SEWAGE PURIFICATION AND DISPOSAL

SEWAGE

- **Is the waste water from a community, containing solid and liquid excreta derived from housed, street and yard washings, factories and industries**
  -
- **Resembles dirty water with unpleasant smell.**
- **Sullage: Waste water which does not contain human excreta (Kitchen and bathrooms waste water)**

Amount of sewage:

- **Habit of people: More use-more sewage**

- **Time of the day and season**

"Average amount of sewage which flows through a sewerage system in 24 h is called as dry weather flow."

Health aspects:

- **Creation of nuisance, unsightliness and unpleasant odors.**
- **Breeding of flies and mosquitoes**
- **Pollution of soil and water supplies**
- **Contamination of food**
- **Increase in the incidence of disease especially enteric and helminthic diseases.**

Composition of Sewage

- **99.9% Water+ 0.1% solids (organic/inorganic in suspension/solution).**
- **Offensive oudour: Organic matter**
- **May contain no. of pathogenic m.o.:**
  - **1g faeces: 1000 million of *E. coli***
  - **10-100 million: faecal *Streptococci***
  - **1 to 10 million : *C. perfringens* spores**

Human: 100 g average faeces/day

AIM of Sewage Purification

- **Raw sewage should not be discharged in rivers/ sea or other sources.**
  - **O2 utilized by aerobic m.o. of sewage--------lack of O2----------death of aquatic life.**
  - **H2S production--------offensive odour**

AIM:

✓ **To stabilize the organic matter ----------safely disposal**

✓ **To convert the sewage water into effluent with acceptable standard of purity so disposed on land, river, sea etc.**

✓ **A standard test that is an indicator of organic content of sewage is BOD (Biochemical Oxygen demand)**

Expression of strength of sewage

- **BOD: Amount of O_2 absorbed by the sample of sewage during a specified period (5 days) at specified temperature (20^0C) for aerobic destruction or use of organic matter by living organisms.**
  - **Natural water: 1mg/l** **Untreated domestic sewage: 300mg/l**
  - **Strong sewage: ≥300mg/l** **Weak sewage : 100mg/l**
- **COD: It measures the oxygen equivalent of that portion of organic matter in a sample which is susceptible to oxidation by strong chemical oxidizer**
- **Imp. in toxic waste.**
- **Suspended solids: domestic sewage : 100 (weak) to 500 mg/l (strong sewage)**

Decomposition of organic matter

- **In sewage takes place by 2 ways:**

1. **Aerobic: Most efficient method**

- **Require continuous supply of free dissolved oxygen**

- **Organic matter** → **Bacteria, fungi & protozoa** → **CO_2, H_2O, Ammonia, nitrates & sulphate**

2. Anaerobic: Effective when sewage is highly concentrated with plenty of solids

Slower → **Extremely complex mechanism**

Methane, ammonia, CO_2 and H_2

Modern sewage treatment

- **Based on biological principles----------Anaerobic and Aerobic bacteria.**
- **Treatment divided into 2 stages:**

Primary

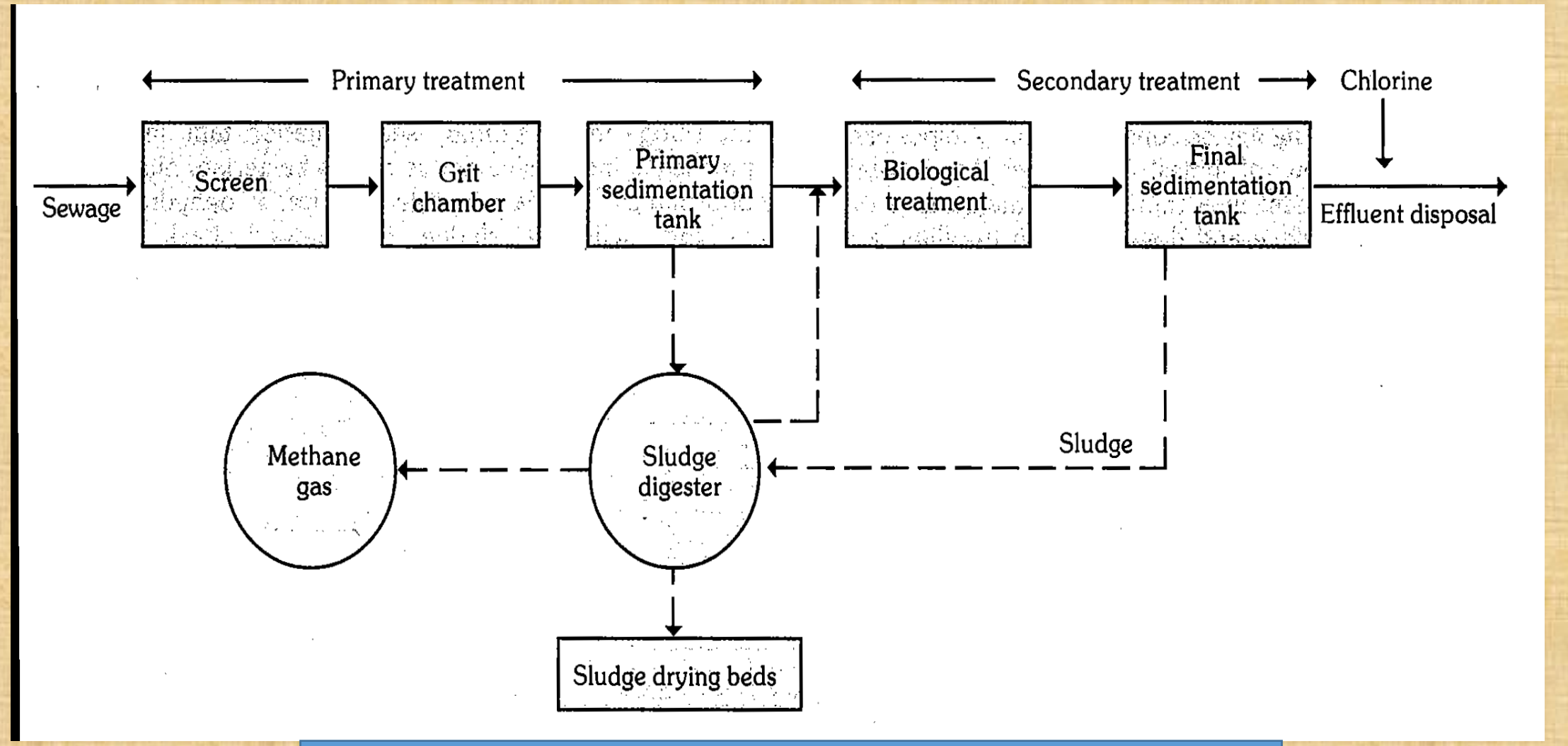
Solids are separated by screening and sedimentation----------Anaerobic digestion

(1st stage of purification)

Secondary

Effluent ---------Aerobic oxidation

(2nd stage of purification)



Modern Sewage Treatment Plant

PRIMARY TREATMENT

1. Screening:

- **Sewage first passed through metal screen**

(Vertical or inclined 5 cm apart: fixed type or moving type)

- **Large floating objects are screened**
- **Required time to time removal either manually or mechanically**
- **Disposed off by trenching or burial method**

2. Greet chamber/detritus chamber:

- Sewage then passed through a narrow chamber
- 10-20 meter length
- Maintain constant velocity 1 foot/sec.
- Allow settlement of heavier solids (sand/gravels) and pass through of organic matter
- Required periodic or continuous removal
- Disposed off by trenching or dumping

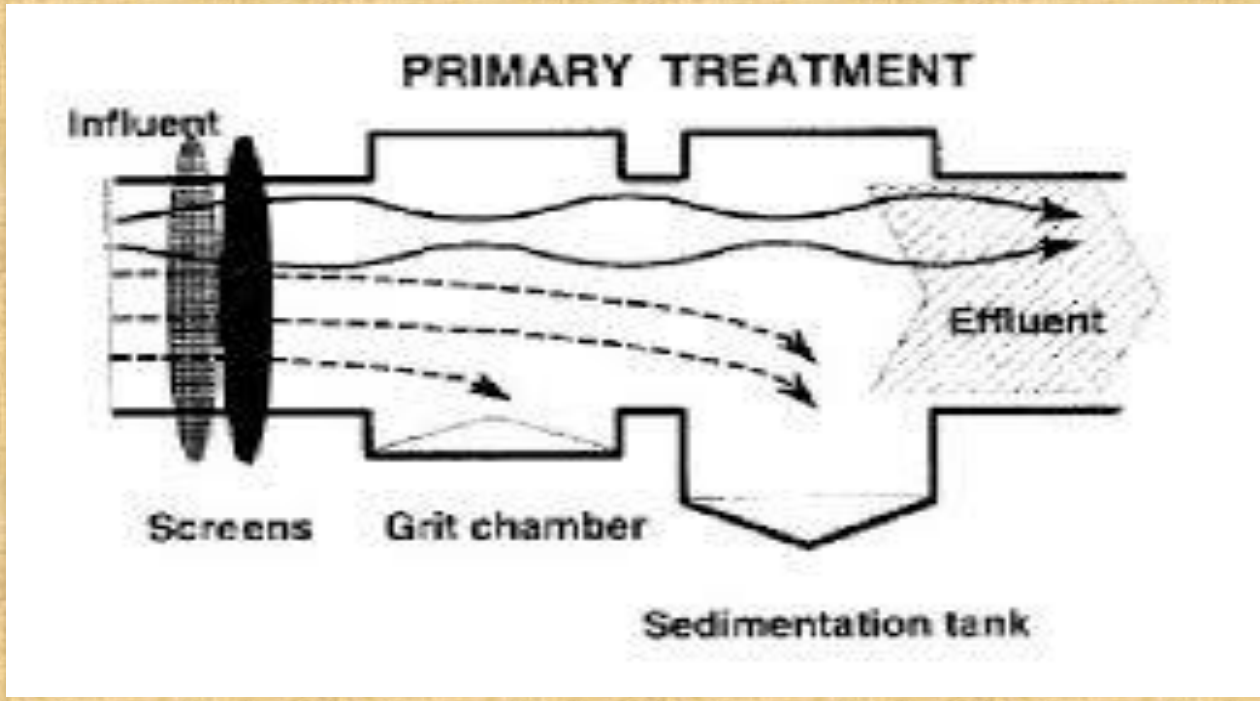
3. Primary sedimentation: in a huge tank, holds ¼ to 1/3 of dry weather flow.

- **Velocity: 1-2 feet/ min.**
- **Retention time : 6-8 h**
- **Purification: Sedimentation**
- **50-70% solids settle down due to gravity**

- **30-40 % reduction of coliform organisms**
- **Settle down organic matter called as sludge (removed mechanically)**
- **Complex organic matter broken down------simpler soluble substances and ammonia.**
- **Fats and grease rise on the surface-----Scum**
- **Trade waste: require treatment with lime, aluminium sulphate and ferrous sulphate (ppt of animal protein)**

Secondary treatment

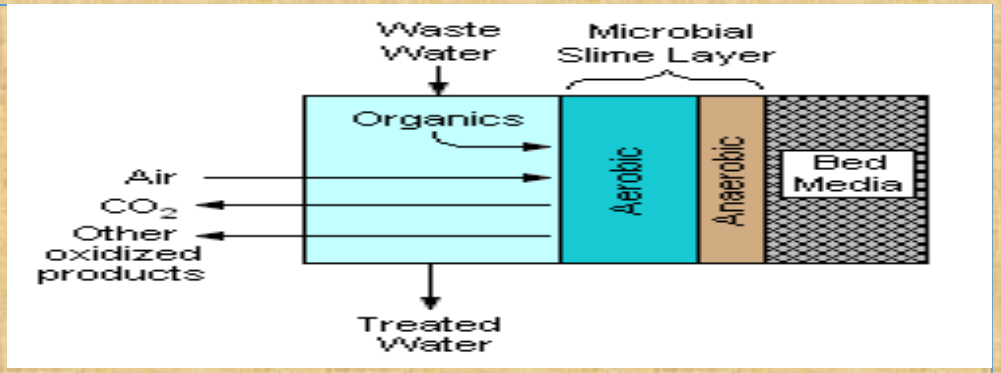
- **Primary treatment----------organic matter in solution/colloidal state and numerous living organisms**
- **High BOD value-----pollution of soil/water**
- **Subjected to Aerobic oxidation either by:**
  - **Trickling filter method**
  - **Activated sludge method**



Trickling filter method

- **Percolating filter: a bed of crushed stones or cinker**
- **1 – 2 meter (4-8 ft.) deep**
- **2-30 m (6 -100 ft.) diameter**

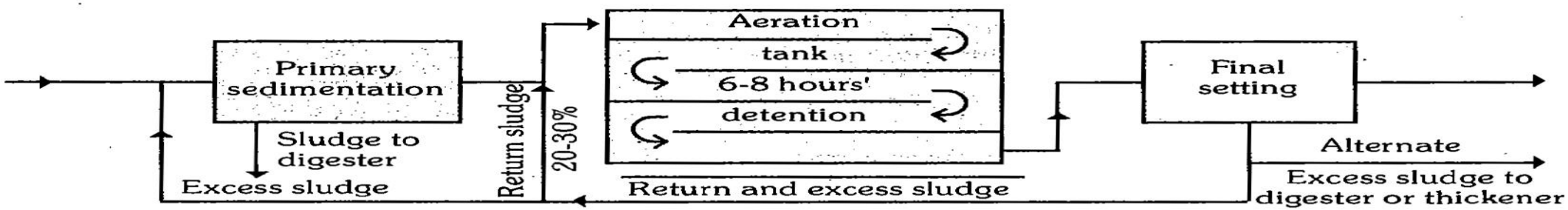
Depends on population size



- **Effluent from Prim. Sed. Tank sprinkled uniformly over the bed through revolving device (hollow pipes with holes in row).**
- **Over the surface and down of filter complex biological growth (zoogleal layer) consists of algae, fungi, protozoa and bacteria occurs.**
- **Effluent percolate through filter bed----------oxidized**
- **Wind blows freely through beds supplying oxygen**
- **Zoogleal layer lives, grows and dies---------sloughs off----break away and washed down (light green, flocculent material called humus.**
- **Oxidized sewage ----------secondary sedimentation tank/ humus tank**

Activated sludge process

- **Modern method of purifying sewage.**
- **The heart: Aeration tank**
- **Effluent from pri. Sed. Tank mixed with sludge from final settling tank (activated sludge/ return sludge: rich in culture of aerobic bacteria).**
- **Activated sludge: effluent= 20-30%**
- **Mixture ----------Aeration in aeration chamber for 6-8 hrs.**
- **Aeration by Mechanical agitation or by compressed air from bottom (diffused aeration*better)**
- **Organic matter----------CO2, nitrates and water**
- **Typhoid and cholera organism- dies, coliform-reduced**
- **Occupy less space and require skilled operations**
- **Suitable for large cities (1 acer of this works for 10 acers of percolating filter)**



- **Secondary sedimentation: 2-3 h detention period**
- **Sludge called as aerated sludge/ activated sludge----dehydrated--valuable manure (inoffensive, rich in bacteria, nitrogen and phosphates).**
- **Part of sludge in aeration tank and part moves to sludge digester.**

Sludge digestion

- **1 million gallons of sewage----------15-20 tons of sludge.**
- **It is a thick black mass containing 95% water and have revolting odour.**
- **Methods of disposal:**

1. **Digestion: incubated under favourable conditions of temperature and ph----------anaerobic auto-digestion----complex solid broken down into---water, CO2, methane and ammonia.**
   - **Volume---reduced.**
   - **Takes 3-4 weeks to complete.**
   - **Residue---in offensive, sticky and tarry mud, dry readily form excellent manure**
2. **Sea disposal: By pumping into sea**
3. **Land: composting with town refuse**

Disposal of effluent

- **1. By dilution: Rivers and streams**
  - **Diluting capacity depends on dissolved oxygen contents of receiving bodies.**
  - **Effluent should not have more than 30 mg/l suspended solids and BOD5 should not exceeds 20 mg/l (8:1 dilution)----Royal commission of England 5^{th} report.**

2. Disposal on land: irrigation

Other method of sewage disposal

1. Sea outfall
2. River outfall
3. Land treatment
4. Oxidation pond
5. Oxidation ditches

1. Sea outfall

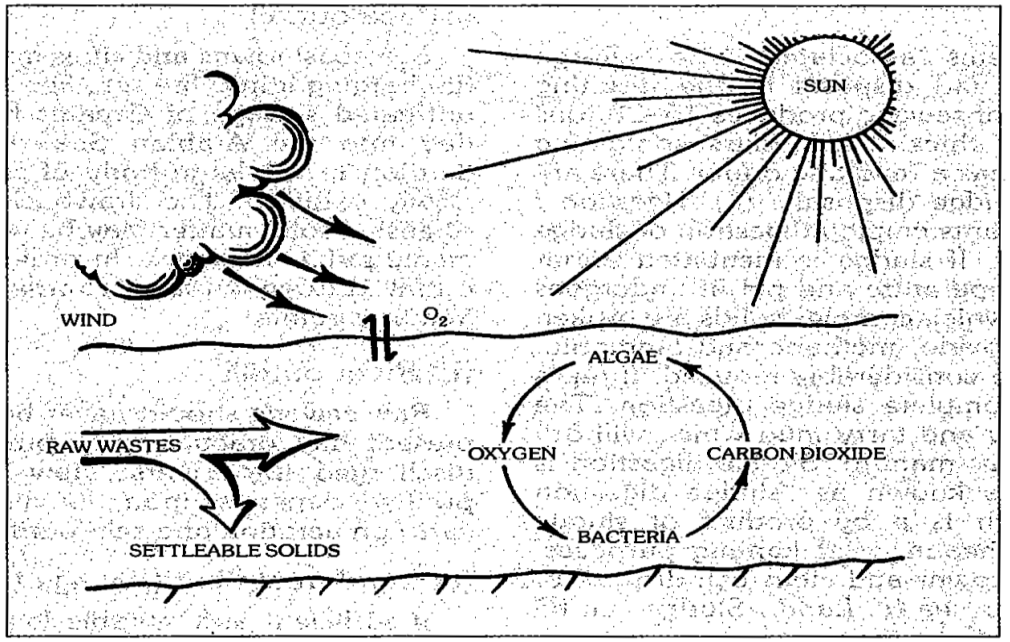
Discharge sewage into sea in deep at many points

- **River outfall**

3 Land treatment/ sewage farming/broad irrigation:

- **In many Indian towns and cities**
- **Sewage of 100-300 persons----an acre land**
- **During rainy season badly managed farms stink a condition called as sewage sickness (lack of aeration and rest pause on land.**

- **Oxidation pond: Stabilization pond, redox pond, sewage lagoons**
- **Open shallow pool 1-1.5 m deep with an inlet and outlet.**
- **1. Algae**
- **2. Bacteria**
- **Sunlight**



- **Oxidation ditches/ Aerated lagoons:** **Mechanical rotor used fro extended aeration**
- **For 5000 -20,000 population require 22 acre land for oxidation pond and 2.5 acers for aerated lagoons.**
- **Low cost methods**

THANKS