitation Methods for hospitals.

(i) Hand washing.

Wash hands after touching blood, secretions, excretions and contaminated items, whether or not gloves are worn.

- Wash hands immediately after gloves are removed, between Patients contacts.
- Use a plain Soap for routine hand washing
- Use a antimicrobial agent for specific circumstances.

(ii) Gloves.

Wear gloves when touching blood, body fluids, secretions, excretions and contaminated items. Put on clean gloves just before touching mucous membranes and intact skin.

(iii) Mask, eye protection, face shield.

Wear a mask and eye protection or a face shield during Procedures and patient care activities that are likely to generate splashes or sprays of blood, body fluids, secretions and excretions.

(iv) Gown.

Wear a gown during procedures and patient care activities that are likely to generate splashes or sprays of blood, body fluids, secretions and excretions.

v) Patient-care equipment.

Ensure that reusable equipment is not used for the care of another patient until it has been cleaned and reprocessed appropriately.

vi) Environmental control.

Ensure that the hospital has adequate procedures for the routine care, cleaning and disinfection.

vii) Occupational health and bloodborne pathogens.

Take care to prevent injuries when using Needles, scalpels and other sharp instruments or devices.

- Use ventilation devices as an alternative to mouth-to-mouth resuscitation Methods.

3) Environmental Sanitation Methods for Swimming pools.

Proper sanitation is needed to maintain the visual clarity of water and to prevent the transmission of infectious waterborne diseases.

- * Contamination can be minimised by allowing the swimmer showering before and after swimming and also not letting the children with intestinal disorders swim.
- * Effective treatments are needed to address contaminants in pool water because prevention of introduction of pool contaminants, pathogenic and nonpathogenic into swimming pools is impossible.
- * To kill pathogens and help prevent recreational water illnesses, pool operators must maintain proper levels of chlorine or another sanitiser.
- * Overtime, calcium from Municipal water tends to accumulate, developing salt deposits in the swimming pool walls and equipment like filters, pumps, reducing their effectiveness. Therefore, it is advised to either completely drain the pool, and refill it with fresh water, or recycle the existing pool water using Reverse osmosis.
- * Pool operators must also store and handle cleaning and sanitation chemicals safely.

4) Environmental Sanitation Methods for public bathing places?

A capable manager or caretaker shall be in charge of public bathing places. So, he is the responsible for maintaining the public bathing place continually in good repair and in a clean, sanitary and healthful manner.

Vector Control

Adequate measures for the control of Arthropods and rodents, (or) any other insects or Mosquitoes.

Water quality

The water used at Public bathing places for swimming or recreative bathing shall meet the bacteriological, chemical, physical and radiological standards of the department.

Circulation.

Water shall be introduced to and withdrawn from the pool in a manner that provides uniform circulation and uniform disinfectant residual throughout the entire pool.

Clarity of the pool.

Water in the pool shall be sufficiently clear to permit a black disc, 6 inches in diameter on a white field, when placed on the bottom of the pool at the deepest point, to be clearly visible from the runway or deck around the deep area of the pool.

Disinfection of pool water.

When chlorine or a hypochlorite compound is used for disinfection, the free chlorine residual in the water in all parts of the pool.

5) Environmental Sanitation Methods for Public Gatherings (Mela's)?

During the Mela.

1. Supply of protected water - regular disinfection of water source.
2. Maintaining cleanliness of ~~mela~~ ^{mela} ground by scavengers.
3. First aid centres in the different zones of the Mela ground.
4. Isolation and treatment of the sick in the hospital.

After the Mela is over.

1. cleaning the area - particularly in a permanent place of pilgrimage by disposal of refuse of all types.
2. the whole place is should be sanitise and pour some bleaching powder along the sides of the road.

Before the Mela.

After selection of the site the whole area should be cleared of Jungles and vegetations and divided into plots. Each plot should be kept under the supervision of a Sanitary Inspector with a Conservancy Squad who will be responsible for all sanitary measures for that area.

2. There must be a provision of police patrol to enforce all Sanitary measures in general. The place should be carefully marked out and provision should be made for the accommodation of police. Hospital, water supply, residential blocks and latrines. All shallow depressions and pools should be filled up or fenced in, so that people cannot use them.
3. Medical and Sanitary Arrangements should be arranged along with the Medical offices.
4. Each block should be placed under the charge of a Sanitary Inspector who will inspect daily the area under him and report the occurrence of any suspicious case of illness. Arrangements must also be made for receiving daily report from sweepers in charge of latrines.

6) Environmental Sanitation Methods for Hostels.

A) Pest Control Programme.

Engage a registered pest operator to carry out regular pest control works.

- Look for signs of pest infestation such as rodent droppings, Cockroach droppings etc..)
- Check for stagnant water which can breed mosquitoes and destroy all potential breeding habitats.
- Ensure no stray animals/crows in the premises.

Toilets.

- Check to ensure all toilets facilities are in good working order at all times.
- Keep toilets clean and floor dry at all times.
- Clean and sanitise toilet bowls, urinals and wash hand basins
- Clean mirrors, door knobs, and any other surfaces where there is contact with users.
- Check for any leakage in the Sanitary pipes, especially at the joints. Any leaks or defects should be rectified immediately.

- Use an inspection card to monitor the daily maintenance of the toilet
- Schedule more frequent cleaning during peak hours.

Personal Hygiene.

- Dormitory and Hostel managements / operators are also encouraged to educate their students, staff and workers.
- To observe good personal hygiene and toilet practices like wash hands with soap and water before and after meals and after visiting crows.
- Keep the environment tidy and litter free.
- Spit, cough or sneeze into tissue and throw the soiled tissue into litter bin.
- Do not share personal items like toothbrush, razors.