ENVIRONMENT AND HEALTH

Generally environment is divided into the following components for better understanding:

1) **Physical**: Water, air, soil, housing wastes, radiation etc

2) **Biological**: Plant and animal life including bacteria, viruses, insects, rodents and animals.

3) **Social**: Customs, culture, habits, income, occupation, religion etc.

WATER

SAFE AND WHOLESOME WATER:

1) **Free from pathogenic agents**

2) **Free from harmful chemical substances**

3) **Pleasant to taste; that is free from colour or odour**

4) **Usable for domestic purposes.**

Water requirement:

Drinking water requirement is about 2 litres per head per day.

150-200 litres per capita is considered as an adequate supply to meet the needs for all urban and domestic purposes

Uses of water:

1) Domestic purposes
2) Public purposes:
3) Industrial purposes:
4) Agricultural purposes:
5) Power production:
6) Carrying away waste

SOURCES OF WATER SUPPLY:

1) RAIN

2) SURFACE WATER: impounding reservoirs;
rivers and streams;
tanks ponds and lakes.

3) GROUND WATER: shallow wells
deep wells
springs

WATER POLLUTION:

NATURAL AND MAN MADE

NATURAL: these comprise dissolved gases such as nitrogen, carbon dioxide, hydrogen sulphide etc.

MAN MADE: this is mainly due to industrialization and urbanization. The sources of pollution are:

1) **sewage: decomposable organic matter and pathogenic agents**
2) **Industrial and trade wastes**
3) **Agricultural pollutants**
4) **Physical pollutants**

CHEMICAL POLLUTANTS:

Bleaching agents, dyes, pigments, sulphides, ammonia etc.

Biological pollutants:

Those caused by the presence of infective host:

Viral

Bacterial

Helmintic

Leptospiral

Those caused by the presence of an aquatic host:

Snail: Schistomiasis

Cyclops: guineaworm, fish tapeworm

In addition water is also associated with following:

- Dental health
- Cyanosis in infant
- CVS diseases
- Malaria, filaria etc

1974-water (prevention and control of pollution) Act

PURIFICATION OF WATER:

1) On a large scale

2) On a small scale

PURIFICATION OF WATER ON A LARGE SCALE:

1) STORAGE

2) FILTERATION

3) DISINFECTION

STORAGE:

The following changes take place when water is stored:

1) **Physical: 90% of the suspended impurities settle down in 24 hours**

2) **Chemical: Aerobic bacteria oxidize the organic matter present in the water with the aid of dissolved oxygen. Ammonia is reduced and a rise in the nitrate occurs.**

3) **Biological: Tremendous drop in the bacterial count that is 90% in the first 5-7 days.The optimum period for storage of water is 10-14 days.**

FILTERATION:

Two types:

1) Biological or slow sand filters and

2) Mechanical or rapid sand filters

SLOW SAND OR BIOLOGICAL FILTERS:

First used in Scotland in 1804 and

Then in England

ELEMENTS OF A SLOW SAND FILTER:

1) **Supernatant water**

2) **A bed of graded sand**

3) **An under drainage system**

4) **A system of filter control valves**

SUPERNATANT WATER:

1) **Depth of water varies from 1-1.5metre**

2) **Provides a constant head of water so as to overcome the resistance**

3) **Provides a waiting period of 3-12 hours for the raw water to undergo partial purification by sedimentation, oxidation and particle agglomeration.**

SAND BED:

It is the most important part of the filter.

1) **The depth of the sand bed is about 1metre**

2) **The sand grains have an effective diameter between 0.2-0.3metre**

3) **The sand bed is supported by a layer of graded gravel 30-40cm deep.**

4) Water moves very slowly through the sand bed undergoing various processes such as mechanical straining, sedimentation, adsorption, oxidation and bacterial action

5) The rate of filtration is between 0.1-0.4 metre cube/hr/square metre of sand bed surface.

Vital layer: Also called as schumtzdecke, zoogleal layer, or bilological layer.

- **This layer is slimy, gelatinous, and consists of thread like algae, bacteria, diatoms and planktons.**

- The formation of vital layer is known as ripening of the filter

- Takes several days to form, and when fully formed extends 2-3cm into the top portion of the sand bed

- The vital layer is the heart of the filter as it removes organic matter, holds back bacteria and oxidizes ammonical nitrogen into nitrates.

UNDER-DRAINAGE SYSTEM:

1) Its situated at the bottom of the sand bed and consists of porous pipes which has dual functions of providing an outlet for filtered water and supporting the filter medium above.

Filter box: the first three elements that is supernatant water, sand bed, and under-drainage system are contained within this filter box-2.5-4 metres deep.

FILTER-CONTROL:

1) The filter is equipped with certain valves and devices the purpose of which is to maintain a constant rate of filteration.

2) An important component of this regulation system is the venturimeter which measures the bed resistance or loss of head.

When the resistance builds up, the operator opens the regulating valveto maintain a steady rate of filteration

3) When the loss of head exceeds 1.3 metre its uneconomical to run the filter.

FILTER CLEANING:

When the bed resistance increases to such an extent that the regulating valve has to be kept fully open, then cleaning of the filter is necessary

The supernatant water is drained off and the sand bed is cleaned by a method called scraping where the top layer of the sand bed is scraped by 1-2cm.

This operation could be carried out manually by unskilled labours using hand tools or mechanical equipment.After several years of operation, and say about 20-30 scrapings, the thickness of the sand bed would be reduced by 0.5-0.8 metre.Then the sand bed is closed down and new one constructed.

ADVANTAGES OF SLOW SAND FILTER:

1) Simple to construct and operate

2) The cost of construction is cheaper

3) The physical, chemical, bacteriological quality of filtered water is very high.

4) Slow sand filters have been shown to reduce bacterial count by 99.99%

RAPID SAND OR MECHANICAL FILTERS

- Used since 1885 in USA.

- Two types:gravity type (Paterson's filter)
  Pressure type (Candy's filter)

The following steps are involved in the purification of water by rapid sand filters:

1) Coagulation: Chemical coagulant such as alum 5-40mg or more per litre depending on the turbidity, colour, temperature, and the ph value of the water.

2) Rapid mixing: The treated water is then treated to violent agitation in a mixing chamber for a few minutes.This allows for quick and thorough dissemination of alum throughout the bulk of the water

3) Flocculation: This involves slow and gentle stirring of the water in a flocculation chamber for about 30 minutes.The mechanical flocculator is the most widely used. It consists of a number of paddles which rotate at 2-4rpm. This results in the formation of a thick white copious precipitate of aluminum hydroxide.

4) Sedimentation: The water is now led from the flocculation chamber to sedimentation tanks where the water is detained for a period of 2-6hrs where the flocculent precipitate together with impurities and bacteria settle down .

At least 95% of the flocculent precipitate needs to be removed before the water is admitted to filters.

Filtration: The partially filtered water is now led into the rapid sand filtration.

FILTER BEDS:

- The sand particle size here varies between 0.4-0.7m
- The depth of the sand bed is 1m
- Its supported by a layer of graded gravel 30-40cm deep
- The depth of the water above the sand bed is 1-1.5m
- The under-drains at the bottom of the filter beds collect the filtered water.
- The rate of filteration is 5-15m^3 /m^2 /hour

FILTERATION:

- The alum floc not removed by sedimentation is held back by the sand bed.
- A slimy layer is formed comparable to the zoogleal layer.
- It adsorbs bacteria, and ammonia is reduced to nitrates.
- As filtration proceeds, the bacteria and the suspended impurities clog the filters
- The filters are then cleaned by a procedure known as backwashing

***BACK WASHING*:**

- Depending on the loss of head the filters have to be washed daily or weekly

- Washing is accomplished by reverse flow of water through the sand bed known as back-washing

- The washing is stopped when clear sand is visible and the washed water is sufficiently clear.

- The whole process takes about 15 minutes and sometimes compressed air is used as a part of the backwashing processes

ADVANTAGES OF RAPID SAND FILTER:

1) It can deal with the raw water directly as no preliminary storage is necessary

2) The filter beds occupy less space

3) Filtration is rapid that is 40-50 times that of a slow sand filter

4) The washing of the filter is easy

5) There is more flexibility in operation

DISINFECTION:

For a chemical agent to be potentially useful as a disinfectant in water, it should have the following props:

1) Should be capable of destroying the pathogenic organisms present

2) Should not leave residual products of reaction

3) Ready and dependable availability at a reasonable cost

4) Possess the property of leaving residual concentration

5) Be amenable to easy detection

CHLORINATION:

1) Is a supplement and not a substitute to sand filtration

2) Chlorine kills pathogenic bacteria, but has no effect on spores and certain viruses except in high doses

3) It oxidizes Fe, Mn and H_2S, It destroys taste and odour producing substances.

4) Action of Cl_2 : The action of chlorine is mostly due to Hypochlorous acid.

Principles of chlorination:

1) The water to be chlorinated must be free from turbidity

2) Chlorine demand of the water must be estimated. The chlorine demand of the water is the difference between the amount of chlorine added to the water and the amount of residual chlorine remaining at the end of a specific period of contact(1hr) at a given temperature and Ph of water.The point at which the chlorine demand of water is met is called the '**break point**'.

3) A contact period of at least one hour is necessary to kill bacteria and viruses.

4) The minimum recommended concentration of free chlorine is 0.5mg/ml for 1hr.

5) The sum of the chlorine demand of the specific water plus the free residual chlorine of 0.5mg/ml constitutes the correct dosage of the chlorine to be applied.

METHOD OF CHLORIINATION:

1) Chlorine gas
2) Chloramines
3) perchloron

PURIFICATION OF WATER ON A SMALL SCALE:

1) HOUSE HOLD PURIFICATION OF WATER:

A) Boiling

b) Chemical disinfection:
i) Bleaching powder
ii) Chlorine solution
iii)High test hypochlorite
iv) Chlorine tablets
v) Iodine tablets
vi) Pottasium permanganate

c) Filteration: Pasteur Chamberland filter, Berkefeld filter, Katadyn filter

2) DISINFECTION OF WELLS:

1) FIND THE VOLUME OF WATER IN THE WELL

2) FIND THE AMOUNT OF BLEACHING POWDER REQUIRED FOR DISINFECTION

3) DISSOLVE THE BLECHING POWDER IN THE WATER

4) DELIVERY OF CHLORINE SOLUTION IN THE WELL

5) CONTACT PERIOD: 1HR

6) OTA-TEST

AIR POLLUTION:

SOURCES OF AIR POLLUTION:

1) Automobiles
2) Industries
3) Domestic sources
4) Miscellaneous

AIR POLLUTANTS:

1) Carbon monoxide
2) Sulphur dioxide
3) Lead
4) Carbon dioxide
5) hydrocarbons

6) Cadmium

7) Hydrogen sulphide

8) Ozone

9) Polynuclear Aromatic Hydrocarbons

10) Particulate matter

ADVERSE HEALTH EFFECTS OF AIR POLLUTION:

- Air pollution and associated mortality
- Chronic respiratory morbidity
- Exacerbation of chronic diseases
- Acute respiratory diseases
- Effects on ventilatory function
- Cancer of lungs
- Heart diseases
- Neurological and behavioural effects

PREVENTION AND CONTROL OF AIR POLLUTION:

1) CONTAINMENT: Prevention of escape of toxic substances in the ambient air

2) REPLACEMENT: technological advances

3) DILUTION:

4) LEGISLATION: Ex: clean air act, The Air (Prevention and Pollution) Act

DISINFECTION OF AIR: Mechanical ventilation,

- UV Radiation
- Chemical mists
- Dust control

NOISE POLLUTION:

- It is defined as "the wrong sound, in the wrong place, at the wrong time".

- The 20th century is described as the century of noise.

SOURCES OF NOISE:

Automobile factories
industries,
Aircrafts
Bus stands
Railway stations
Festival times

PROPERTIES OF NOISE:

1) ***LOUDNESS:*** Loudness or intensity depends upon the amplitude of vibrations which initiated the noise. The loudness is measured in decibels.

2) ***FREQUENCY***: The frequency is denoted as Hertz. The human ear can hear frequencies from about 20-20,000htz.

The range below 20hz is infraaudible and those above 20,000hz ultrasonic

BASIC INSTRUMENTS USED IN THE STUDY OF NOISE:

1) The sound level meter
2) The octave band frequency analyzer
3) The audiometer

EFFECTS OF NOISE EXPOSURE

1) AUDITORY EFFECTS:Auditory fatigue & deafness
2) Non-Auditory effects: 1)Interference with speech
   2) Annoyance
   3) Reduced efficiency
   4) Physiological changes
   5) Economic burden

CONTROL OF NOISE:

1) ***CAREFUL PLANNING OF CITIES:***

1) ***CONTROL OF VEHICLES***

2) ***IMPROVE ACOUSTIC INSULATION OF BUILDING***

3) ***LOCATION OF INDUSTRIES AND RAILWAYS***

4) ***PROTECTION OF EXPOSED PERSONS***

5) ***LEGISLATION***

6) ***EDUCATION***

DISPOSAL OF WASTES:

- Mainly the domain of sanitarians and public health engineers

- However, health professionals are expected to have basic knowledge about it.

SOLID WASTES:

- Includes garbage (food wastes), rubbish (paper, plastics, wood, metals, demolition products, sewage residue, manure etc.

- The output of daily wastes depend on the dietary habits, the lifestyle, the living standards and the degree of urbanization and industrialization

Solid waste if allowed to accumulate, is a health hazard because:

1) It decomposes and favours fly breeding
2) It attracts rodents and vermin
3) The pathogens present in the solid wastes may be conveyed back to the man's food through flies and dust
4) There is a possibility of water and soil pollution
5) Heaps of refuse present an unsightly appearance.

<u>SOURCES OF REFUSE</u>:

1) Street refuse
2) Market refuse
3) Stable litter
4) Industrial refuse
5) the domestic refuse

STORAGE:

- ***The first consideration to be given is to the proper storage of refuse***
- ***A galvanized steel bin is used for the purpose***
- ***For a family of 5 members, a bin with the capacity of $1^1/2$ or 2.c.ft***
- ***A recent innovation in western countries is the paper sack***
- ***In India, usually public bins are used***

COLLECTION:

- Depends upon the funds available

- House to house collection is by far the best method of collection

- In India there is no house to house collection, instead people are expected to empty the waste in public bins

METHOD OF DISPOSAL

There is no single method of disposal.The choice depends upon cost and availability of land and labour. The principal methods of refuse disposal are:

1) ***Dumping***
2) ***Controlled tipping***
3) ***Incineration***
4) ***Composting***
5) ***Manure pits***
6) ***burial***

DUMPING

Refuse is dumped in low lying areas and is used as a method of waste disposal as well as a reclamation of land

As a result of bacterial action, refuse decreases considerably in volume and is converted gradually into humus

***Drawbacks of open dumping*:**

Refuse exposed to flies and rodents
Bad smell and unsightly appearance
Refuse is dispersed by the action of wind
Drainage from dumps contributes to pollution of water

CONTROLLED TIPPING

Also called as sanitary landfill. Most satisfactory method of disposal when land is available

Three methods:

1) The trench method:

- used where level ground is available
- A long trench is dug 2-3m deep and 4-12m wide
- The refuse is compacted and covered with excavated earth

2) The ramp method:

- this method is well suited where the terrain is moderately sloping
- Some excavation is done to secure the covering material

3) THE AREA METHOD:

- Used for filling land depressions
- The refuse is deposited, packed and consolidated in uniform layers up to 2-2.5m.
- Each layer is sealed on its exposed surface with a mud of at least 30cm
- Such sealing prevents infestation by flies and rodents and suppresses the nuisance of smell and dust
- Chemical, bacteriological and physical changes occur in buried refuse.
- The temp raises to 60 degs within 7 days and kills pathogens
- Takes 2-3weeks to cool down and takes 4-6months for complete decomposition of the organic matter

INCINERATION:

- The refuse which is disposed of hygienically by burning is called incineration
- This method is suitable when land is not available
- Therefore practiced in industrialized countries
- It has limited application in India

COMPOSTING

is a method of combined disposal of refuse and night soil or sludge

Is a process of nature whereby organic matter breaks down under bacterial action resulting in the compost which has considerable manurial value for the soil

The principal byproducts are carbon dioxide, water and heat.
The temp raises to 60 degrees or higher and destroys eggs,larvae of flies, weed seeds and pathogenic agents

The end product of compost contains few or no-disease producing organisms

Two methods of composting are used:

The Bangalore method (Anaerobic method)
Mechanical composting (Aerobic method)

Bangalore method or hot fermentation process:

- Trenches are dug 3 ft deep, 1.5-2.5m wide and 4.5m-10m wide depending upon the amount of of refuse and night soil to be disposed off

- The pits should not be located less than 800m from the city limits

- First a layer of refuse about 15cm thick at the bottom of the trench

- Over this night soil is added to a thickness of 5cm

- This is continued alternatively till the the heap rises to 30cm above the ground level.

- The topmost layer should be of refuse at least 25cm in thickness

- Then the heap is covered with excavated earth

- When properly laid, a man's leg will not sink in the compost mass

- At the end of 4-6 months the decomposition is complete and the resulting manure is of high quality with the absence of pathogens or microorganisms.

MECHANICAL COMPOSTING:

- In this method compost is literally manufactured on a large scale by processing raw materials
- First the refuse is cleared of salvageable materials such as rags, bones, metals, glass
- It is then pulverized in a pulverizing equipment in order to reduce the size of the particles to less than 2 inches
- The pulverized refuse is than mixed with sewage, sludge or night soil in a rotating machine and incubated

- The factors which are controlled in the operation are carbon-nitrogen ratio, temperature, moisture,ph, aeration

- The entire process is completed in 4-6 weeks

***MANURE PITS*:**

- In rural areas in India there is no system for collection and disposal of refuse

- As a result refuse is thrown around

- This problem could be solved in rural areas by digging manure pits by individual householders

- The garbage, cattle dung, straw, and leaves should be dumped into the manure pits and covered with earth after each day's dumping

- Two such pits will be needed so that when one is closed, the other is in operation

- In 5-6months, refuse is converted into manure

BURIAL:

- This method is suitable for small camps

- A trench is dug 1.5m wide and 2m deep, refuse is laid down and at the end of each day it is covered with 20-30cm earth

- When the level of trench is about 40 cm from ground level, the trench is filled with earth and is compacted and a new trench is dug

- The contents may be taken out after 4-6 months and used as manure

STEPS TO ENSURE PROPER WASTE DISPOSAL:

- PUBLIC EDUCATION

- ECONOMICS AND FINANCE

- INTERNATIONAL CO-OPERATION