Municipal Solid Waste

It includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi solid form excluding industrial hazardous wastes but including treated bio-medical wastes. (MSW Rules 2000)

Types of Municipal solid waste:-

A) Garbage:- It include all type of biodegradable organic waste obtain from domestic activity. Normally density is 450-900 kg/m³. Example:- waste from kitchen, hotels, vegetable peels etc.

B) Rubbish :- All types of non-biodegradable waste except ashes. Density - 50-400 kg/m³. Example :- paper pieces, broken glass, furniture, cardboards.

C) Ashes:- Its incombustible waste product from the furnace and have density of 700-850 kg/m³.

Properties of solid waste:-

1. Density of solid waste.
2. change in volume of MSW (Municipal Solid Waste)
3. Moisture content.
4. chemical formula and energy content of solid waste.

Methods of Disposal:-

1. Incineration (Burning @ 1200-1500°c):- In this method, waste is heated in the presence of abundant supply of oxygen at high temperature. It is generally used for those waste have quantity of combustible waste. It is an exothermic process (release heat).

2. Thermal pyrolysis (450-500°c):- It is the process of burning the waste in limited supply of oxygen and waste is converted into charcoal like product.

3. Distillation: It the process of separating the component which have different viscosity.

4. Pulverization:- In this method waste is broken down into smaller parts which can finally disposed by any other method.

5. Autoclaving:- It is also known as "steam sterilization process". It is use to dispose radioactive waste. In this method steam is brought in contact with waste under control condition and for sufficient duration.

6. Composting: composting is the biological decomposition of organic waste such as food or plant material by bacteria, fungi, worms and other organisms. The natural organic components of MSW (Food and plant wastes, paper etc) can be composted aerobically to carbon dioxide, water and a compost product that

can be used as soil conditioner. Anaerobic digestion or fermentation produces methane, alcohol and a compost product.

Methods of composting:-

(a) Anaerobic Method (Bangalore Method):- It was developed at 'Bangalore' in India by Acharya (1939). In this method pit about 1m are dug, breath and length are depend upon availability of land. The pit should have sloping walls and floors of 90cm slope to prevent water logging. Organic residues and night soil are put in alternate layers and filling pit is covered within a 15-20 cm thick layer of refuse. The material are allowed to remain in the pit without 'turning and watering' for three months.

(b) Aerobic Method (Indore method):- It was developed at Indore in India by Howard (1924-1926). The site is selected at high level so that no rain water gets in during monsoon, it should be about 1 m deep, 1.5-2m wide and any suitable length. The pit is filled layer by layer and it should not take longer than 1 week to fill. The material is turned three times during the whole period of composting. The first time 15 days after filling, next another 15 days and third after another month.

C/N Ratio:- It is the Ratio in composting of input material, which is very important for bacterial activity to continue. Range for optimum digestion = 30-50.
where, C = carbon   and N = Nitrogen.

(i) If C/N Ratio is more:- N is used up prior to the carbon, there by leaving the decomposition incompletely (growth of bacteria will be retarded due to scarcity of N).

(ii) If C/N Ratio is less:- Carbon will be exhaust prior to the nitrogen and excess nitrogen reacts with hydrogen to form ammonia which is disasters for the methane formers, hence again leaving decomposition incompletely.

7) Landfill:- Landfill shall only be permitted for non-usable, non-recyclable, non-biodegradable, non-combustible and non-reactive inert waste and other wastes such as residues of water processing facilities as well as pre-processing rejects from waste processing facilities. In this method waste is dump over low line

area in the layer of 1.5m which is then properly compacted and left out for atleast 7 days. Insecticide is spread over each layer to prevent the growth of insect and flies. It takes 2-12 month to stabilize the waste which finally settle by 20-40% of its initial height.

Disadvantages:- (i) Production of CH_4, CO_2.

(ii) Leachate formation – It is the mixture of acid, NBD and water which is toxic in nature.

Materials used to control gases and leachate movement – Bentonite, Butyl rubber, Bitumen, Asbestos.

Air Pollution

Air pollution:- Presence of any solid, liquid & gaseous substance present in the atmosphere in such concentrations that may or tend to be injurious to human beings, other living creatures, plants or property.

Types of Air pollutants:-

(i) Primary pollutants:- Materials that when released pose health risks in their unmodified forms or those emitted directly from identifiable sources.

(ii) Secondary pollutants:- Pollutants which are form from two or more primary pollutants in the atmosphere (in absence or presence of sun light).

Primary Pollutants	Secondary pollutants.
Oxides of Sulphur ($SO_x \rightarrow SO_2$)	Sulphuric acid
Oxides of Nitrogen (NO_x)	Ozone
Oxides of Carbon (CO, CO_2)	PAN (Peroxy-Acetyl-Nitra
Hydro carbon	Photo chemical smog.
H_2F, H_2S	
Lead (Pb)	
SPM – Suspended particulate matter	

Primary pollutants

1. Oxides of Sulphur (SO_2):-

Sources:- Burning of fuels in power plant, refineries, steel plants and chemical plant.

Effect:- It is an irritant gas which cause respiratory problems as it cause deficiency of oxygen in the

body. It also effects mucous membrane.

2. oxides of Nitrogen (NOx)
Sources:- Automobile, furnaces and incineration plant.
Effect:- cause eyes and nasal irritation.

3. carbon Monoxide (CO)
Sources:- incomplete combustion of carbonaceous material, automobile exhausts.
Effect:- Carbon monoxide poses high affinity for haemoglobin, so it replaces oxygen from the haemoglobin to form carboxyhaemoglobin. If 50% of oxygen is replaced by CO death is certain. It also effect the nervous systems cause heart attack.

4. H_2S:
Sources:- Anaerobic decomposition, volcanoes, pulp industry.
Effect:- foul smell (Rotten egg smell).

5. H_2F:-
Sources:- pottery, fertilizers and alluminium industry.
Effect:- It is more poisonous to plant and animal as compare to human.

6. Lead (Pb):-
Sources:- Automobile.
Effect:- Damage to Kidney, liver and affect mental development of infants (babies).

7. CO_2:
Sources:- combustion of coal, petrol and diesel.
Effect:- greenhouse effect, global warming and climate change.

secondary Pollutant

1. PAN:- Smog is caused by the interaction of some hydrocarbons and oxidants under the influence of sunlight giving rise to dangerous peroxy acetyl nitrate (PAN).
Effect:- Respiratory and eye irritants. Mutagenic -causing skin cancer.

2. Sulphuric acid:- It is formed by the simple chemical reaction between SO_2 and H_2O vapour, since it causes acid rains.

3. Ozone:- It is a colourless gas.
Effect:- It reduces lung function, coughing, sneezing, chest pain etc.

4. Photochemical smog:- Smog is the mixture of smoke and fog. Photochemical smog is a mixture of pollutants which includes particulates, nitrogen oxides, ozone, aldehydes, PAN, unreacted hydrocarbons etc. The smog often has a brown haze due to the presence of nitrogen.

Effect:- Visibility reduction, cracking of rubber, fading of dyes, eye irritation, painful eyes.

unit of measurement:- As per Environmental Protection agency.

① Particulate, Fallout or Dust fall:-
Unit:- mg/cm^2. month   or mg/cm^2. year

② Particulate counting:-
Unit:- Number of particles/m^3 (gas).

③ Suspended particulates and gaseous contaminants:-
Unit:- Mass per unit volume (microgram per cubic meter).

Air Pollution Control:-
① Gaseous Pollutants:- These are removed from atmosphere by Adsorption. gaseous Pollutant compounds which is used to remove the gaseous pollutant.

(i) Oxide of Sulphur:- Vanadium Penta oxide.

(ii) Oxide of Nitrogen:- Platinum Metal

(iii) Oxide of carbon :- Palladium metal.

(iv) Hydro carbon:- Activated Alumina.

② Particulate Pollutants:-
Natural Methods:- The natural self-cleansing properties of the environment helps in controlling particulate pollutants.

(i) Dispersion

(ii) Gravitational settling (size > 20 mm)

(iii) Adsorption

(iv) Precipitation

(v) Adsorption.

Noise Pollution

Sound that is unwanted or disrupts one's quality of life is called as noise. when there is lot of noise in the environment, it is termed as noise pollution.

Unit:- It is measured in the units of decibels and denoted by the dB. It is propagate in the form of sinusoidal path.

Measurement of sound:- The sound is measured in units called the decibels (dB) in honour of Alexander Graham Bell, the inventor of the telephone.

The intensity of sound is measured on a logarithmic scale due to a wide range of variation of intensity of sound. The two sounds of the same character and of intensities l_1 and l_2 are said to be differ by m bels.

when, $m = \log_{10} \frac{l_1}{l_2}$.

The unit of bel is comparatively large and hence, in practice a decibel $= \frac{1}{10}$ of bel is used.

Thus, the two sounds as mentioned in the previous case are said to differ by m decibels.

when, $\boxed{m = 10 \log_{10} \frac{l_1}{l_2}}$

The range of audible sound to painful noise varies from 1 to 1013. But this wide range is covered on the logarithmic scale between 1 to 130 dB units.

Level of Noise : The softest sound a normal person ear can detect has a pressure 20 μpa or 20×10^{-6} pa. It is also called as threshold of hearing.

Control of Noise Pollution:-

(i) Ear Protection aids.
(ii) Design of doors and windows.
(iii) Enclosures.
(iv) Improvement in working methods.
(v) Legislative measures.
(vi) Planting of trees.
(vii) Town planning.
(viii) Treatment of walls, floors, and ceilings.
(ix) Use of silencers or filters.
(x) Vibration damping.