The amount of oxygen required by microorganisms to oxidize organic waste aerobically is called BOD (Biological Oxygen Demand).

* If ratio of $\frac{BOD}{COD} > 6$ biological treatment is favoured
* If ratio of $\frac{BOD}{COD} < 3$ then biological treatment is not necessary.

Methods are:-

1) Aerated lagoon
2) Oxidation ditch
3) Oxidation pond
4) Oxidation lagoon by aerated lagoon
5) Trickling filter
6) Activated sludge process.

* In above process trickling filters are proved better than activated sludge as trickling filter can handle toxic substances very effectively.

SOLID WASTE MANAGEMENT

Collection of solid waste :-

* There are 23 municipal corporations and about 1170 municipalities in the country (1999).
* Various aspects of waste management are under different sections leading to communication problems and shifting responsibilities.
* The collection bins are of varied type.
* In some places only a cement cylinder is used. In many places these bins are dirty with stinking smells that people do not go near but aim and throw garbage towards the side of the bin.
* Waste collection efficiency is less than 50% in many cities.
* Un-segregated cities waste is simply dumped at outskirts of city or town.
* During rains toxins present in the garbage get into water and mingle with ground water.
* There are now a group of rag pickers in almost all places, scrumaging these heaps of rubbish.

* In Delhi, chennai and other places NGO organisations like 'VAITAVARAN', 'EXNORA' are managing the urban waste.

* Much of the organic waste is diverted to organic farming and vermiculture in Pune & Mumbai.

* with tricycle carts, the garbage collectors called Street beautifiers are given uniforms

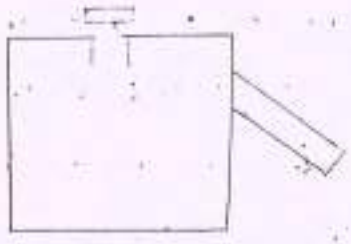
* the carts have 2 compartments.

* one is for degradable waste and other for non-degradable waste.

* Solid waste management starts with provision of waste, collection in streets & Residential areas.

* the design of garbage collecting system varies from place to place.

* A typical refuse enclosure with top opening for users and side opening for collection some of these are of iron and some are concrete structures.



*Garbage bin with top opening for users & side opening for refuge collectors.

concrete Bins:

wastes are exposed to flies etc., not asthetic. Garbage is scattered around. Dogs and animals have access to wastes. Rain soaks the material

Transport of solid waste:

* the most expensive item in solid waste disposal in the cost incurred in transporting the waste from streets to dumping or disposal grounds.

* Diesel trucks and open lorries are used in cities.

* Bullock / Buffalo carts are used earlier but they were replaced with lorries.

* An animal drawn cart is least polluting but it is slow.

* Most of the time the economic plans of solid waste disposal are upset due to high transportation costs.

* This is modified with animal carts.

* ① Management of solid waste disposal methods:

→ In order to discuss about the management of solid waste, we shall stress on three R's

* Reduce. (decrease the production of waste)
* Reuse
* Recycle. (Recycling the discarded materials into useful materials).

* These three main methods are
  * Sanitary land disposal.
  * Composting.
  * Incineration.

Sanitary landfill:-

* Sanitary landfill can be defined as the use of solid wastes for land reclamation.

* In mineral excavations, granite quarries & soil excavation for brick making, low lying areas are created.

* Restoration to original level with solid wastes is a good example for sanitary landfill.

* Low lying areas can also be used to raise the level so that cultivation can be conducted & industrial development can take place in that area.

* Many solid wastes are of offensive nature attracting disease vectors like flies & rodents.

* Sites for sanitary landfill are chosen for improving that environment, but for further degrading that place.

* Simple engineering techniques are used so that the landfill does not pose dangers to public health and environment.

* The waste must be deposited and levelled in layers not exceeding about 2 meters in depth.

-The whole of the surface of each layer of wastes is covered with soil & other suitable material to a depth of 15-25 cms on same day as the wastes are delivered to site.

*The sanitary landfill is the cheapest method.

* Most of the solid wastes are disposed by uncontrolled dumping which spoils the land & causes serious health risks & ground water contamination. The land values of reclaimed land & its surroundings are low & hence many builders do not prefer this sanitary landfill.

*Crude dumping is most common practice leading to following hazards.

→ Fly generation.
→ Encouragement of rodents
→ Static water pollution
→ Surface water pollution.
→ Fire & smoke pollution.

*Decomposition in sanitary landfill arises some chemical changes which may brought by bacteria present in organic content of waste.

* Gases like carbon monoxide, carbon dioxide, methane, hydrogen, hydrogen sulfide are produced.

* Whenever rainfall & sometimes groundwater if it passes through landfill, leachate will occure, it can be 20-30 times stronger than settled sewage, having BOD of 6000 to 7000mg/l.

* So that heap of wastes are levelled every day & sides are covered by 15-25 cms with soil, sand ash & previously composted waste.

Composting:-

* Under natural conditions dead vegetable and animal materials decompose under the influence of bacteria and fungi, where ever they fall and add to the fertility of soil. In many places farmers have depended on organic manure derived from animal excreta, agricultural wastes and vegetation.

* Urban areas generate domestic and commercial wastes on large scale around 300 to 800gms/person/day. A city with a population of million may generate almost 500tonnes per day. B/w 25-75 % of this may be vegetable matter. It is a biological process.

* Microorganisms in water take up biodegradable organic matter as their food, similarly microorganisms in soil also use biodegradable organic matter as food. This process can be either aerobic & anerobic.

* When the compost is applied to soil it lightens heavy soil, improves the texture of light sandy soil, increases water retention and enlarges root systems of plants. It makes available additional plant nutrients since it contains N, P and K. Typical percentages being N = 1.2%; P = 0.4% & K = 1.2%.

* Composting needs proper control to make the process proceed without production of odours, propagation of insects, destroy pathogens present in original wastes, destroy weed seeds, retain maximum nutrient content of N, P and K.

* There are two main groups of bacteria i.e., anerobic bacteria which functions in absence of oxygen and aerobic bacteria which requires oxygen.

The important features are

* It is a lengthy process extending over a period of 4-12 months.

* It is a low-temperature process and destruction of pathogen is accomplished by their exposure to unfavourable environment for long periods

* The gaseous products of reduction are methane, hydrogen sulfide & other gases with offensive odors.

* Anerobic composting is practiced in Indian villages on small scale for combined disposal of solid waste. The materials are placed in alternate layers in small trenches which are sealed and left undisturbed for many months. The contents are dug out & used as compost. This is called Bangalore system.

* Aerobic composting is characterised by rapid decomposition, high temperatures are attained which achieve speedy destruction of pathogens, insect eggs & weed seeds.

* Aerobic system is also called Indore System at one time.

Incineration:-

* The third method of practice in solid waste disposal is incineration. In many places both in cities and villages, in the agriculture farms, small scale incineration takes place. It is a common sight to see small fires of burning dry leaves, paper etc., on sides of roads. Such fires produce considerable smoke and air pollution.

* Incinerators need to have air pollution control measures today. Certain wastes like hospital wastes must be incinerated only to avoid environmental contamination. Ultimately the ashes which may contain heavy metals have to be disposed of safely.

V - HAZARDOUS WASTE

Hazardous wastes:-

* Hazardous waste is defined as the wastage of industrial, institutional or consumer origin due to physical, chemical or biological characteristics.

* These wastes are danger to human and environment. These wastes are solid waste because they are confined in solid containers.

* These wastes should be properly treated, stored, collected, transported and disposed off seperately in order to reduce their effects on human and environment.

Hazardous products mingled with municipal solid waste:-

House hold cleaners:-	Concern
chlorine, bleach, furniture polish, glass cleaners, shoe polish, spot remover, drain openers etc,	Corrosive, flammable & Irritants
Personal care products:-	
Hair waving lotions, medicated shampoos, Nail polish remover	poisonous & flammable

Automotive products:-

Car batteries, Diesel fuel, Kerosene, gasoline & waste oil.	flammable, poison & corrosive.

Miscellaneous products:-

photographic chemicals, herbicides, chemical fertilizers, House plant insecticides	corrosive & poisonous

Paint products:-

Enamel, paint & paint solvents	flammable

Characteristics of Hazardous waste:-

Based on physical & chemical properties, Hazardous wastes are classified as

* Toxic wastes
* Reactivity wastes
* Ignitability wastes
* Corrosivity wastes

Toxic wastes:-

* Small amount of toxic if present in waste will be poisonous and effects human & animals. The effect of toxic to the exposed persons can be Acute & chronic. Chronic toxicity are unable to identified early because their effects are not observed for long years in exposed person. Toxic waste are also noted as Carcinogenic and mutagenic that is causing cancer and biological changes in children of exposed person.

Reactivity waste:-

* Reactive wastes are those waste which strongly reacts with air & water and generate toxic gases. These waste are unstable to shock & heat, gunpowder and nitroglycerine are the common examples of reactive wastes.

Ignitability wastes:-

* Gasoline, paint thinners and alcohol are the ignitable wastes which can be burnt at relatively low temperature of less than 60°C.

Corrosity wastes:-

* Corrosive wastes like acids and bases forms chemical reactions in order to destroy materials & living tissue.

Biomedical waste:-

* The wastes such as solid waste as well as liquid wastes produced by hospitals, nursing homes, clinics, research laboratories, diagnostic centers, veterinary hospitals etc, are potential sources of health hazardous and need to be sprially treated and disposed of.

* Approximately 1.45 kg of waste is generated per patient per day in Indian hospitals, where as it is much higher in developed countries.

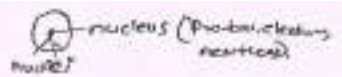
* In western countries, approximately 15-20% of this total waste is found to be hazardous and infected where as the % of hazardous and infected waste in India is usually much higher, since we dont have proper waste segregation practices in all the hospitals except in big hospitals.

* According to 1988, Indian rules notified for disposal of biomedical wastes, such waste are to be segregated in bins (or) containers.

These wastes can be categorized as follows

* Human anatomical waste (Human's tissue, organs, body parts etc.)
* Animal waste.
* Microbiology and biotechnology waste such as laboratory cultures, microorganisms, human & animal cell cultures, toxins etc.
* Waste sharps such as needles, syringes, broken glass etc.
* Discarded medicines and cyto-toxic drugs.
* Soiled waste such as bandages, plaster materials contaminated with blood etc.
* Solid waste (disposal items like tubes excluding sharps)
* Liquid waste generated from any of infected areas.
* Incineration ash.
* Chemical waste.

Nuclear waste :-



* In nuclear waste, the atomic nuclei gets discharged. By the disintegration of the atomic nuclei certain elements like radium, uranium, thorium etc.,

* Spontaneously emit protons (α particles), electrons (β) and electromagnetic waves of very short wave length (γ rays).

* Such elements that give of radiations as they disintegrate are said to be radio active and this property is called radioactivity.

* Radioactive pollution is the physical pollution of air, water and soil by radio active materials. Radio active waste material released mainly from the thermonuclear explosion pose a serious threat to living organisms. The fall out of the radioactivity spreads all over the world and contaminates air, soil, water, vegetation and animals.

Hazardous waste technologies :- (methods)

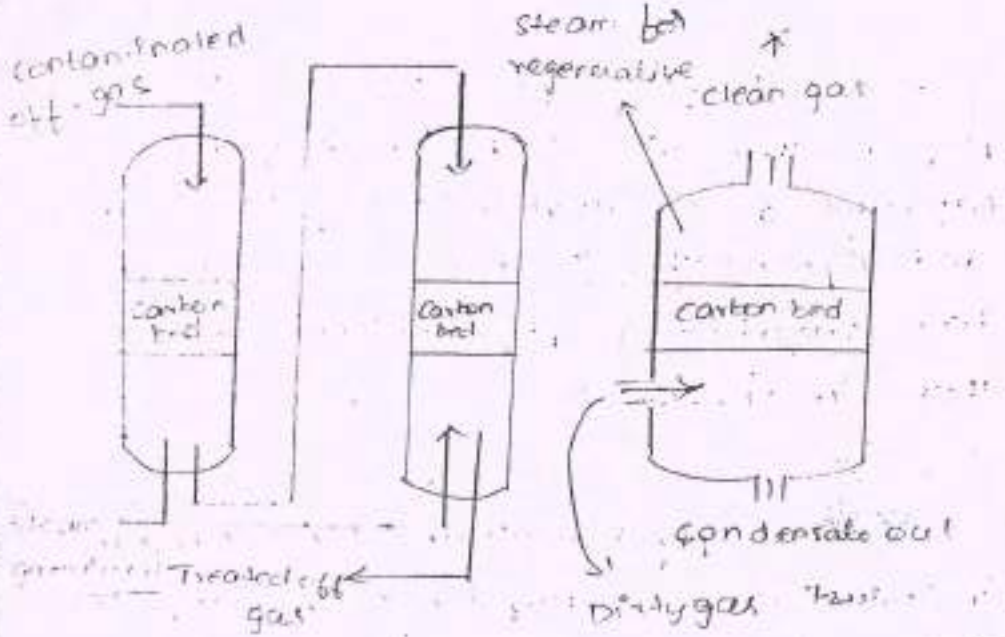
* Even with after rigorous hazardous waste reduction program, there will still be large quantities of hazardous waste that will require treatment and disposal. The treatment technologies have been categorised as physical, chemical, biological, thermal & stabilisation.

Physical treatment methods :-

Various physical treatment methods adopted in industry are adsorption, resin adsorption, sedimentation, electrodialysis, Reverse Osmosis, Solvent extraction, distillation, evaporation and filtration.

Adsorption :-

When a gas or vapour is brought in contact with solid a part of it is taken up by the solid. The molecules that disappear from the gas either entering inside of the solid or remain on the outside attached to the surface. The phenomenon is termed as adsorption.



*The process of adsorption involves passing of gas through adsorbes which contains porous solid particles. Adsorption is physical surface phenomenon & require considerable solid of surface area. The most commonly used adsorbents are activated carbon, activated alumina, silica gel, activated bauxite and lithium chloride.

*The process of adsorption involves.

* contact blw pollutant with adsorbent.

* seperation of adsorbed pollutant by replacing of adsorbent.

* final disposal of gases from adsorption chambers.

*The efficiency of adsorption depends upon following factors:

* Both physical & chemical characteristics of adsorbent.

* Nature of gas passed through adsorbent.

* Concentration of gas to be adsorbed.

*The process of adsorption is highly efficient process for some contaminants such as flammable organic compounds. However, the adsorbed bed installation is very costly make the process uneconomical..

Resin & adsorption :-

*waste treatment by resin involves two basic steps.

*containing liquid waste steam with resin and allowing the resin to adsorb the solute from the solution.

* Subsequently regenerating the resin by removing adsorbed chemicals by simply washing with proper solvent.

Sedimentation :-

* Sedimentation is the physical process where by particles suspended in liquid settle by means of gravity. The fundamental elements of most sedimentation processes are:
* A basin (or) container of sufficient size to maintain the liquid to be treated in a relatively quiscent state for a specified period of time.
* A means of diverting the liquid to be treated into the above basin in a manner conducted to selting.
* A means of physically removing the settled particles from the liquid.

Electrodialysis :-

* The electrodialysis involves seperation of an aqueous stream and depleted stream. Success of process depends on special synthetic membranes, usually based on ion-exchange resins, which are pesmeable only to a single type of ion.

* In ion exchange method, hard water is made to pass through some compounds known as zeolities. Zeolites are made up of aluminium, silica and soda. They may be natural or artificial in occurance and are highly capable of removing calcium and magnesium from water. these Ca & Mg are replaced by Na by ion exchange phenomena. The most white in colour zeolite used for ion-exchange process is permutit ($SiO_2 Al_2O_3 Na_2O$). It is white in colour.
* The reaction takes place when hard water is made to pass through zeolite is as follows

$$2SiO_2 Al_2O_3 Na_2O + Ca(HCO_3)_2 = 2SiO_2 Al_2O_3 CaO + 2NaHCO_3$$

* In electrodialysis, single type of ion is permeable. cation exchange membrane permit passage only of the ions under influence of electric field, while anion exchange membrane permit passage of only +ve charged ions.

$Ca(HCO_3)$
$CaCl_2$
$CaSO_4$

Mg

waste to non-hazardous waste streams decrease the quantity of hazardous wastes and thus it makes easier to treat the hazardous waste

Recycling of Industrial wastes

* The industrial wastes such as glass, wood fibre from paper products and metals from various industries have their own value. All the waste materials produced from these industries are recyclable/reproduced and regenerated

There are two methods are used for recycling. They are,

* waste reuse
* waste recycling

waste reuse

* In some industries, where the little processing/ treatment is required for the waste materials to be can used as a raw material
* The waste material "as it is" without reprocessed and directly transferring the waste materials to other facility is known as waste reuse or waste exchange
* All the waste materials can be re-used for the industrial feed stocks

waste recycling

* In these waste recycling process if the transfer of the waste materials "as if" is not possible, then the process evolved in the waste material is called recycling
* Recycling is different from the reuse, In reuse initially the waste is treated for the manufacturing process but in recycling - reprocessing is done
Recycling is different from the reuse. In reuse initially the waste is treated for the manufacturing process but in recycling,
for the waste material if the waste material 'as if' is not transfer possible

Treatment of Hazardous waste

* After the recycling, the waste water contains hazardous waste chemicals that should be detorified and neutralised through treatment
* The treatment of hazardous waste can be divided into following groups.
  * Physical treatment
  * chemical treatment
  * Biological treatment

Physical treatment

Physical treatment is conducted by the methods such as phase separation.

Phase separation has mainly three steps. They are,

* lagooning
* sludge drying in beds and
* prolonged storage in tanks

In these treatment, to separate particulate impurities, both lagooning and tank storage are used.

Chemical treatment

Chemical treatment is used to modify the chemical properties of the wastes and to facilitate complete break down of hazardous wastes.

Example: To neutralize acidity or alkalinity.

The various techniques involved in chemical treatment are,

* oxidation
* chemical reduction
* neutralization
* Heavy metal precipitation
* oil/water separation and
* solvents / fuel recovery

Biological treatment

The total impurity obtained after the treatment of hazardous waste are known as sludge which is given biological treatment, before disposal.

This process is known as sludge processing and it is very important in industrial waste water management / treatment.

Collection, transport and disposal of waste in Environment

Waste disposal treatment is a multiphase activity. In these collection, storage, transport, treatment and disposal are interdependent to one another both by technically and organizationally.

* Safe collection and transport of hazardous waste forms a critical link b/w its point of generation and its place of treatment and disposal.
* A safe and secure disposal of hazardous waste should be a proper collection, transport and storage system.
* The non-compatible wastes should be segregated and transported separately.

Solid waste Management:

solid waste generally produced from industries, domestic usage, agriculture & hospitals etc.,

solid waste ↑ with ↑ in population, urbanization & industrialisation.

These solid waste causes land pollution in urban & industrial areas.

Therefore, ↑ in such consumption will ↑ production of solid waste in environment & make earth a dumping ground of non-biodegradable solid waste.

Environmental Aspect of solid waste:

Some aspects of solid waste generated in environment are

1) If sites of solid waste (ie, landfill & dumping a.s) are not operated properly will contaminate the soil & ground water

filling of solid waste in land causes various problems like odours, rat infestation.

Incineration of solid waste produce air pollution

Transportation of hazardous solid waste cause health & hygienic problems.

Sources of solid waste:

* Domestic waste
* Commercial waste
* Industrial waste
* construction waste

Domestic waste:

→ It is generally obtained from dwellings of single & multiple families & low, medium & high rise apartments.

Various types of wastes are

food
packages
metals
plastics
glass
Ashes
Hazardous waste

Commercial waste:

→ waste obtained from shops, markets, offices, institutions, restaurants, hotels, hostels is termed as commercial waste.

Industrial waste:

→ It consists of waste that obtained from fabrication of elements, oil refineries, chemical plants, light & heavy manufacturing process, mining operation & power generation plants.

The type of waste under this category include metals, oils, plastics, lumber.

construction waste:

→ These are minor wastes resulting from construction of new buildings & due to demolition of existing buildings.

Construction waste have low concentration in total solid waste compared to other sources.

Different forms of construction waste are soil, steel, timber, plastic, concrete, glass, vegetation etc.

* Electronic waste:

It is also known as 'e-waste'.

It is one of the highly growing environmental problem in the world.

Electronic wastes are generated when outdated electronic equipments which are connected with power plug & equipments which use batteries for their operation are replaced with advance technological electronic equipment.

These waste includes growing range of electronic products like computers, servers, monitors, TV's, display devices, telecommunication devices, audio & video devices, recording devices etc,

In India, amount of electronic waste is increasing rapidly.

This is because old electronic goods are dumped to obtain newly existing electronic goods.

At present nearly 8000 tonnes of electronic waste is produced annually.

An eco-friendly recycling unit 'E-parisaraa' was constructed in outskirts of Bangalore city.

At this plant, a circuit is developed which makes full use of electronic waste & decrease pollution & landfill wastage.

This plant recover valuable metals, plastics, glass from waste in eco-friendly manner.

Physical properties of solid waste:

→ shear strength
→ particle size distribution
→ Density & moisture content
→ field capacity
→ Hydraulic conductivity

Shear strength:-

Shear strength of solid waste disposed in landfill is nearly equal to zero.

Shear strength is improved if solid waste is disposed along paper & cardboard.

Max. strength of solid waste is observed just after its compaction & gets reduced with time to zero.

Generally, shear strength > 15 kN/m² with 20% dry solids when solid wastes are disposed into landfill.

Particle size distribution:-

The determination of particle size distribution of solid waste is very important parameter.

It is used to select the type of treatment of sludge.

It is required for recycling & reuse of waste.

Generally, solid wastes are described by their volume ie, L x B x H.

The average particle size of solid waste is 100mm approximately.

Density & moisture content :-

Density of solid waste depends on moisture content, degree of compaction & its composition.

Average density of food waste ranges from 100kg/m³ to 1400 kg/m³ for moisture content of 50% to 80%.

The average ~~density~~ density of solid waste compacted in land fill vary from 300kg/m³ to 1500 kg/m³ with 15% to 40% moisture content.

field capacity :-

The max. amount of moisture content which is carried by solid waste under gravity is known as field capacity.

field capacity can be computed from the following eqn.

$$f.c = 0.6 - \frac{0.55 W.}{4500 + W}$$

where W = overburden act in Kg.

f.c = field capacity

Hydraulic conductivity :-

The sludge disposed to landfill contains high moisture content resulting in low hydraulic conductivity.

Hydraulic conductivity of dense solid waste is 7×10^{-6} m/s.

Hydraulic conductivity of loose solid waste is 150×10^{-6} m/s.

Chemical properties of solid waste

There are no. of possible recycle, reuse & transformation technologies.

Due to suitability, chemical properties of solid waste are

- Proximate analysis
- Ultimate analysis
- Amount of energy.

Some more properties in proximate analysis are

- Amount of moisture of % wt
- Fixed carbon
- Volatile matter
- Non-combustible fraction.

Biological properties of solid waste

Biological properties of solid waste are applicable because of aerobic/ anerobic technology to achieve energy & favourable end products from waste.

These may be anerobic & aerobic.

The biological decomposition of food waste with end products of carbon dioxide, methane & other is known as anerobic composting.

The undesirable organic municipal solid waste parts for biological conversion are leather, plastic, wood & rubber.

It also contains fractions of protein, fats, oils, ligno cellulose, hemicellulose etc.

Seperation of waste:-

Seperation is possible when mechanical sorting can be carried out either at source in household & at transfer station

The wastes that are seperated at source are

Cardboard & paper

Food waste

metal ferrous

plastic

Glass

metals

The wastes of other household are.

Yard waste

Bulky waste

Hazardous household waste.

Ion Exchange method:

This method of water treatment is known as base exchange method & zeolite method. In this method, hard water is made to pass through some expt compounds known as zeolites. Zeolites are made of aluminium, silica & soda. They may be natural & artificial in occurance & highly capable of removing calcium & magnesium from water. Ca^{++} & Mg^{++} are replaced by sodium by ion exchange phenomena.

The most common zeolite used for ion exchange process is permutit ($SiO_2 Al_2O_3 Na_2O$). It is white in colour, consists of large grain & have an exchange value of 15000gm/m² to 40000 gm/m³ hardness.

The reaction takes place when hard water is made to pass through zeolite is

$2SiO_2 Al_2O_3 Na_2O + Ca(HCO_3)_2 \rightarrow 2SiO_2 Al_2O_3 CaO + 2NaHCO_3$

$2SiO_2 Al_2O_3 Na_2O + CaCl_2 \rightarrow 2SiO_2 Al_2O_3 CaO + 2NaCl$

$2SiO_2 Al_2O_3 Na_2O + CaSO_4 \rightarrow 2SiO_2 Al_2O_3 CaO + Na_2SO_4$

$2SiO_2 Al_2O_3 Na_2O + Mg(HCO_3)_2 \rightarrow 2SiO_2 Al_2O_3 MgO + 2NaHCO_3$

$2SiO_2 Al_2O_3 Na_2O + MgCl_2 \rightarrow 2SiO_2 Al_2O_3 MgO + 2NaCl$

$2SiO_2 Al_2O_3 Na_2O + MgSO_4 \rightarrow 2SiO_2 Al_2O_3 MgO + Na_2SO_4$

Regeneration of zeolite is necessary since sodium ions present in it gets exhausted when used for long duration. The regeneration can be done by passing salt sol^n through zeolite bed. Reaction which takes place during regeneration are.

$$2SiO_2Al_2O_3CaO + 2NaCl \rightarrow 2SiO_2Al_2O_3Na_2O + CaCl_2$$

$$2SiO_2Al_2O_3MgO + 2NaCl \rightarrow 2SiO_2Al_2O_3Na_2O + MgCl_2$$

The resulting precipitated matter in form of calcium & magnesium chloride are washed with water in sewer.

Ion exchange equipment also known as zeolite softeners are similar to pressure filter with sand is filter replaced by zeolite for thickness of 75cm & above.

The equipment is regenerated automatically either at fixed interval of time or based on amount of water treated.

Advantages:

1) sludge is not formed & there is no problem of sludge disposal.
2) Does not require any skilled supervision.
3) It is possible to reduce hardness of water to zero.
4) Easily operated.
5) process is automatic
6) chemicals are very cheap & easy to handle.

Coagulation:-

→ The phenomenon of colloidal substance loosing charge and coming down as a precipitate on addition of an electrolyte to the colloidal solution is called coagulation.

→ coagulation is also called as flocculation.

Recycling means turning an item into raw materials which can be used again, usually for a completely new product.

This is an energy consuming process.

Recycling reduces waste disposal by transforming useful materials such as plastic, glass & paper into new products.

In 2013 & 2014, UK households recycled about 44% of their rubbish.

A large amount of energy is needed to transport, process and reassemble recyclable materials.

Particularly in UK, recycling is still a very expensive process.

In this, we recycle items that are damaged beyond repair.

This allows for high recycling rate than delivering all materials in one waste stream.

Reusing process is not just about repurposing materials, but using object as it is.

Reusing is better than recycling because it saves energy that comes with having to dismantle and re-manufacture products.

It reduces waste and pollution because it reduces need for raw materials saving both forests & water supplies.

Greater London Authority introduced reusing in their sustainability plan few years ago, 12000 tonnes of goods were reused in 2013. In 2013 alone, this allowed us to save over 2500 tonnes of CO_2.

Sanitation for Hotels:

Sanitation in hotels refers to the treatment of utensils, food material, cloth etc.,

Sanitizing these things lowers the risk of health hazards in their reuse.

Sanitation is done by various methods with the help of sanitizers and chemicals.

Few of them are explained below.

→ Utensils should be immersed in hot water at a temperature of atleast 80°c for 2 minutes

→ whenever heat is used as sanitizer, a three compartment washing Vat is required. First one for washing, Second for heat treatment and the third for rinsing.

→ It is necessary to take care that the wash water should not become dirty before it is changed.

→ In a luke warm solution consisting of atleast 50ppm - 100ppm of chlorine, the utensils should be heated for atleast 2 minutes.

→ Application of chlorine solutions as sanitizers helps in removal of bacteria.

→ the utensils, glasses and other things should be then left to dry. So that the odour of any solution should not be present in the utensils.

→ Precautionary measures should be taken to avoid air entrapping in glasses or dishes and the chlorine solution may disinfect the silver plated articles if applied to them.

→ Therefore proper care is needed during the sanitation of utensils and dishes. Other solutions such as ammonium compounds, Iodine and bromine compounds can also be used for the removal of bacteria from water.