

Sanitary Engineering (66472)

7th Semester Civil Technology

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Topics

Introduction: to wastewater –Sewage:

- **Definition of sewage, Necessity of sewage Treatment, Requirement of a sewage management System.**
- **Characterization and Disposal: Characteristics of sewage: Composition, chemistry of sanitary sewage, B.O.D, C.OD aerobic and anaerobic decomposition, Sewage Disposal Discharge of raw and treated sewage on land and water, standards for disposal, raw and treated sewage on land and water, limit of dilution, self - purification of streams, oxygen economy,**

Definition of Terms

- Before studying the principles for design and construction of house drainage system it is necessary to first understand the basic terms used in subsequent description of topics in this chapter. Important terms are defined as follows:
- **Wastewater:** Water when used for different purpose like domestic commercial, industrial etc., receives impurities and become wastewater. Thus wastewater is used water and it has **physical, chemical, and biological** Impurities in it, wastewater is a general term.
- **Sewage:** The waste water coming from W.C. and containing human excreta is known as sewage.



Definition of Terms

- **Sullage:** The Wastewater coming from bathrooms and kitchens which does not contain fecal matter is known as sullage.
- **Plumbing System:** It is entire system of pipe line for providing water supply to the building or it is a system of pipes for disposal of wastewater from the building.
- **Sewer:** A pipe carrying sewage/ wastewater is called sewer.
- **Soil Pipe:** It is pipe carrying sewage from W.C.
- **Waste Pipe:** It is a pipe carrying sulluge from bathrooms, kitchens, sinks, wash basins, etc.
- **Sewerage System:** A system of sewers of different types and sizes in a town collecting wastewater from the town and carrying it to the wastewater treatment plant.

Sullage



Sewage

- **Waste matter from domestic or industrial establishments that is carried away in sewers or drains for dumping or conversion into a form that is not toxic**



Necessity of Sewage Treatment

- Sewage treatment plant plays an important role for the mankind.
- **The main function of these plants is to make the water of the sewage clean that comes from home, commercial and industrial sectors.**
- **The treatment of sewage water has become the need of the hour** as it stops spreading the diseases and illness caused by the sewage water.
- **It helps society in making the water as well as environment clean.**
- The sewage treatment plant works composed of 3. The three stages of these plants include the primary stage, the secondary stage and the tertiary stage.

Necessity of Sewage Treatment

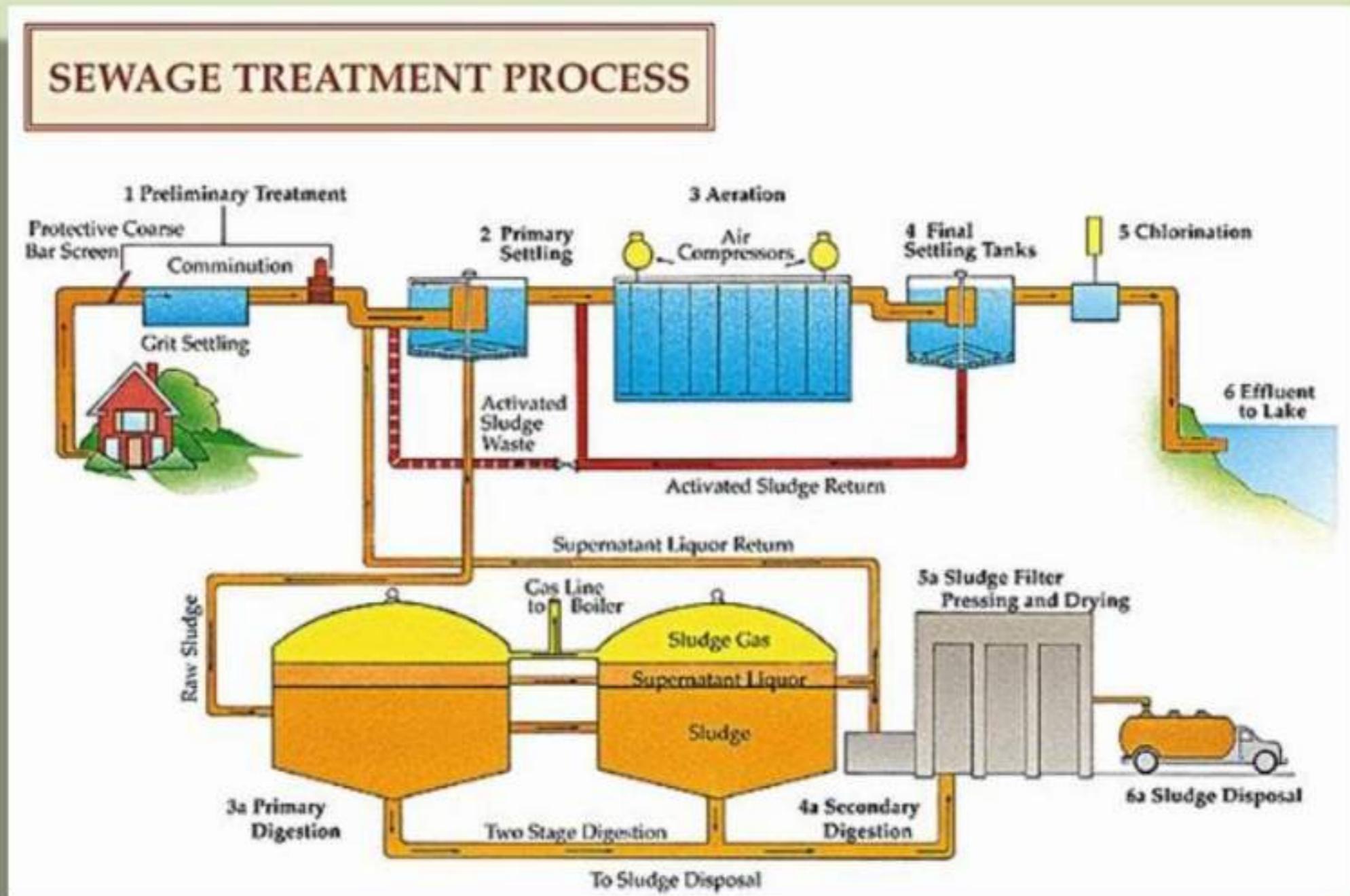
- **In the primary stage, the contaminants that are easy to eliminate are taken out from the wastewater. These substances may include oils, grease, and fats that can be easily removed from the surface area. The solids things like grits, stones, rocks, etc. are strained**
- **At the secondary stage, the removal of biological contaminants in wastewater takes place.**

Necessity of Sewage Treatment

- **At the tertiary treatment, which is the last stage of the plant, the water is get cleaned purely to get discharged in the environment. This is composed of man-made or artificial systems that help in filtration. At this stage, the nitrogen and phosphorous content is eliminated from the water. In addition to this, the water is further disinfected using chemicals like chlorine as well as treatment of UV.**

Through these stages, the final water that comes out is clean and free from pollutants that can be safely released to the environment.

Necessity of Sewage Treatment



The Importance of Managing Sewage

- The scope of sewage management has evolved throughout history with changes in socioeconomic conditions, city structures, and the environment. Today, sewage infrastructure that is well planned and operated supports urban sanitation and related activities. **Effective sewage management is essential for nutrient recycling and for maintaining ecosystem integrity.** It is also important for:
 - **Improving the environment through proper drainage and disposal of wastewater;**
 - **Preventing floods through removal of rainwater;**
 - **Preserving receiving water quality.**

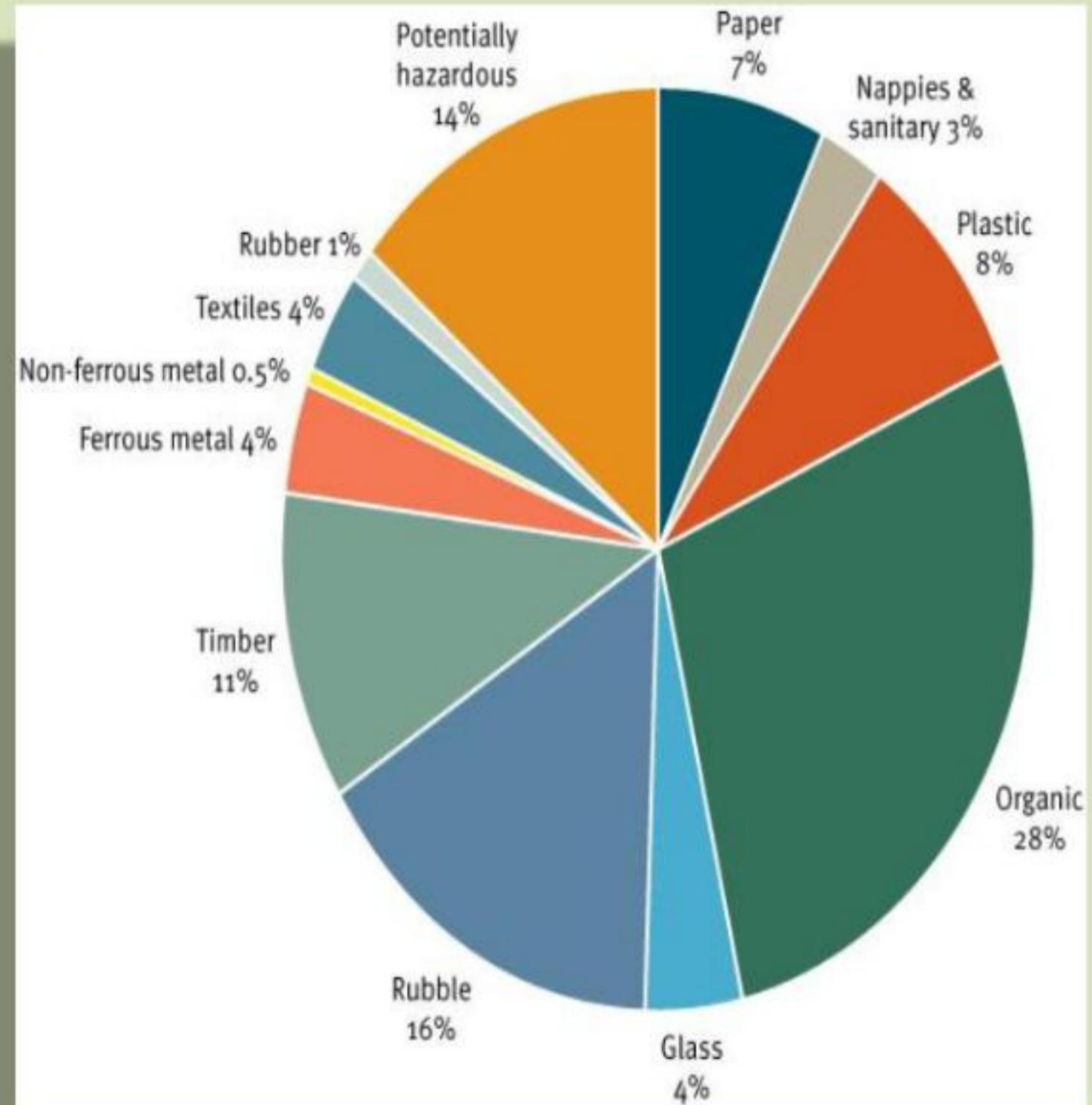
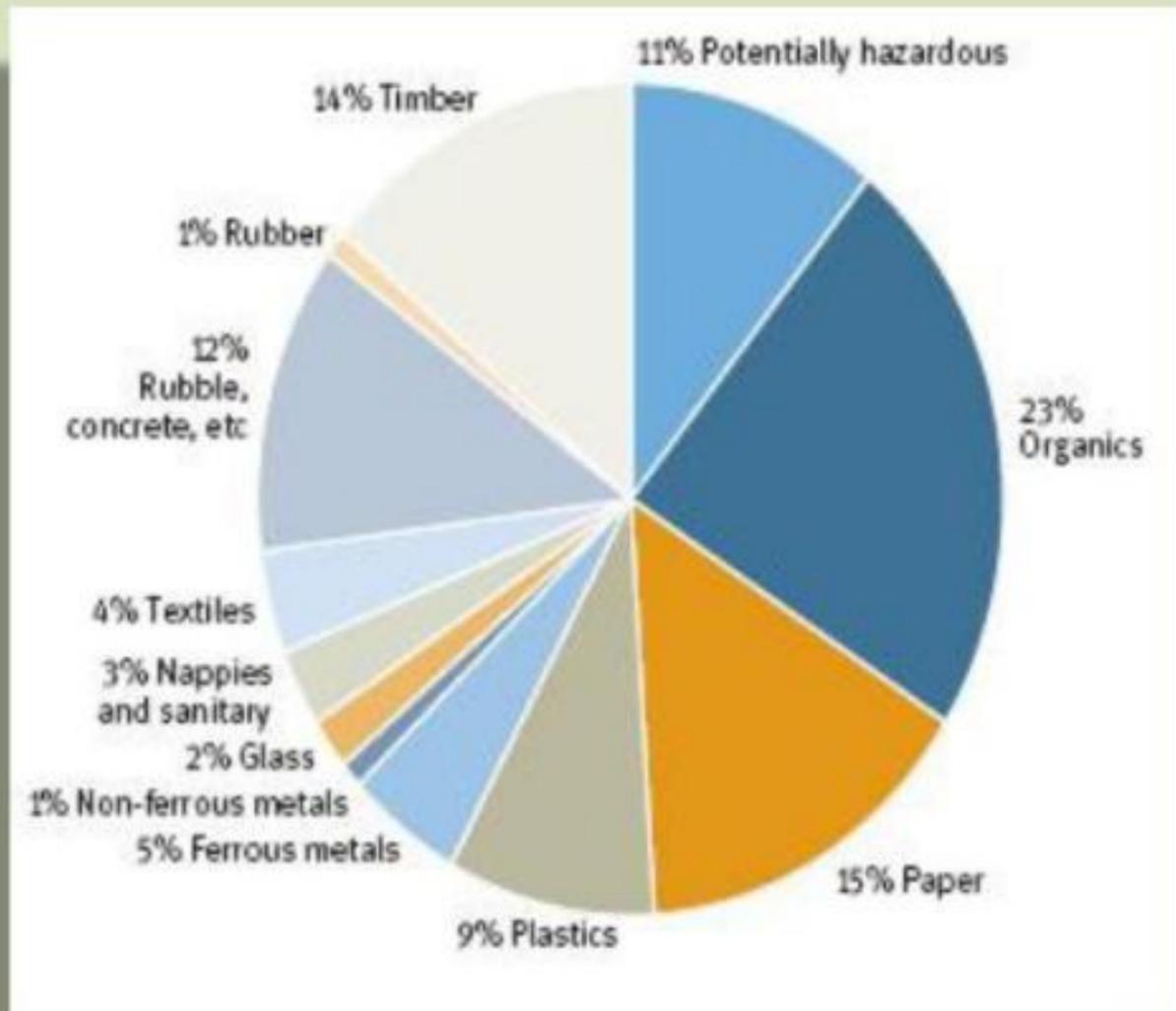
The Importance of Managing Sewage

- **The sewage treatment process facilitates the achievement of water quality objectives.** In addition to nutrient recycling, advanced treatment of wastewater often includes associated unit processes which support the optimization of resource use. **Some of these unit processes include the conversion of sludge into various beneficial by-products, and the process of extracting thermal energy from sewage and wastewater.** In addition, **the sewage collection system can be used as a conduit for optical fibre cables and other communications infrastructure.**

Composition of Sewage

- The composition of wastewater varies widely. This is a partial list of what it may contain:
- **Water (more than 95 percent), which is often added during flushing to carry waste down a drain;**
- **Pathogens such as bacteria, viruses, prions and parasitic worms;**
- **Non-pathogenic bacteria;**
- **Organic particles such as feces, hairs, food, vomit, paper fibers, plant material, humus, etc.;**
- **Soluble organic material such as urea, fruit sugars, soluble proteins, drugs, pharmaceuticals, etc.;**
- **Inorganic particles such as sand, grit, metal particles, ceramics, etc.;**

Composition of Sewage



Composition of Sewage

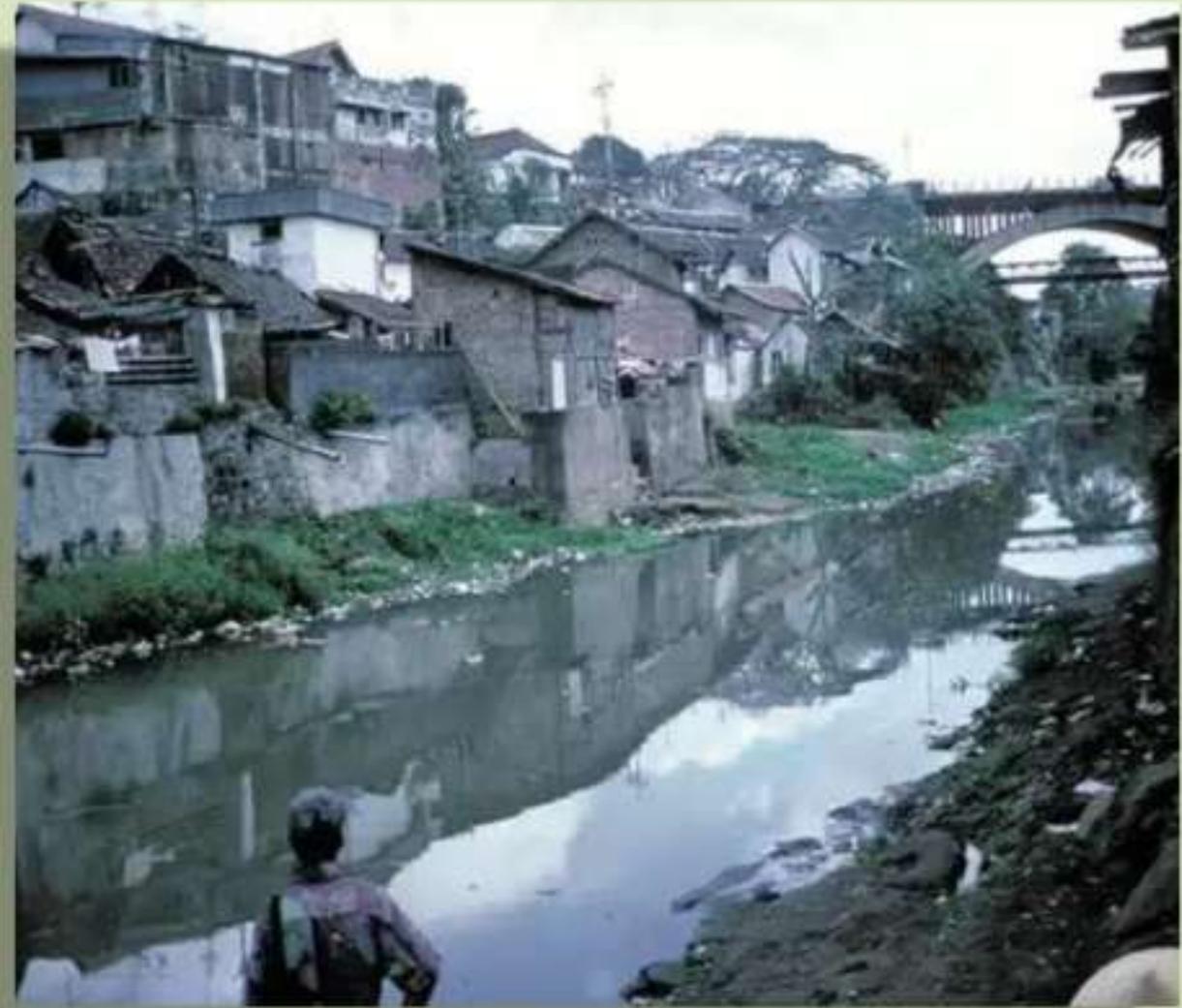
- **Soluble inorganic material such as ammonia, road-salt, sea-salt, cyanide, hydrogen sulfide, thiocyanates, thiosulfates, etc.;**
- **Animals such as protozoa, insects, arthropods, small fish, etc.;**
- **Macro-solids such as sanitary napkins, nappies/diapers, condoms, needles, children's toys, dead animals or plants, etc.;**
- **Gases such as hydrogen sulfide, carbon dioxide, methane, etc.;**
- **Emulsions such as paints, adhesives, mayonnaise, hair colorants, emulsified oils, etc.;**

• **Toxins such as pesticides, poisons, herbicides, etc.**

Introduction

- Wastewaters are usually classified as **industrial wastewater** or the **domestic wastewater** (sewage or municipal wastewater).
- **Characteristics of industrial wastewater vary greatly from industry to industry and within industries also there are variations in the quality depending upon the processes, for example quality of wastewater coming out from a cooling tower will be quite different than the wastewater coming out from any chemical process** on the other hand there are limited variations in the quality of sewage depending upon season, sewerage system, lifestyle of people etc..
- **Quality of sewage also plays an important role in design and construction of various treatment units.**

Wastewater



Introduction

- **Sewage contains organic and inorganic matter, some gases and living organisms** (mainly microorganisms) the organic and inorganic matter may be dissolved, suspended, and colloidal state.
- **The inorganic matter consists of ash, cinder, sand grit, mud and other mineral salts.**
- The organic matter may be nitrogenous or nitrogen free. Gasses includes **methane (CH_4), hydrogen sulphide (H_2S), carbon dioxide (CO_2)** etc. Sewage contains only a small percentage of solids i.e 0.1% while remaining 99.9 % is water.

Wastewater



Characteristics of Sewage

- The characteristics of sewage can be classified under following three heads:
- **Physical Characteristics**
- **Chemical Characteristics**
- **Biological Characteristics**

Physical Characteristics

The Physical Characteristics of sewage are determined using the physical method of analysis:

Colour

- The colour of the sewage indicates the freshness of sewage. If its colour is **greyish brown or yellowish**, it indicates **fresh sewage**. With passage of time, as putrefaction starts it begins to get black. The colour of stale and septic sewage is **black**(When all the oxygen has disappeared from sewage, it becomes septic). Other colors may also be formed due to presence of some specific industrial waste. The color of the sewage can normally be detected by the naked eye.

Odour

- The odour of a fresh sewage is not offensive or practically it can be considered odourless, but as it starts to get stale, it begins to give offensive odour. Within 3 to 4 hours, all oxygen present in the sewage gets exhausted and it starts emitting offensive odour by hydrogen sulphide gas which is formed due to anaerobic decomposition of sewage.

Colour



Physical Characteristics

Temperature

- The temperature has an effect on the biological activity of bacteria present in the sewage and it also affects the solubility of gases in sewage. It also affects the viscosity of sewage (more is the temperature, lesser is the viscosity of sewage).
- The normal temperature, of sewage is slightly higher than the temperature of the water supply because of the additional heat due to utilization of water. Also when the wastewater flows in a closed pipes, its temperature future increases.
- The average temperature of sewage in India is about 20°C which is near about ideal temperature of sewage for biological activities. At higher temperature coupled with the lower dissolved oxygen activities can cause serious problems in disposal of waste water.

Physical Characteristics

Turbidity

- Sewage is normally turbid representing dirty dish water or wastewater from baths having other floating matter like fecal matter, pieces of paper, cigarette ends, match sticks, greases, vegetable debris, fruit skins, soaps, etc.. The turbidity depends on the quantity of solid matter present in suspension state. The turbidity depends on the quantity of solid matter present in suspension state. The turbidity can be determined by the turbidity rod or by turbidimeters e.g. Nephelometric

Turbidity



Chemical Characteristics

- The Chemical Characteristics of sewage helps in indicating the stage of sewage decomposition, its strength, and extent and type of treatment required for making it safe the chemical characteristics of sewage includes.

Chemical Characteristics

Solids

- Solids normally contain **99.9 % water and only 0.1 %** of total solids present in the sewage may be in any of the four: **suspended solids, dissolved solids, colloidal solids, and settle able solids.**
- Suspended solids are those solids which remain floating in sewage, dissolved solids are those which remain dissolved in sewage just as a salt in water. Colloidal solids are finely divided solids remaining either in solution or in suspension . Settleable solids are that solids which settles out, if sewage is allowed to remain undisturbed for a period of 2 hrs.

Chemical Characteristics

- The proportion of these different types of solids is generally found to be as given below:
- it has been estimated that about 1000 kg of sewage contains about 0.454 kg of total solids, out of which 0.225 kg is in solution, 0.112 kg is in suspension and 0.112 kg is settle able.
- Also solids can be **organic** or **inorganic**. About 45 % of total solids are organic and the remaining 55 % is inorganic
- **Inorganic matter** consists of minerals and salts like sand, gravel, dissolved salts, chlorides, sulphates, etc.

Chemical Characteristics

- **Organic matter** consists of
- **Carbohydrates** like cellulose, cotton, starch, sugar, etc..
- **Fats and oils** received from kitchens garages, etc..
- **Nitrogenous compounds** like protein and their decomposed product, including wastes from animals, urea, fatty acids etc.
- Generally presence of inorganic solids in sewage is not harmful. They can be removed by mechanical units in treatment plants. But the suspended and dissolved organic solids are responsible for creating nuisance if disposed of without treatment.

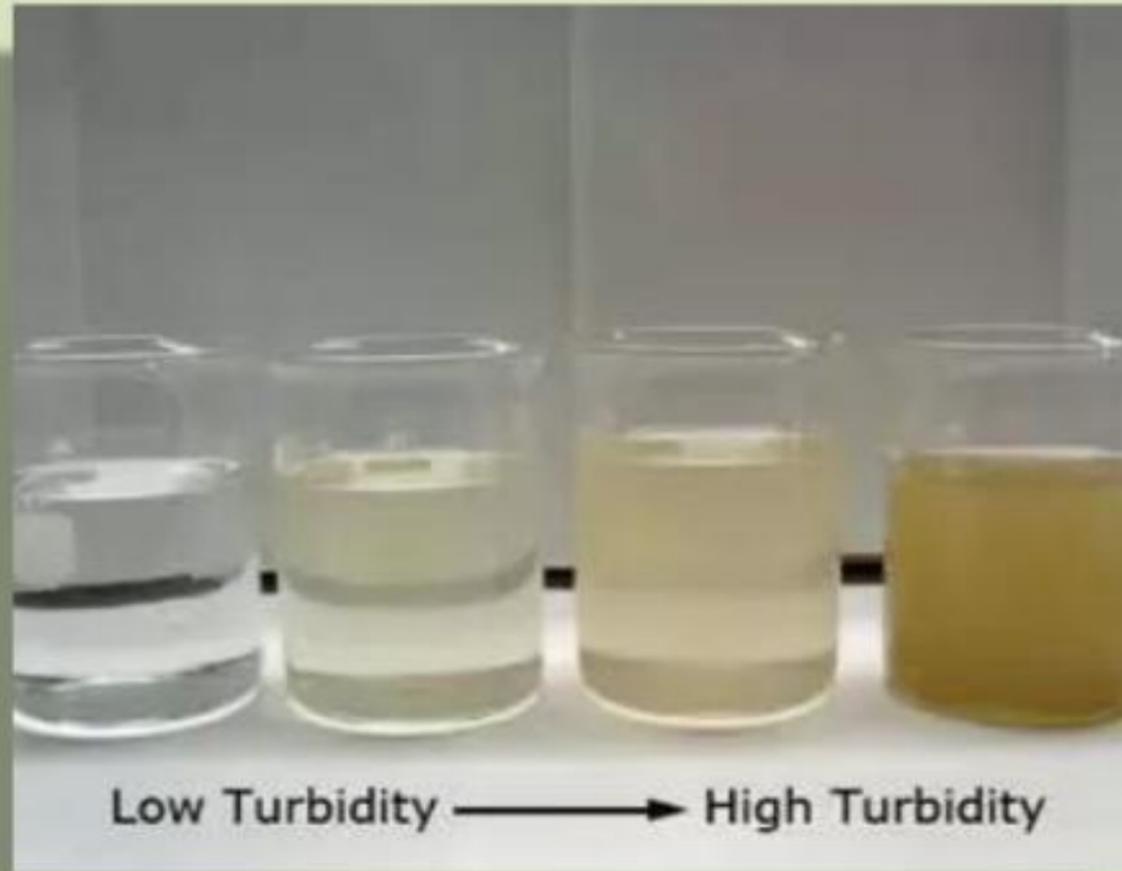
Chemical Characteristics

- **The amount of various kinds of solids present in the sewage can be determined as follows:**
- **Total Solids (S_1 in mg/ lit)**
- It can be determined by evaporating a known volume of sewage sample and weighing the dry residue left. The mass of the residue divided by the volume of sample evaporated will give total solids in mg/lit.
- **Suspended Solids (S_2)**
- These are solids which are retained by filter of 1 μm pores. So they are called non filterable solids. Their quantity can be determined by passing a known volume of sewage through a glass filter and weighing the dry residue left. Mass of the residue divided by the volume of the sample will give S_2 in mg/lit.
- **Dissolved Solids and colloidal (S_3)**
- Difference between total and suspended solids i.e. $S_1 - S_2$ represents the dissolved solids and colloidal solids.

Chemical Characteristics

- **Volatile and Fixed Suspended Solids**
- The total suspended solids (S_2) may either be volatile or fixed.
- To determine their proportions, the non filtered residue is burnt and ignited at about $550\text{ }^{\circ}\text{C}$ in a muffle furnace for about 15 to 20 minutes.
- Loss of weight due to ignition will represent the volatile solids in the sample (S_4) and $S_2 - S_4$ will give the fixed solids (S_5).

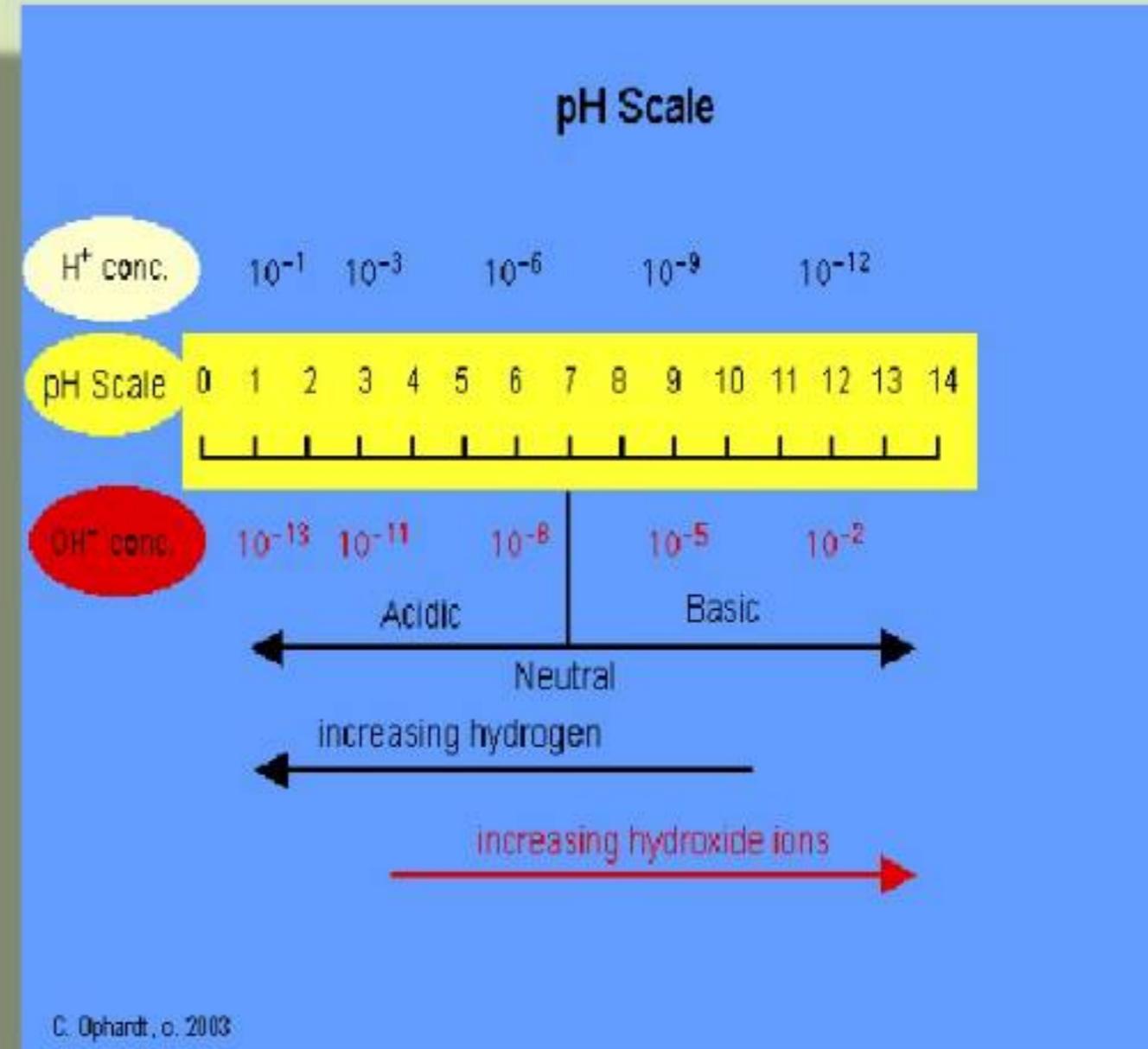
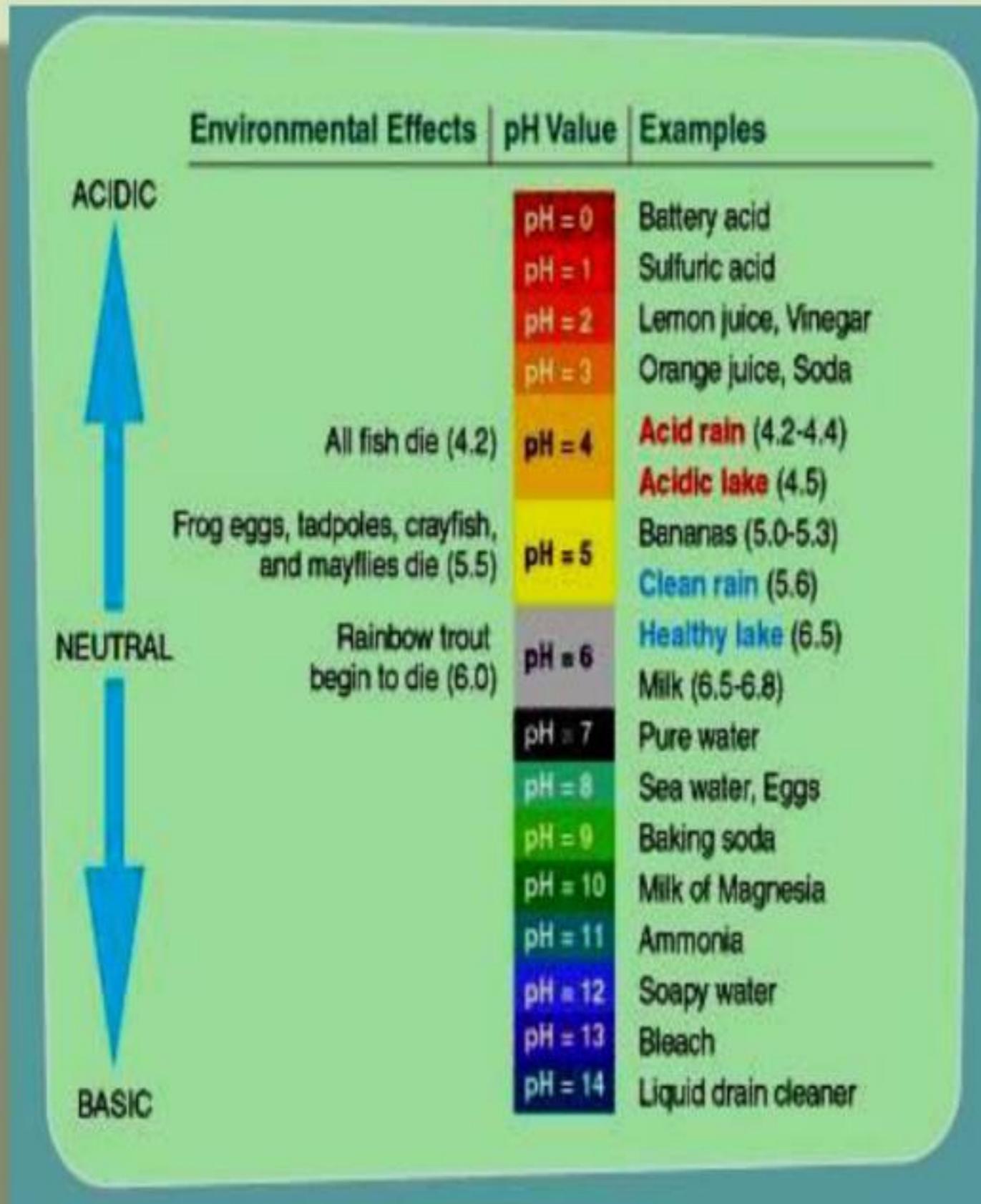
Solids



pH

- The pH value of sewage indicates the logarithm of reciprocal of hydrogen ion concentration present in the sewage. It is thus an indicator of the acidity or the alkalinity of sewage. If the pH value is less than 7, the sewage is acidic and if the pH value is more than 7, the sewage is alkaline.
- The fresh sewage is alkaline, with passed of time pH tends to fall due to production of acid by bacterial action in anaerobic or nitrification processes. However with treatment of sewage the pH tends to rise.
- Determination of pH is important because efficiency of certain treatment methods depends on it. Especially the biological treatment, for better result the pH of sewage should be around 7.0 in biological treatment as microorganisms can flourish in that pH range.
- pH can be determined using pH meter (Potentiometer)

pH



Nitrogen Content (Nitrogen Compounds)

- The presence of nitrogen in sewage is an indication of the presence of the organic matter and may occur in one or more of the following forms:
- **Free ammonia called ammonia nitrogen**
- **Albuminoid or Organic Nitrogen**
- **Nitrites**
- **Nitrates**

Nitrogen Content

(Nitrogen Compounds)

- The free ammonia indicates the very first stage of decomposition of organic matter (thus indicating recent pollution); **albuminoid nitrogen** indicates the quantity of nitrogen in sewage before the decomposition of organic matter. **Nitrates** indicates the presence of fully oxidized organic matter in sewage.
- The **nitrites** thus indicates the intermediate stage of conversion of organic matter of sewage into stable forms, thus indicating the progress of treatment. Their presence shows that the treatment given to the sewage is incomplete, and sewage is stale. Whereas the presence of nitrates indicates the well oxidized and treated sewage.
- Organic nitrogen can be measured by adding strong alkaline solution of KMnO_4 to already boiled water sample and again boiling the same. Ammonia gas thus liberated is measured which gives the quantity of organic nitrogen. The sum total of **ammonia nitrogen** is called **kjedahl nitrogen**.

Nitrogen Content

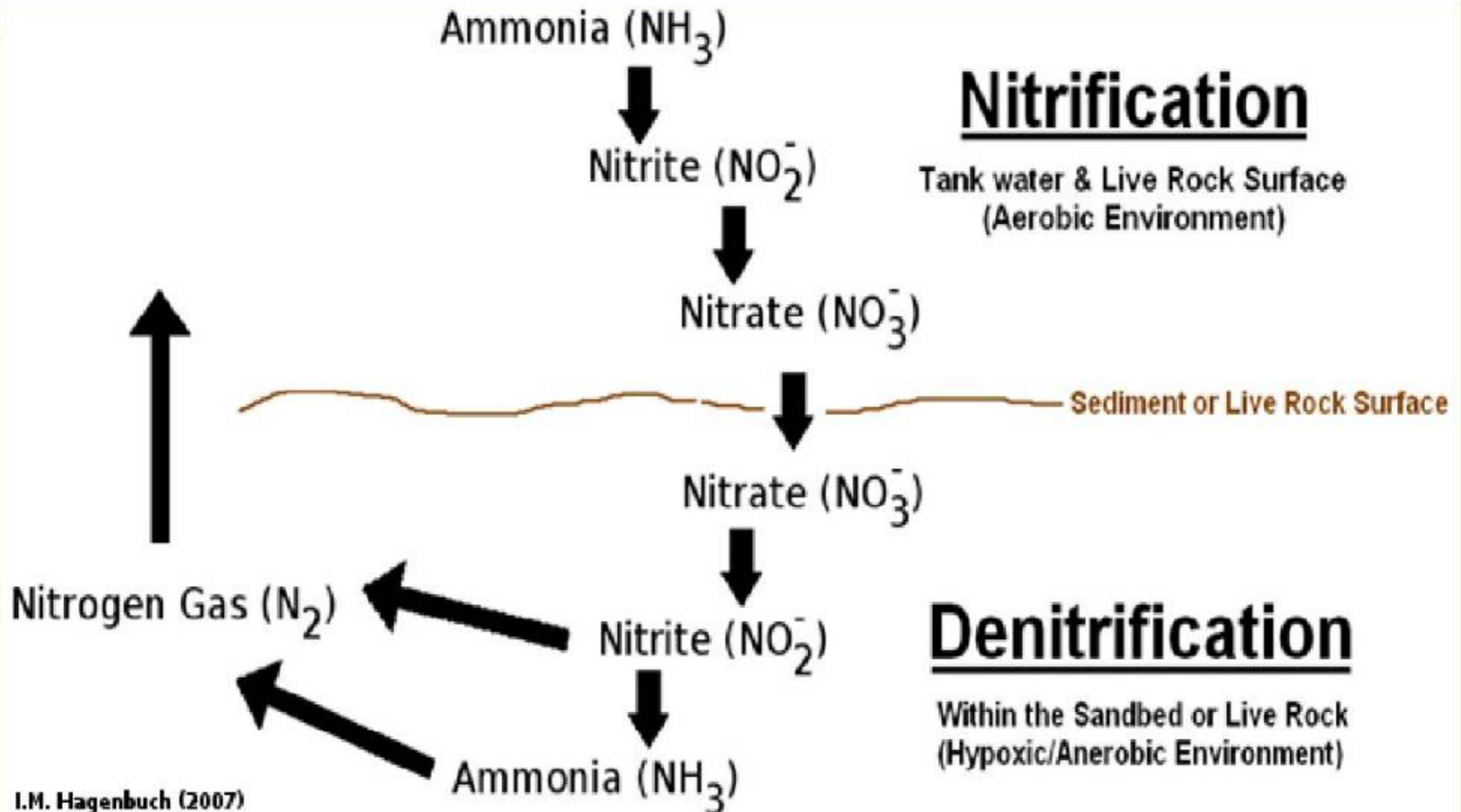
(Nitrogen Compounds)

- Nitrites are dangerous but as oxidation of nitrites to nitrates is very fast it is generally not found in water bodies.
- As Nitrates represent fully oxidized matter its presence in sewage is not dangerous. But if the sewage contains higher nitrates and if it is disposed of in a water body then the nitrates content in the water body would increase. Higher quantity of nitrates adversely affects the health of infants, causing a disease called methemoglobinemia (commonly called as blue baby disease). Children suffering from this disease may vomit; their skin colour may become dark and may die in extreme case.
- Nitrites and Nitrates are measured by colour matching techniques.

Mathemoglobinemia



Nitrogen Content (Nitrogen Compounds)



Chlorides Contents

- Chlorides are generally found in sewage and are derived from kitchen wastes, human feces and urinary discharges. The normal chloride content of sewage is 120 mg/lit, whereas the permissible limit of chloride content in water is 250 mg /lit.
- However, large amount of chlorides may enter from industries like ice cream plants, meat salting etc.. Hence, when the chloride content of a given sewage is found to be high, it indicates the presence of industrial wastes or infiltration of seawater, thereby indicating strength of sewage.
- It can be determined by titrating the wastewater with standard silver nitrate solution using potassium chromate as indicator.

Chlorides Contents



Fats, Oils and Greases

- Fats, oils and greases are derived in sewage from the discharge of animals and vegetable matter, or from the garages, kitchens of hotels and restaurants, etc..
- Such matter form scum on the top of the sedimentation tanks, clogs the voids of the filter media and affects the diffusion of oxygen. They thus interfere with the normal treatment methods. Hence these detection and removal is important.
- Oils and greases are soluble in ether. Hence for their determination, a sample of sewage, sample is first of all evaporated, leaving behind the oil and grease as a residue, which is then weighed.

Fats, Oils and Greases



Toxic

- Copper, lead, silver, chromium, arsenic, phenols, boron, cyanides, etc.. are some of the toxic compounds affecting the microorganisms resulting in malfunctioning from industrial waste.

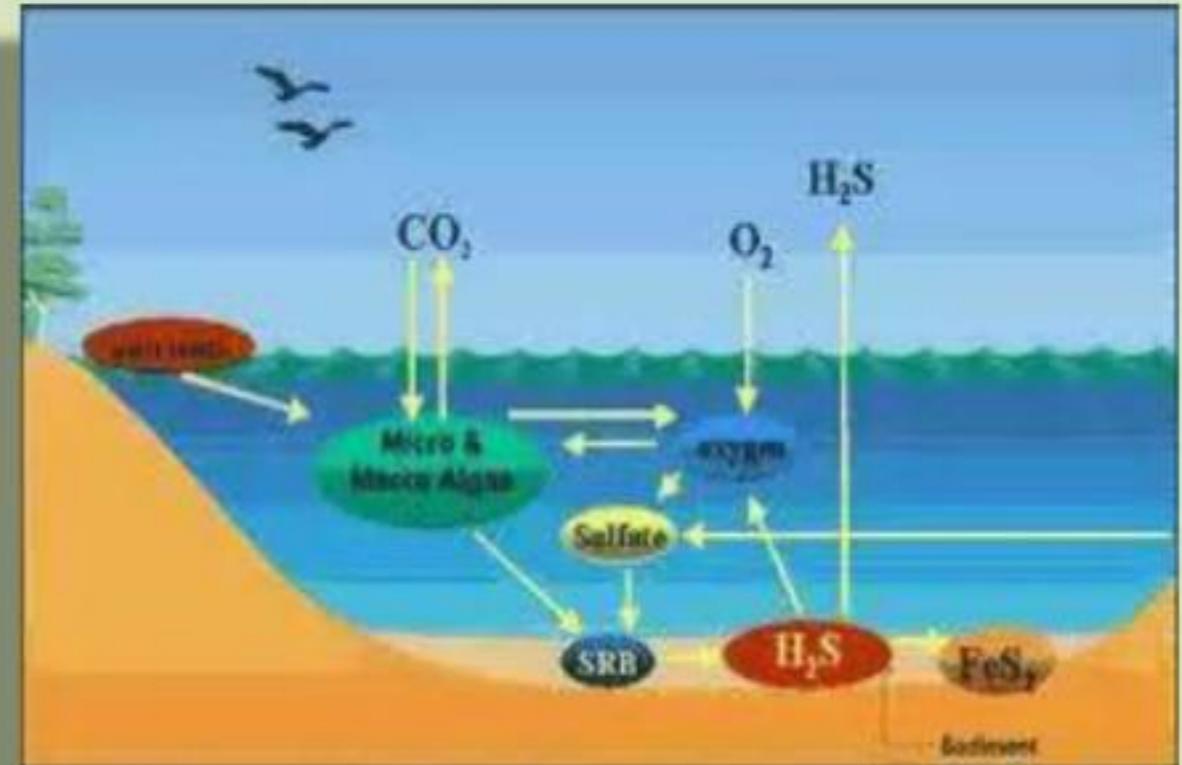
Toxic Waste



Sulphides, Sulphates and Hydrogen Gas

- Sulphides and sulphates are formed due to the decomposition of various sulphur containing substances in sewage. This decomposition also leads to evolution of hydrogen sulphide gas, causing bad odours, besides causing corrosion of concrete sewer pipes.
- In aerobic digestion of sewage, the aerobic and facultative bacteria oxidizes the sulphur and its compounds present in the sewage to initially form sulphides, which ultimately breakdown to form sulphates ions, which is a stable and unobjectionable end products.
- In an-aerobic digestion of sewage the anaerobic and facultative bacteria reduce the sulphur and its compounds into sulphides, with evolution of H_2S gas along with methane and carbon dioxide, thus causing very obnoxious odours.

Sulphides, Sulphates and Hydrogen Gas



Dissolved Oxygen

- Dissolved oxygen is the amount of oxygen in the dissolved state in the wastewater. Through the wastewater generally does not have DO, its presence in untreated wastewater indicates that the waste water is fresh. Similarly, its presence in treated wastewater effluent indicates that the considerable oxidation has been accomplished during the treatment stages. While discharging the treated wastewater into receiving waters, it is essential to ensure that at least **4 mg/l** of DO is present in it. If DO is less, the aquatic animals like fish etc. are likely to be killed near the vicinity of disposal. The presence of DO in wastewater is desirable because it prevents the formation of obnoxious odour. DO determination also helps to find the efficiency of biological treatment.

Dissolved Oxygen

The actual quantity of DO is governed by

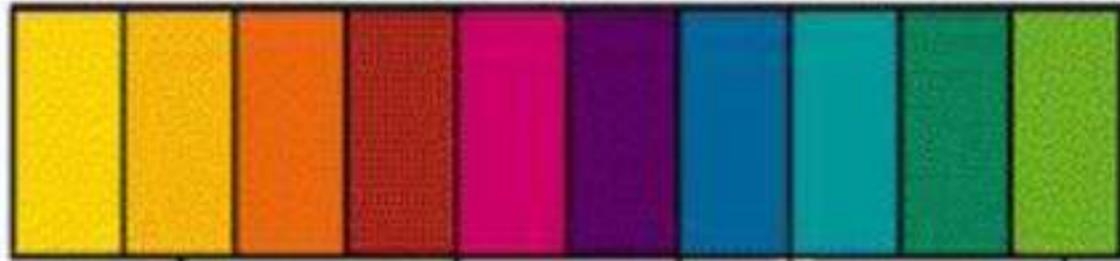
- Solubility of Oxygen
- Partial Pressure of oxygen in atmosphere.
- Temperature
- Purity (Salinity, suspended solids etc.) of water
- The DO of wastewater decreases as the temperature increases.
- The solubility of sewage in waste. DO content of sewage is determined by winklers method.

Dissolved Oxygen

RANGE OF TOLERANCE FOR DISSOLVED OXYGEN IN FISH

PARTS PER MILLION (PPM)
DISSOLVED OXYGEN

0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0



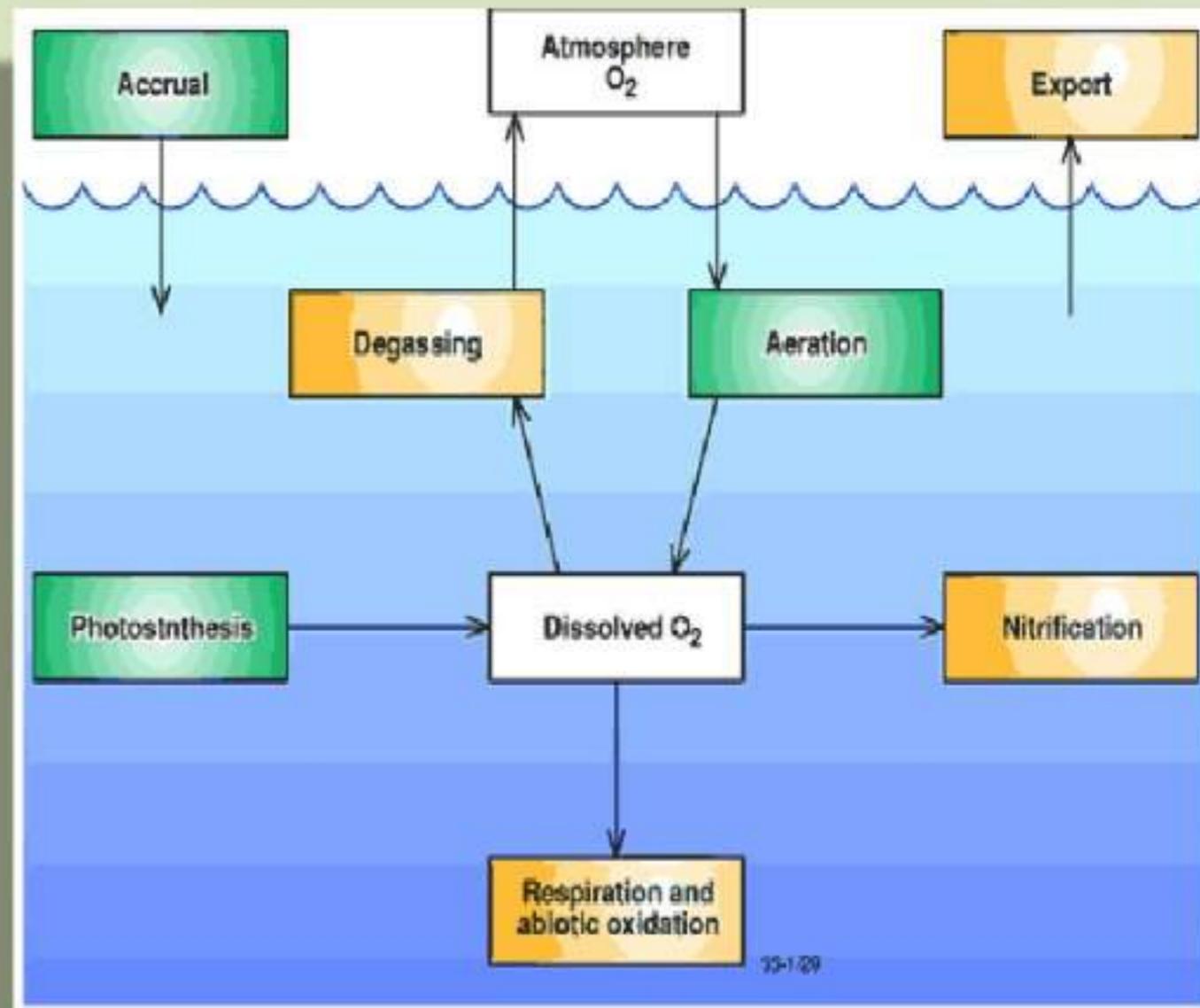
< 3.0 PPM
too low for
fish populations

3.0 - 5.0 PPM
12-24 hour
range of tolerance /
stressful conditions

6.0 PPM
supports
spawning

> 7.0 PPM
supports
growth/activity

> 9.0 PPM
supports
abundant
fish populations



Biochemical Oxygen Demand

There are two types of organic matter

- (i) Biodegradable or biologically active
- (ii) Non biodegradable or biologically inactive
- Organic matter is often assessed in terms of oxygen required to complete oxidize the organic matter to CO_2 , H_2O , and other end products of Oxidation.
- **Biochemical Oxygen Demand (BOD)** is defined as the amount of oxygen required by the microorganisms (mostly bacteria) to carry out decomposition of biodegradable organic matter under aerobic conditions.

Biochemical Oxygen Demand

- The BOD test is widely used to determine the pollution strength of domestic and industrial wastes in terms of the oxygen that they will require if discharged into natural watercourses. It is the one of the most important test in stream pollution control activities.
- This test is of prime importance in regulatory work and in studies designed to evaluate the purification capacity of receiving bodies of water.
- It is also useful in design of wastewater treatment plant and also to measure the efficiency of some treatment processes.

Biochemical Oxygen Demand

- The test is of prime importance in regulatory work and in studies designed to evaluate the purification capacity of receiving bodies of water.
- It is also useful in design of wastewater treatment plant and also measure the efficiency of some treatment processes.
- The organic matter present in the wastewater may belong to two groups:
 - **Carbonaceous matter**
 - **Nitrogenous matter.**
- The ultimate carbonaceous BOD of a waste is the amount of oxygen necessary for microorganisms in the sample to decompose the biodegradable carbonaceous material. This is the first stage of oxidation and the corresponding BOD is called as first stage BOD.

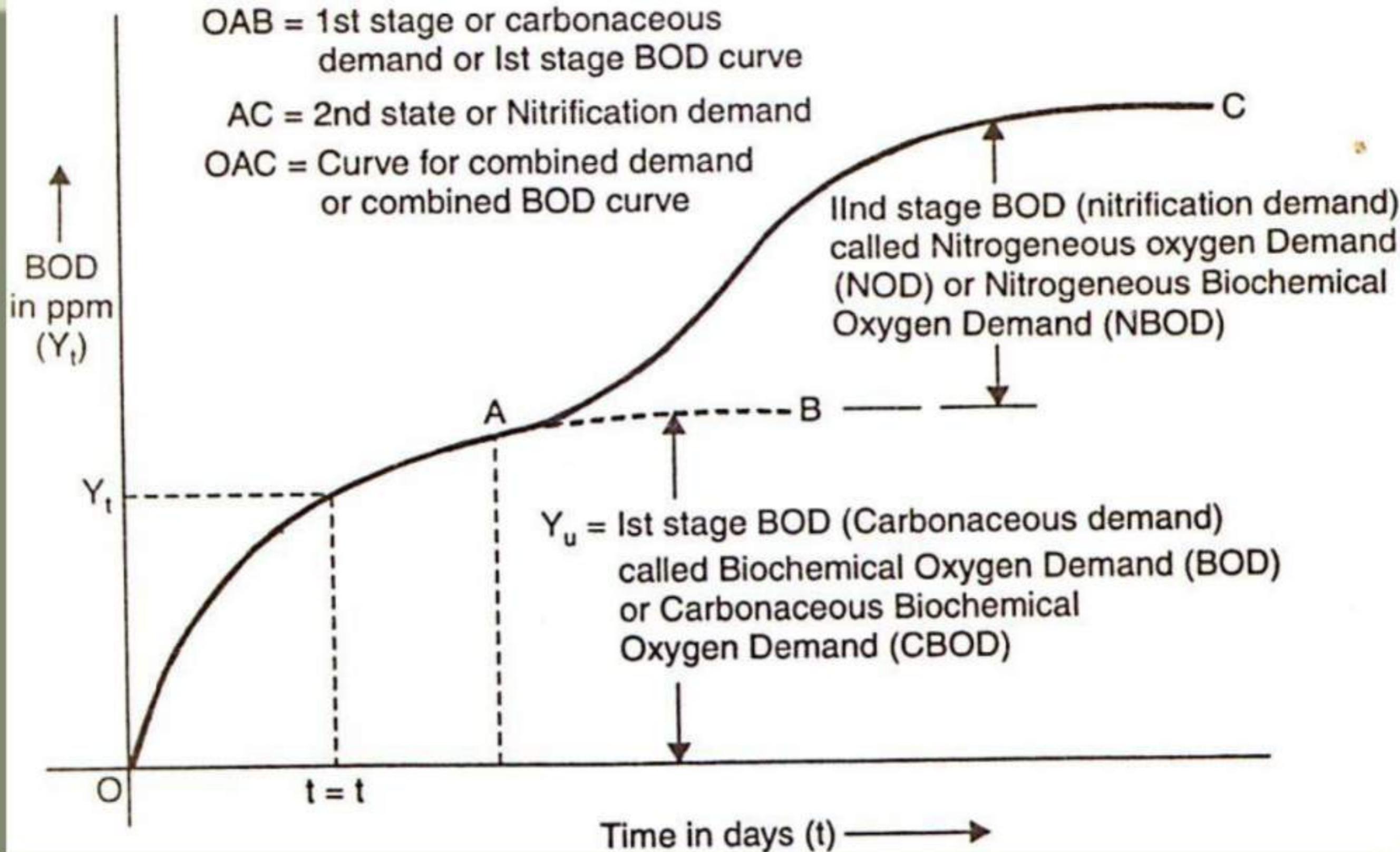
Biochemical Oxygen Demand

- In the second stage the nitrogenous matter is oxidized by autotrophic bacteria, and the corresponding BOD or nitrification demand.
- In fact, polluted water will continue to absorb oxygen for many months, and it is not practically feasible to determine this ultimate oxygen demand.
- Hence the 5 days period is generally chosen for the standard BOD test, during which oxidation is about 60 to 70 % complete, while within 20 days period oxidation is about 95 % to 99 % complete. A constant temperature of 20⁰ C is maintained during incubation. The BOD value of 5 Day incubation period is commonly written as BOD 5 or simply as BOD.

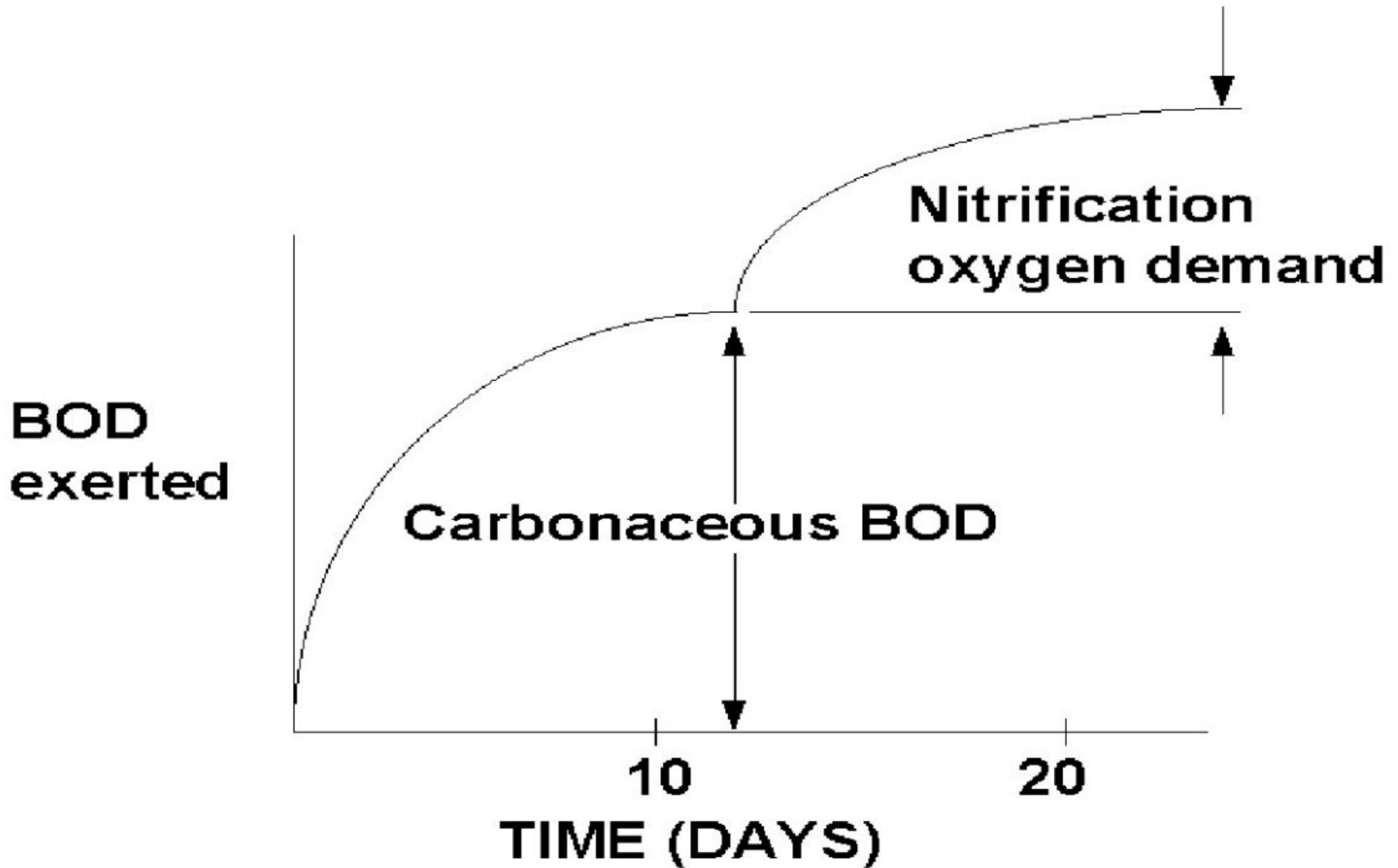
Biochemical Oxygen Demand

- Another reason for selecting 5 days as standard duration is to avoid interference of nitrification bacteria. Nitrification starts after 6th or 7th day. Sanitary engineers are generally interested in carbonaceous BOD only, so by selecting 5 days we generally get only the carbonaceous BOD. Interference of Nitrification can be eliminated by pretreatment of sample or by using inhibitory agents like methylene blue.
- Now a day BOD test is also done at 27 °C and duration of 3 days (BOD_3^{27}), results can be obtained faster and it is more nearer to the actual field conditions in INDIA

BOD Curve



BOD Curve



Limitation of BOD Test

Following are the imitation of BOD Test:

- It measures only the biodegradable organic matter.
- Time duration of the test is very long i.e. 5 days, so if quick results are needed it is not useful.
- Pretreatment is needed if the sample contains toxic waste.
- Nitrifying bacteria can cause interferences and could give higher results. To avoid them proper care must be taken.
- It is essential, to have high concentration of active bacteria present in the sample.

Chemical Oxygen Demand

- The BOD test takes minimum 5 days time and due to this it is not very useful in control of treatment processes. An alternative test is COD test. It is widely used as a means of measuring the amount of organic matter in the waste. It can be used to measure both biodegradable and non biodegradable organic matter. COD test, takes 3 hours in comparison to 5 days for BOD test, In COD test, a strong chemical oxidizing agent like potassium dichromate is used in acidic medium to oxidize the organic matter present in the waste. Almost all type of organic matter with a few exceptions can be oxidized by the action of strong oxidizing agents under acidic conditions. COD can be defined as amount of oxygen required to chemically oxidize organic matter using a strong oxidizing agent like potassium dichromate under acidic condition.

Total Organic Carbon

- TOC test consists of acidification of the wastewater sample to convert inorganic carbon to CO_2 which is then stripped. The sample is then injected into high temperature furnace where it is oxidized in presence of a catalyst. The CO_2 that is produced is measured by means of infrared analyzer and converted instrumentally to original organic carbon content. The test is accurate and correlates to BOD well. Certain types of organic matter are oxidizing in TOC test so its value is less than BOD test. For a typical domestic wastewater $\text{BOD}_5 / \text{TOC}$ ratio varies from 1.0 to 1.6. TOC is not widely used because of the cost of the instrument and the skill necessary in its operation.

Total Organic Carbon



Theoretical Oxygen Demand

- The oxygen required to oxidize the organic matter present in a given wastewater can be theoretically computed. If the organics present in the wastewater are known. Thus if the chemical formulas and the concentrations of chemical compounds present are known to us, we can easily calculate the theoretical oxygen demand of each of these compounds by writing the balance reaction for the compound with the oxygen to produce CO_2 and H_2O and oxidized in organic compounds.
- But in actual practice it is virtually impossible to know the details of the compounds present in any natural raw water or wastewater.

Biological Characteristics

- The sewage contains many microorganisms like bacteria, algae, fungi, protozoa, etc. bacteria being the most predominant. Most of the bacteria found in the sewage are harmless non-pathogenic bacteria. They are helpful in oxidation and decomposition of sewage. A little no of bacteria, however, are disease producing pathogens, which are the real danger to the health of the public.
- In case of sewage samples, the routine bacteriological tests, as performed for water samples, are generally not performed, because of the high concentration of bacteria present in it. But at the time of outbreak of epidemics, certain tests may be done to find the type of pathogens

Population Equivalent

- Industrial wastewaters are generally compared with per capita normal domestic wastewaters, so as to rationally charge the industries for the pollution caused by them. The strength of the industrial sewage is thus, worked out as below:

[Standard BOD₅ of industrial Sewage]=

[Standard BOD₅ of domestic sewage per person per day] x [Population equivalent]

Population Equivalent

- The average standard BOD₅ of domestic sewage is worked out to be about 0.08 kg/day/ person. Hence, if the BOD₅ of the sewage coming from an industries is worked out to be 350 kg/ day, then

$$\text{Population Equivalent} = \frac{\text{Total BOD 5 of the industry in kg/day}}{0.08 \text{ kg/day/person}}$$

$$= \frac{350}{0.08} = 4375$$

Population Equivalent

- The population equivalent, thus, indicates the strength of the industrial wastewaters for estimating the treatment required at the municipal sewage treatment plant, and also helps in assessing realistic charges for this treatment to be charged from the industries instead of charging them simply by volume of sewage.

Industrial Waste Water



Characteristics of Industrial Waste Water

- The characteristics of the industrial wastewater usually vary from industry to industry and it also varies from process to process. In general Industrial effluent differs widely from normal domestic sewage obtained from the residences and commercial establishments. They have too high a proportion of suspended solids, dissolved organics and inorganic solids, BOD, alkalinity or acidity, and the different parameters will not be in the normal domestic sewage. The Pollutants in the industrial wastewater includes the raw materials, process chemicals, final products, process intermediates, process by products, oils, and impurities in raw material and process chemicals. Such industrial wastewaters cannot always be treated easily by the normal method of treating domestic wastewater and specially designed methods or sequence of methods may be necessary.

Pollutants in industrial Waste Water and their effects

- **Organic Substances:** These deplete DO of stream and impose great load on secondary treatment unit.
- **Inorganic substances:** These includes carbonates, chlorides, nitrogen, phosphorous etc.. They cause eutrophication of water bodies, increases dissolved solids content and can also be harmful to aquatic life.
- **Acids and alkalies:** These generally affects the aquatic life of receiving water body. They also cause serious problem in operation of treatment units.
- **Toxic Substances:** These includes cyanides, Sulphides, acetylene, phenols, heavy metals, ammonia etc. due to which flora and fauna of receiving waters is greatly affected. They may cause problems in the biological treatments.
- **Colour producing substances:**
 - They impart objectionable color in the receiving water bodies.
- **Oils:** They hinder self purification as they remains floating on the surface and cause problem in oxygen diffusion

Organic Pollutants

They Include oils, fats, phenols, organic acids grease and several other organic compounds



Inorganic Pollutants

- They include fine particles of different metals, chlorides, sulphates, oxides of iron, cadmium, acids and alkalis

Inorganic Pollutants



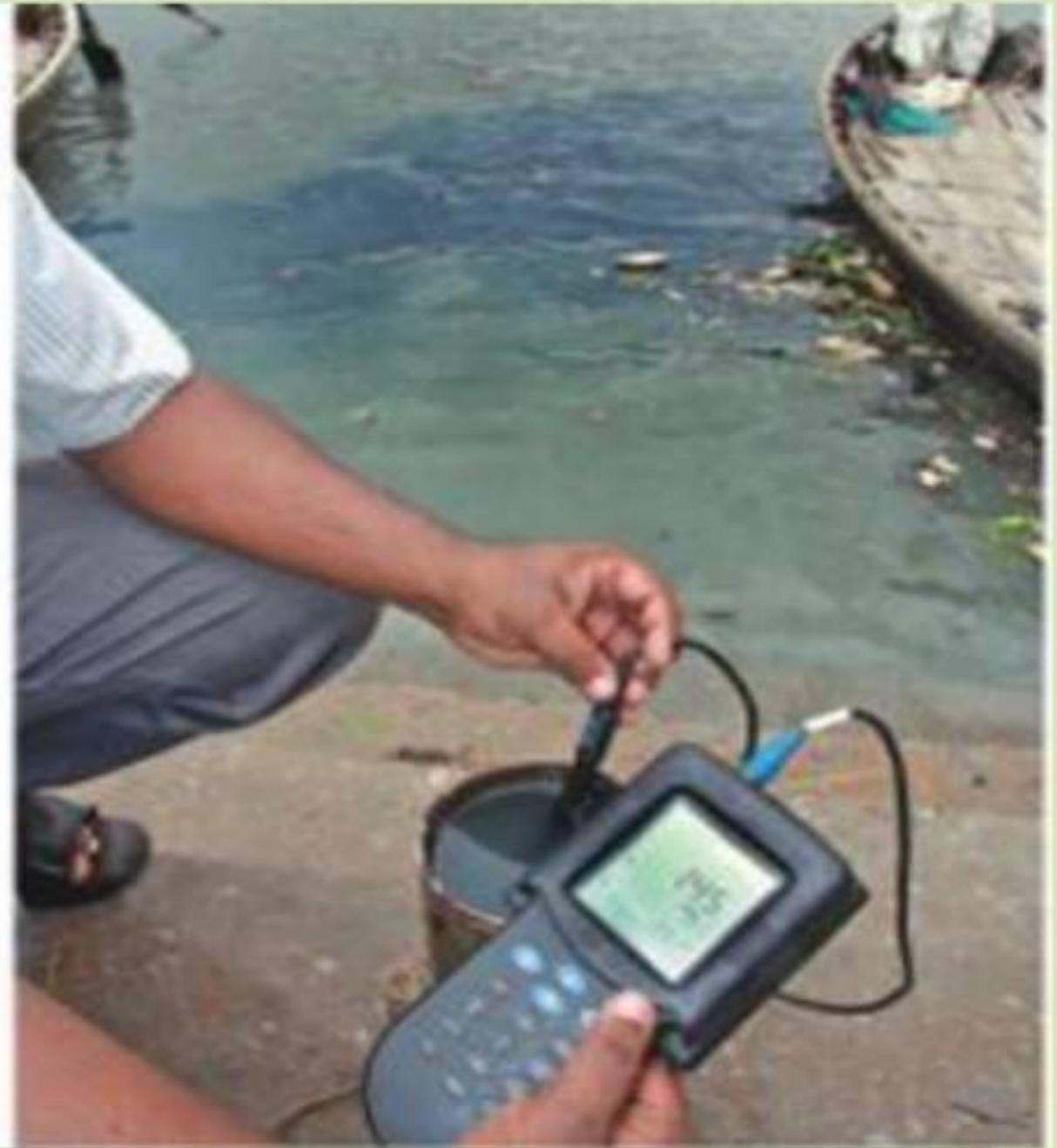
Marine Pollution



Textile Industry

- The Characteristics of waste from a textile Industry depends on the type of fiber used. These fibers may be
 - Cotton
 - Wool
 - Regenerated
 - Synthetic
- The Pollutants in textile Industry waste Include natural Impurities in the fiber used, as well as the process chemical
(for eg. dyes, bleaching powder etc.)

Textile Waste



Thanks



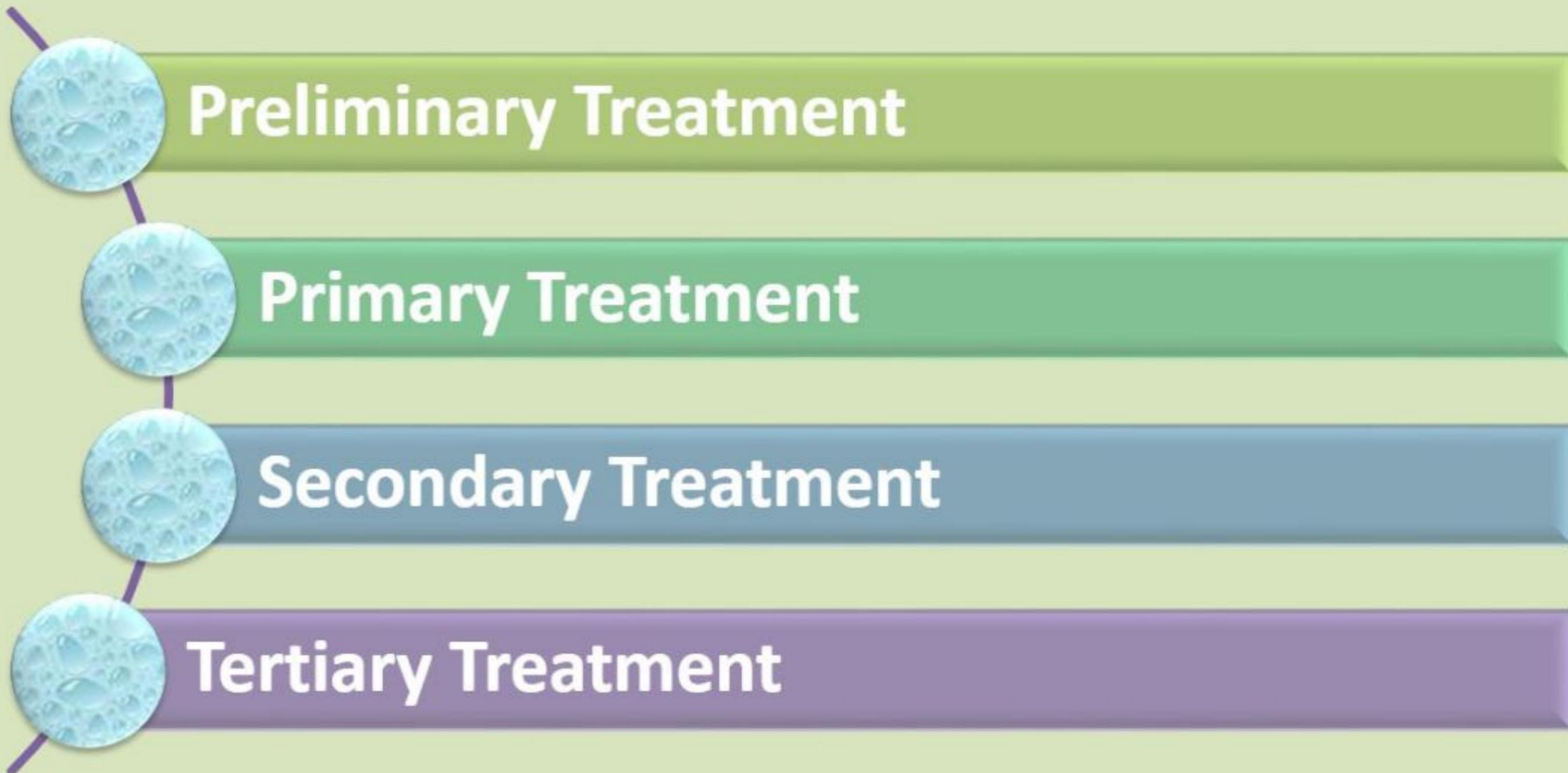
To All

Presentation

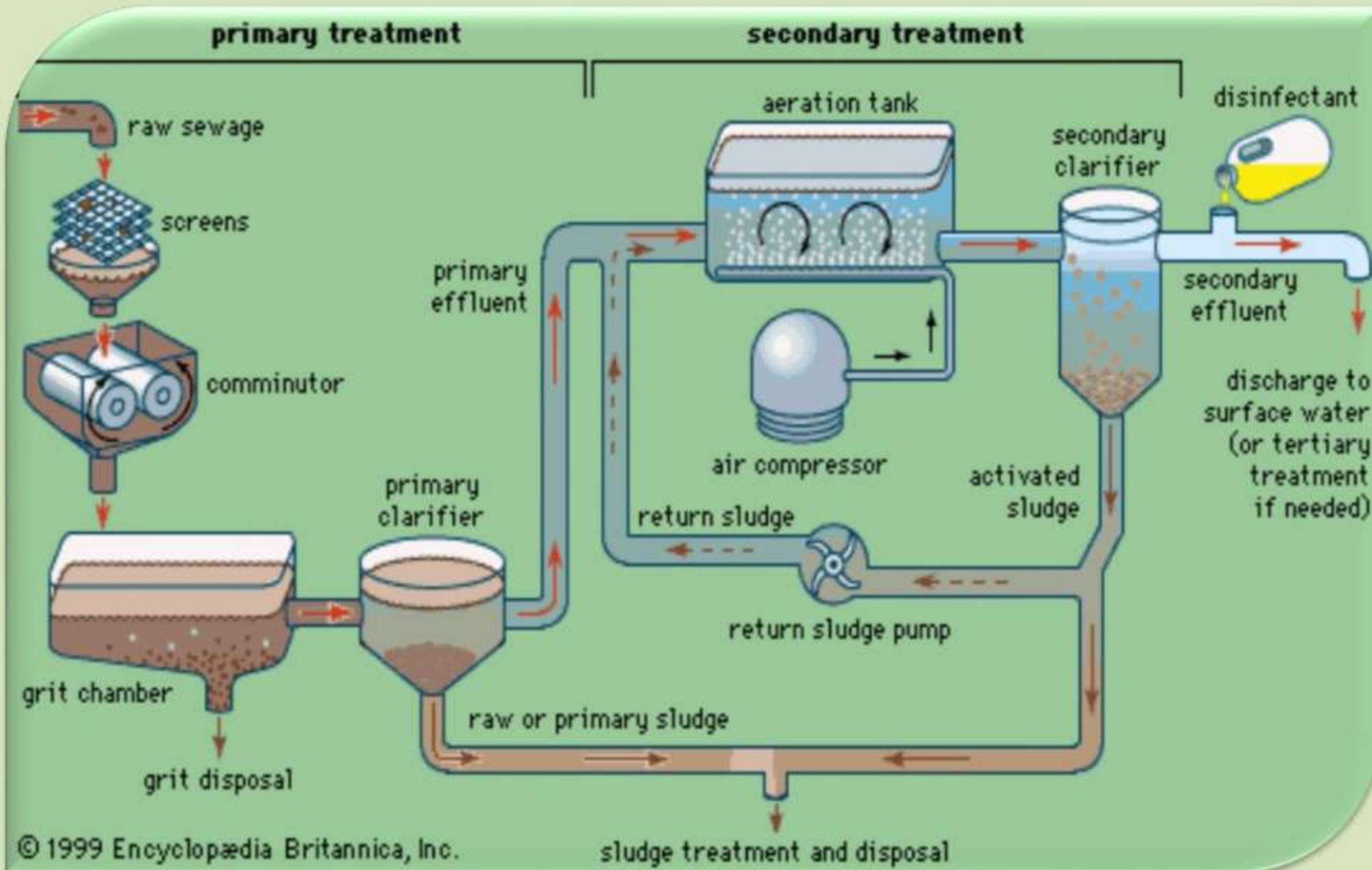
on

Waste Water Treatment Process

WASTE WATER TREATMENT PROCESS



Waste Water Treatment Process



Preliminary Treatment

Removal of waste water constituents such as rags, sticks, floatable grit, and grease that may cause maintenance or operational problem with the treatment operations, processes, and ancillary systems

Preliminary Treatment

Preliminary treatment consists of following units

- Screening For removal of floating matter.
- Grit Chamber For removal of sand and grits.
- Comminuters For grinding large size suspended solids
- Flootation Units For removal of oil and grease
- Skimming Tanks
- Flow Measuring units such as partial flume
- Pumps
- Pre-aeration Units

Primary Treatment

Removal of a portion of the suspended solids and organic matter from the wastewater.

Advanced Primary Treatment

Enhanced removal of suspended solids and organic matter from the wastewater. Typically accomplished by chemical addition or filtration known as

Coagulation and Flocculation.

Primary Treatment

Primary treatment consists of following processes/units

- Sedimentation Primary Settling Tanks
- Coagulation Secondary Settling Tank
- Flocculation

Secondary Treatment

Removal of biodegradable organic matter [insoluble or suspension state} and suspended solids. Disinfection is also typically included in the definition of conventional secondary treatment

Secondary Treatment with Nutrient Removal

Removal of biodegradable organics,
suspended solids, and nutrients
(nitrogen phosphorus, or both
nitrogen and phosphorus)

Secondary Treatment

Secondary Treatment Process for Wastewater Applications:

- Aeration Systems
- Biological Treatment Systems
- Sludge and Bio solids Processing Systems

Secondary treatment consists of following processes.

- Activated Sludge Process
- Oxidation Ponds and lagoons
- Trickling Filter

Tertiary Treatment

Removal of residual suspended solids (after secondary treatment), usually by granular medium filtration or micro screens. Disinfection is also typically a part of tertiary treatment. Nutrient removal is often included in this definition

Tertiary Treatment

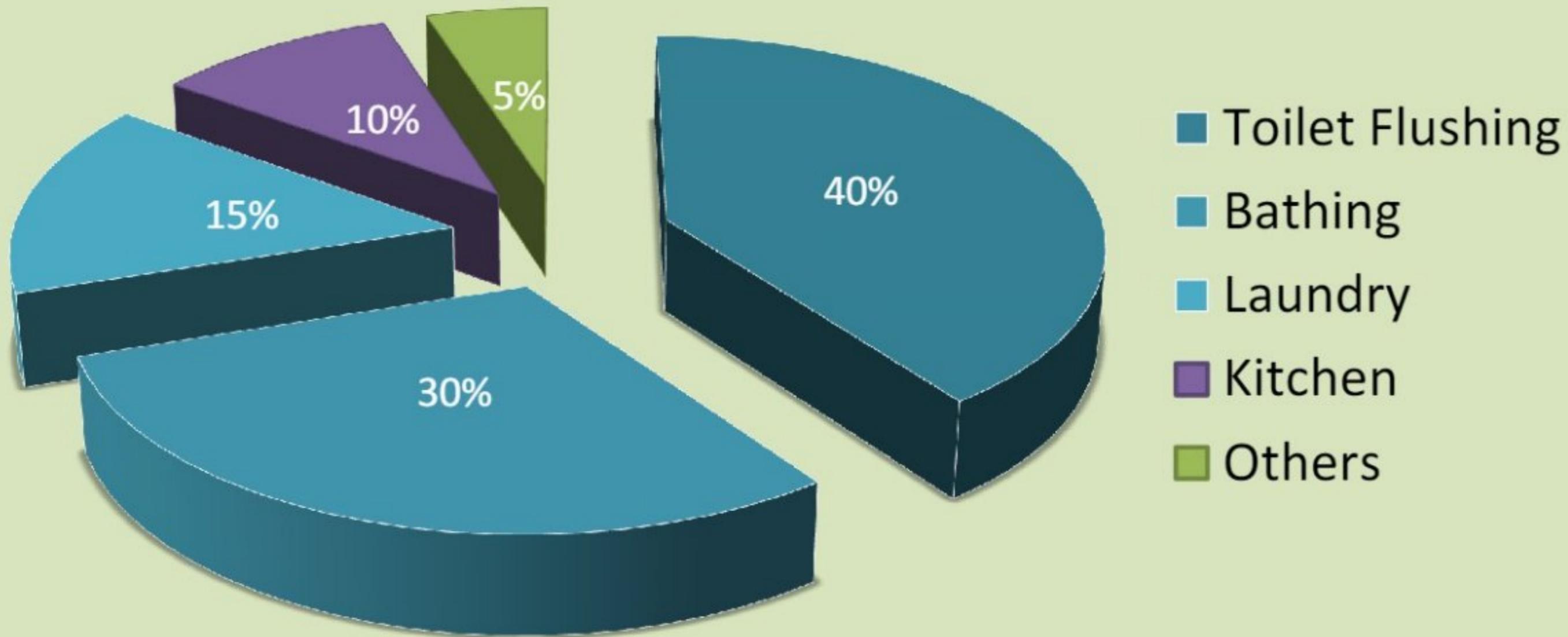
Tertiary treatment consists of following processes and units.

- Membrane Filtration and Separation
- Dechlorination and Disinfection Systems
- Reverse Osmosis (RO) Systems
- Ion Exchange
- Activated Carbon Adsorption
- Physical/Chemical Treatment

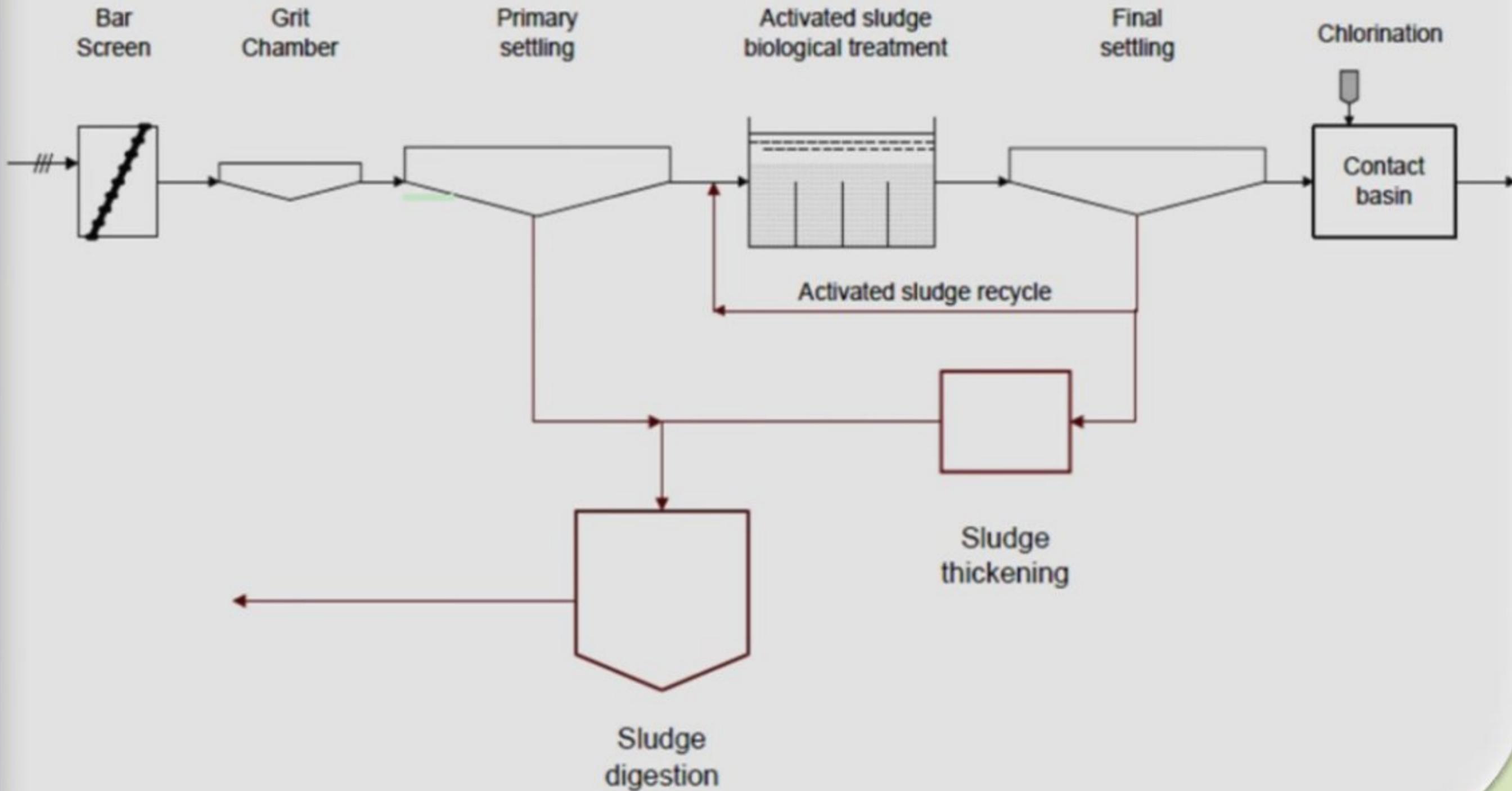
Functions of Water Treatment Units

Unit Treatment	Function (Removal)
Screening	Floating matter
Sedimentation	Suspended matter
Coagulation	Suspended matter, a part of colloidal matter and bacteria
Chemical methods	Iron, Manganese, etc.
Filtration	Remaining colloidal dissolved matter, bacteria
Disinfection	Pathogenic bacteria, Organic matter and Reducing substances
Softening	Hardness
Aeration, chemicals use	Colour, Odour, Taste

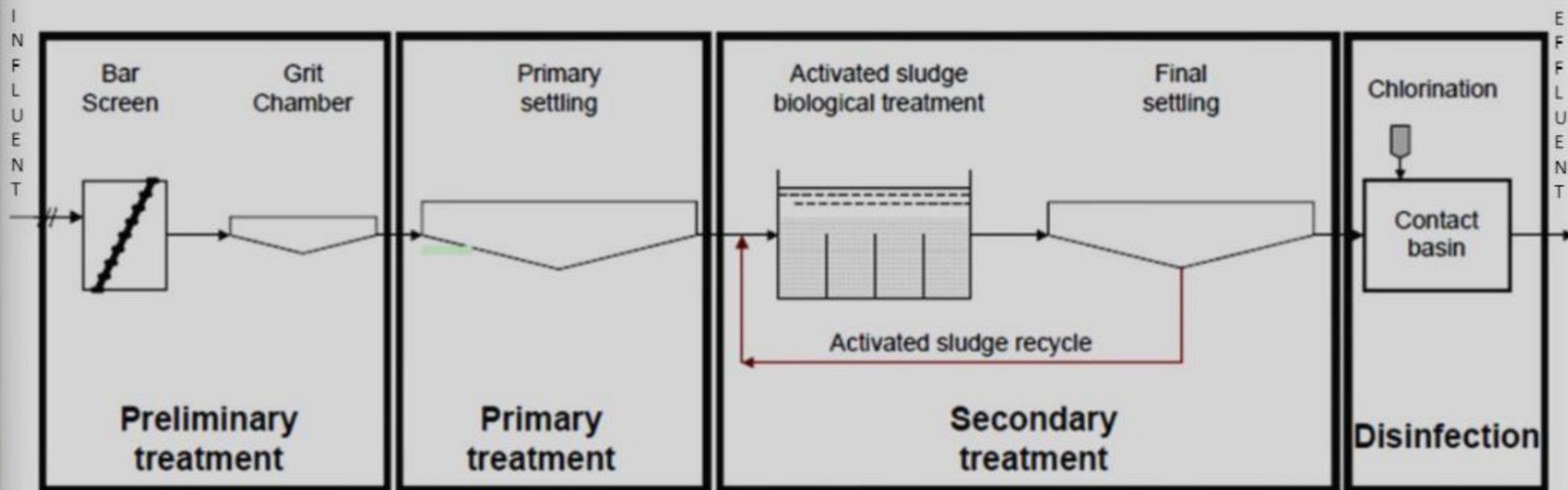
Source of Domestic Wastewater



Typical wastewater treatment plant



Typical wastewater treatment plant



Can also have tertiary treatment to remove nutrients and other pollutants

Plan of a Typical Waste Water Treatment Plant



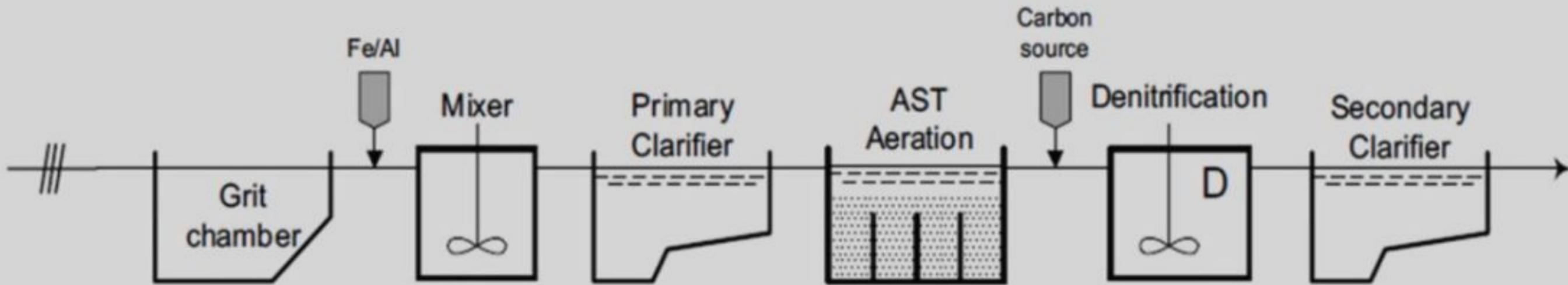
Primary Treatment Process

Sedimentation is primary treatment Process.

Sedimentation is a physical water treatment process used to settle out suspended solids in water under the influence of gravity.

Removal Efficiency of Primary Treatment Process :

- Removal efficiency of Biological Oxygen Demand (B. O.D.) in primary treatment process is 30%
- Removal efficiency of Total Suspended Solids (T.S.S.) in primary treatment process is 60%



Typical Primary Treatment Plant with preliminary treatment process

Sedimentation Tank



Secondary Treatment Process

Stabilization ponds & Lagoons:

- The ***stabilization ponds*** are open flow through basins specifically designed and constructed to treat sewage and biodegradable industrial wastes.
- They provide long detention periods extending from a few to several days.
- Pond systems, in which oxygen is provided through mechanical aeration rather than algal photosynthesis are called ***aerated lagoons***.
- Lightly loaded ponds used as tertiary step in waste treatment for polishing of secondary effluents and removal of bacteria are called ***maturation ponds***.

Activate Sludge Process

In activated sludge process wastewater containing organic matter is aerated in an aeration basin in which micro-organisms metabolize the suspended and soluble organic matter.

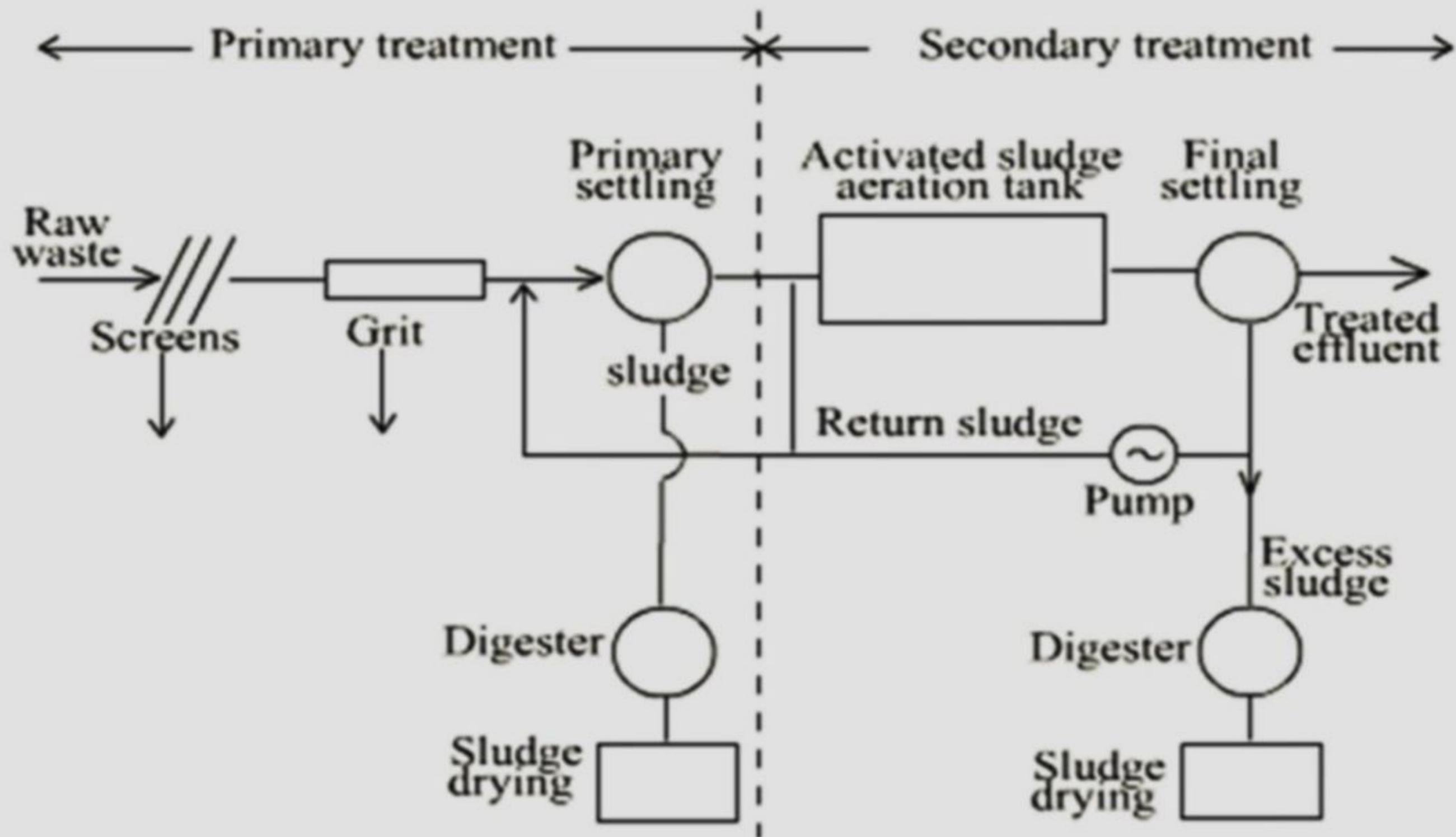
Activated sludge plant involves:

- wastewater aeration in the presence of a microbial suspension
- solid-liquid separation following aeration
- discharge of clarified effluent
- wasting of excess biomass, and
- return of remaining biomass to the aeration tank.

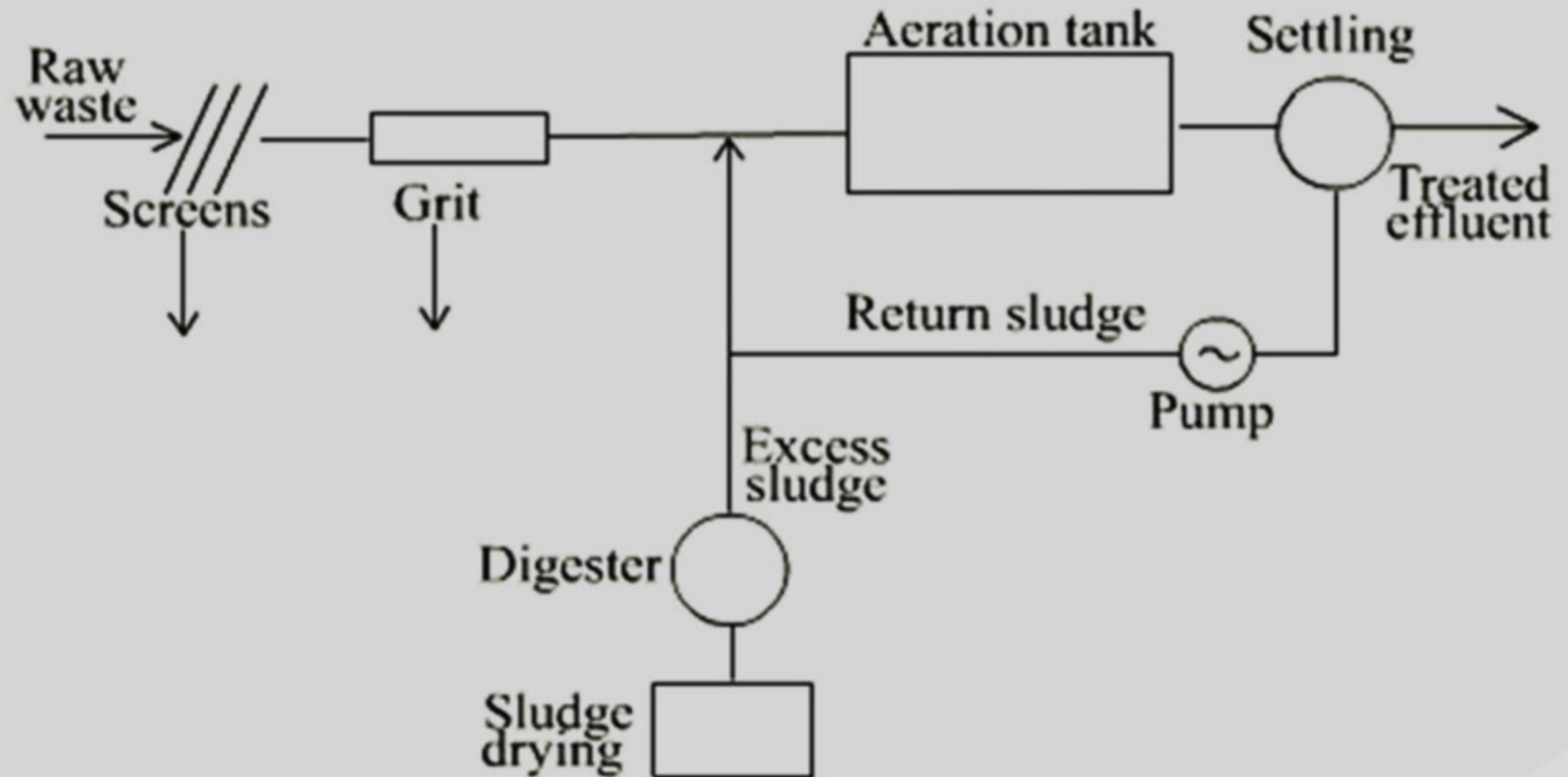
Removal Efficiency of Activated Sludge Process :

Metal	Removal Efficiency
Al	<20%
Mo	<20%
As	<20%
Pb	20-50%
Mn	20-50%
Ag	20-50%
Cd	>50%
Fe	>50%
Cr	>50%

Flow sheet of an activated sludge system



Flow sheet of an extended aeration system



Classification of Stabilization Ponds

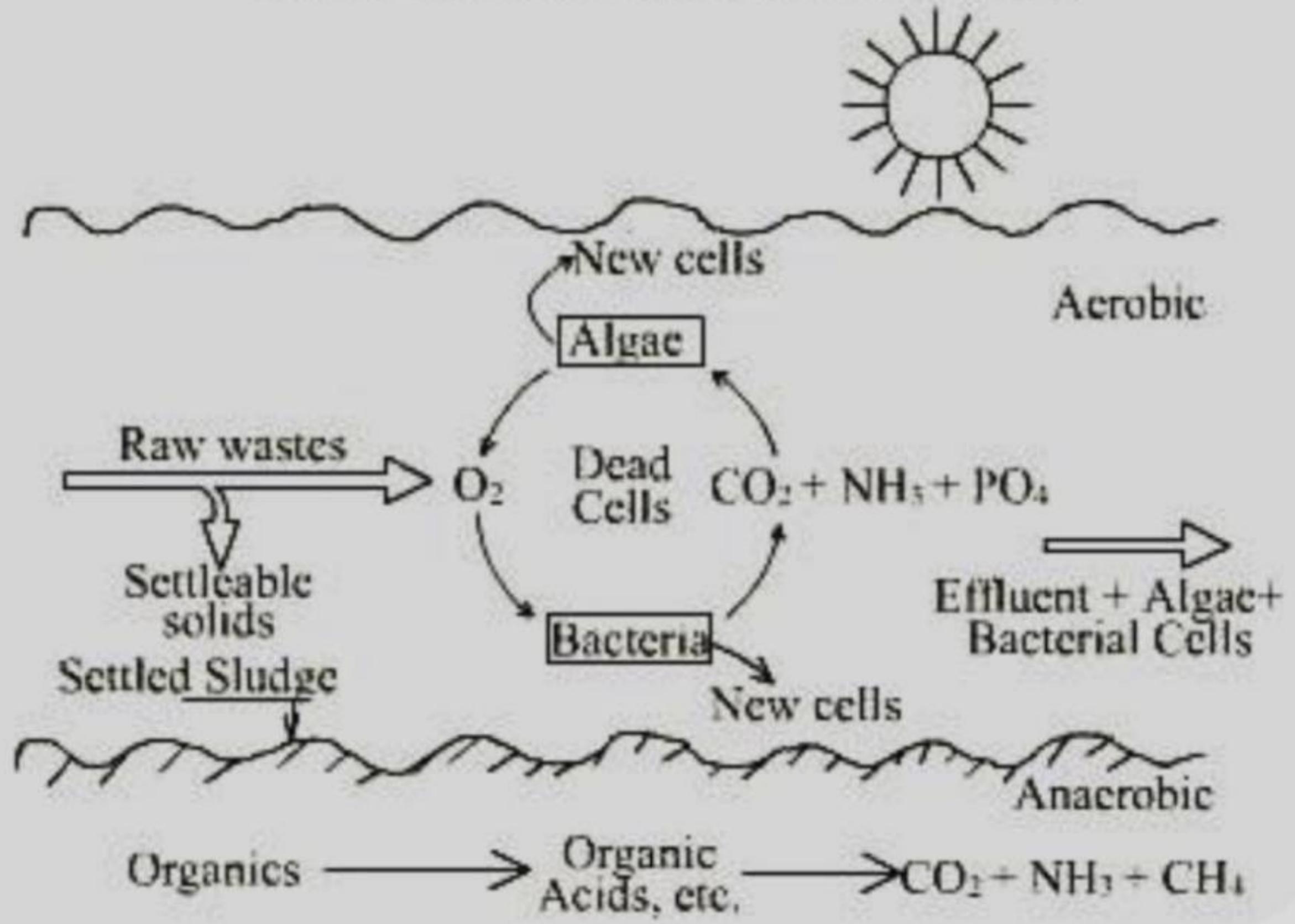
Stabilization ponds may be aerobic, anaerobic or facultative.

Aerobic ponds are shallow ponds with depth less than 0.5 m so as to maximize penetration of light throughout the liquid depth. Such ponds develop intense algal growth.

Anaerobic ponds are used as pre-treatment of high strength wastes. Such ponds are constructed with a depth of 2.5-5m as light penetration is unimportant.

Facultative pond functions aerobically at the surface while anaerobic conditions prevail at the bottom. They are often about 1 to 2 m in depth. The aerobic layer acts as a good check against odour evolution from the pond.

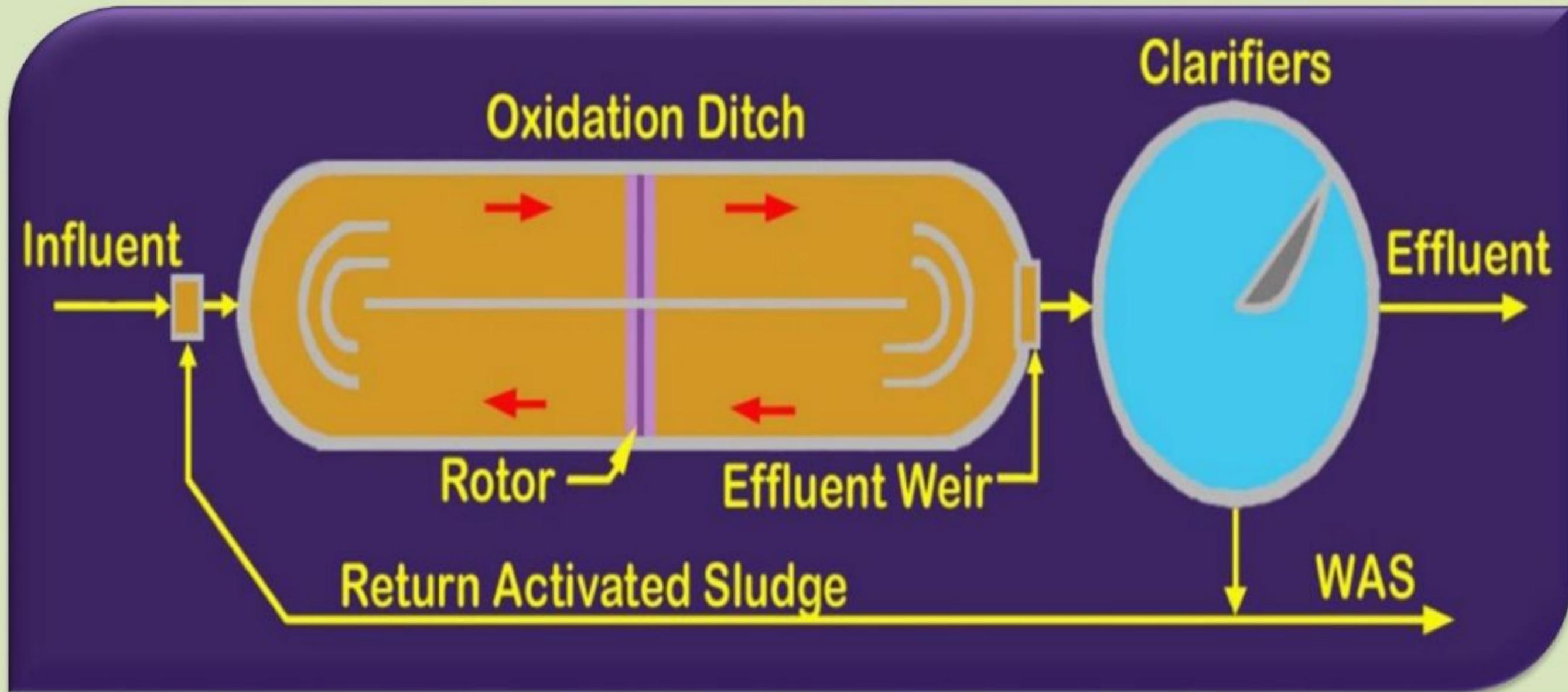
SYMBIOTIC RELATIONSHIP AND FUNCTIONING OF FACULTATIVE STABILIZATION POND



Oxidation Ditch

The oxidation ditch is a modified form of "extended aeration" of activated sludge process. The ditch consists of a long continuous channel oval in shape with two surface rotors placed across the channel.

A Typical Oxidation Ditch



A View of Oxidation Ditch



Tertiary Treatment Process

Tertiary treatment process consists of following process.

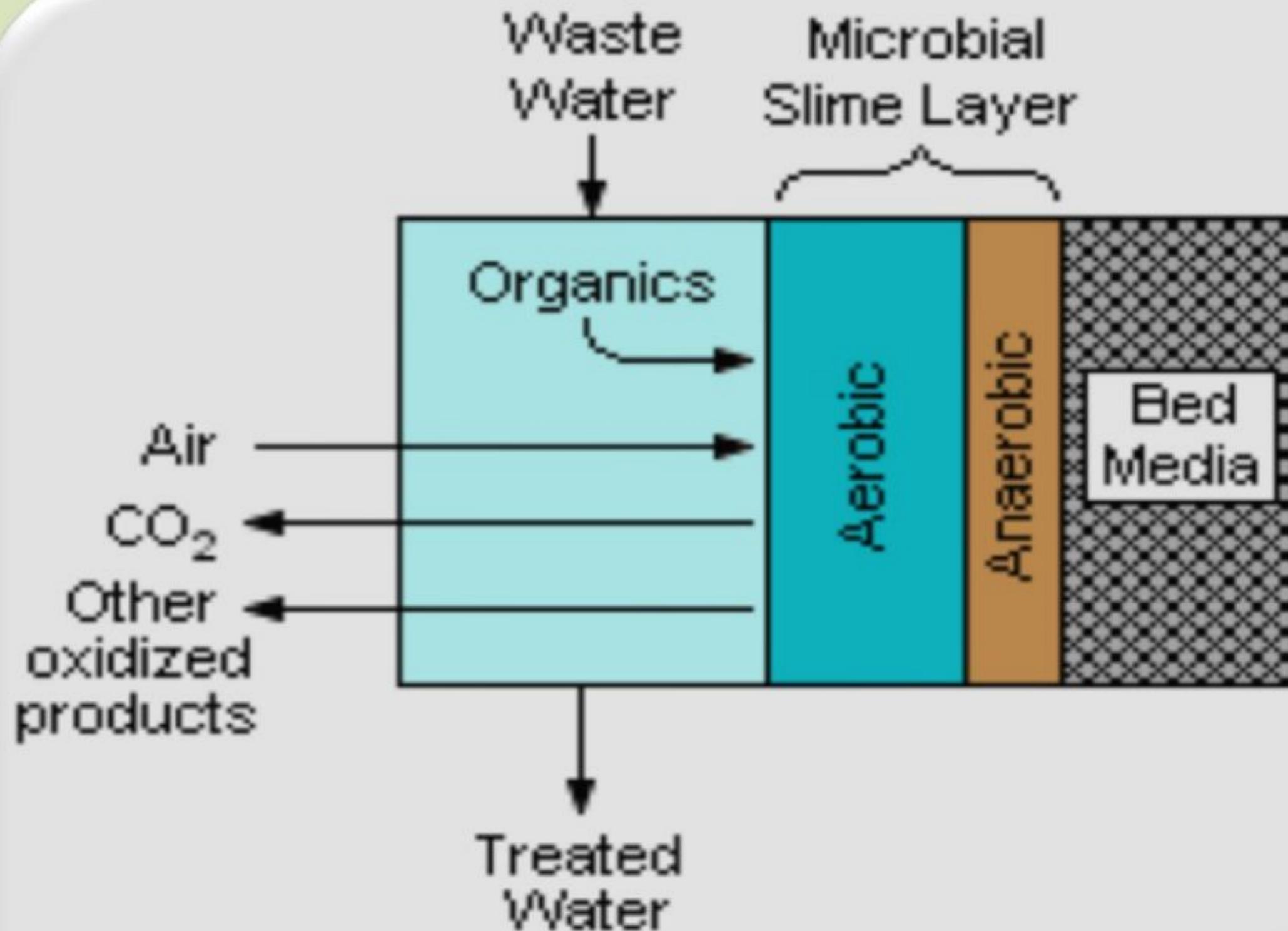
- Filtration Process (Trickling Filter)
- Disinfection Process

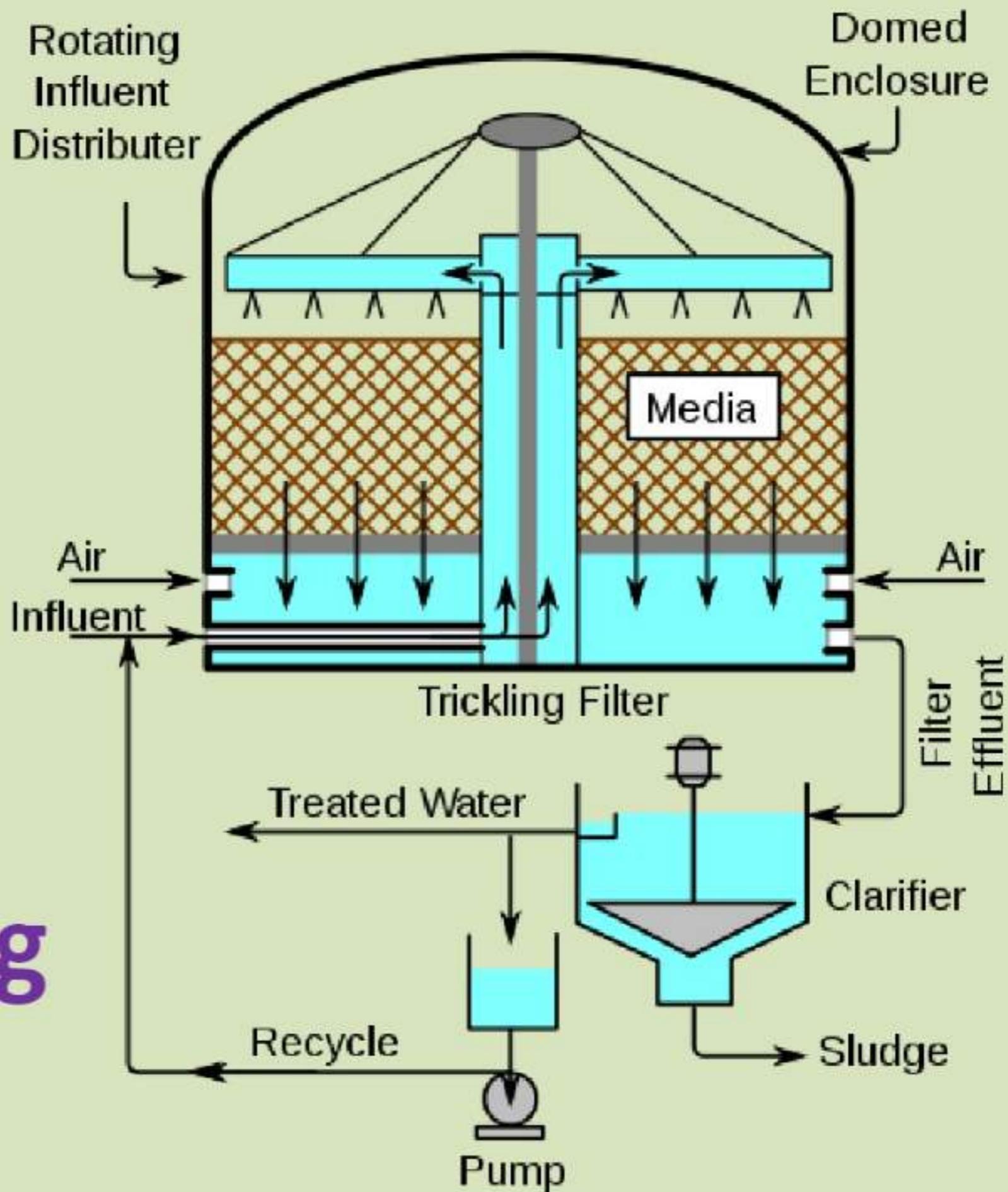
Trickling Filter is an attached growth process i.e. process in which microorganisms responsible for treatment are attached to an inert packing material.

Removal Efficiency of Trickling Filter

The Removal efficiency of Total Organic Carbon (T. O. C.) from Trickling Filter is greater than 90%

Working of Tricking Filter





Trickling Filter

Top view of Trickling Filter

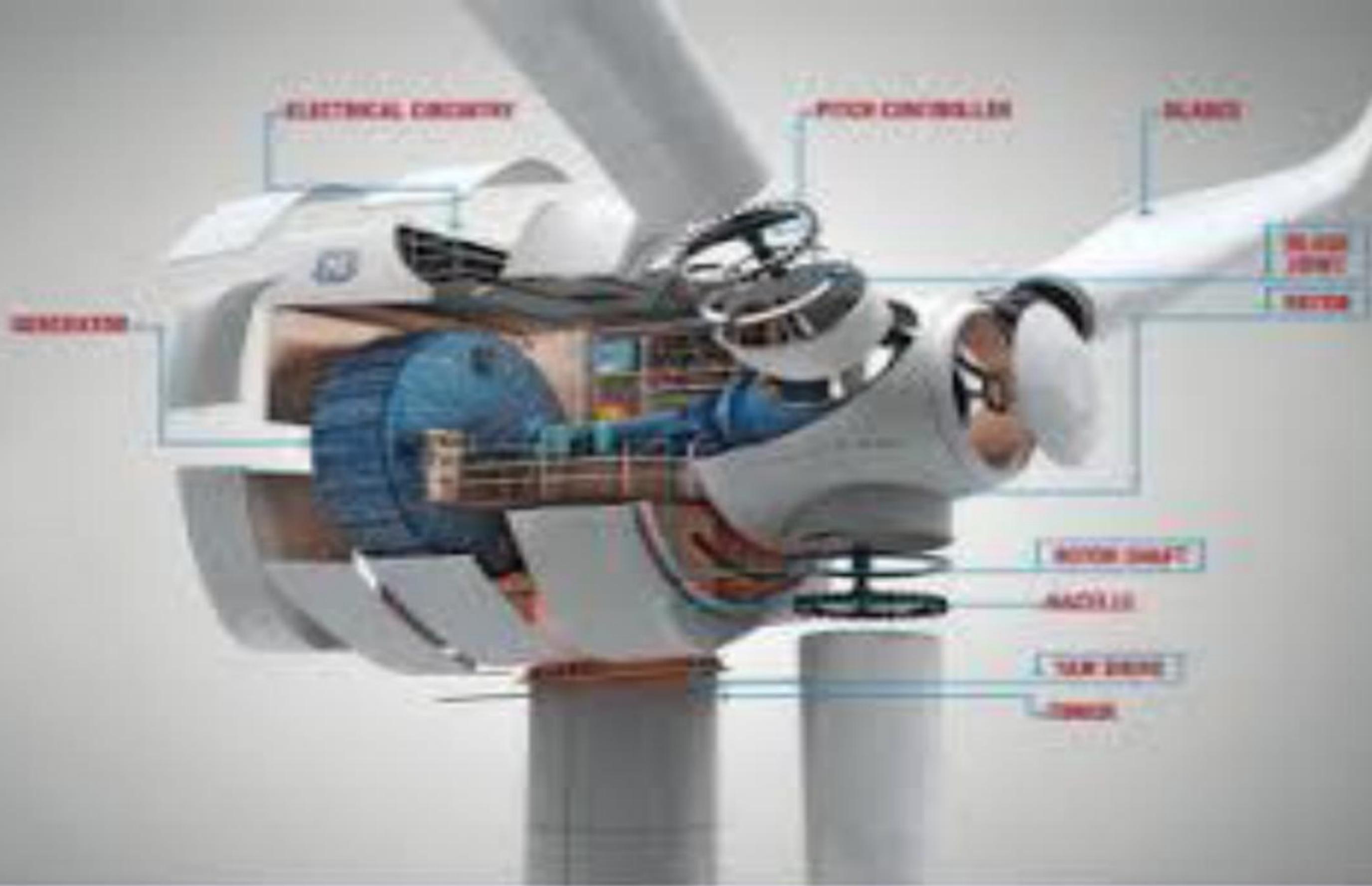


**Thank
You**

- মানুষের অজ্ঞতা ও অসাবধানতার কারণে ডাস্টবিনগুলো সঠিকভাবে ব্যবহার করা হয় না। ফলে বর্জ্য পদার্থ এখানে-সেখানে পড়ে থাকে, বাতাসসহ সার্বিক পরিবেশকে দূষিত করে। বর্ষা মৌসুমে এ পরিস্থিতি আরও ভয়াবহ রূপ নেয়। কঠিন বর্জ্য পদার্থ রাস্তার পাশের ড্রেনে পড়ে তরল বর্জ্য ব্যবস্থাকে একেবারে অচল করে দেয়। এমনিতেই দেশের বেশিরভাগ স্থানে তরল বর্জ্য অপসারণের জন্য পর্যাপ্ত সিউয়ার এবং খোলা ড্রেন নেই; ফলে তরল আবর্জনা বা সিউয়েজের নিরাপদ অপসারণ সম্ভব হয়ে ওঠে না। ড্রেন উপচে পড়া এবং রাস্তায় ছুড়িয়ে-ছিটিয়ে থাকা তরল বর্জ্য পরিবেশ এবং জনস্বাস্থ্য ঝুঁকি দিন দিন বৃদ্ধি করে চলেছে। পানি ও বায়ুবাহিত নানা রোগ বিস্তারে সহায়ক ভূমিকা পালন করছে।



ফ্লেক্সিবল ফায়ার

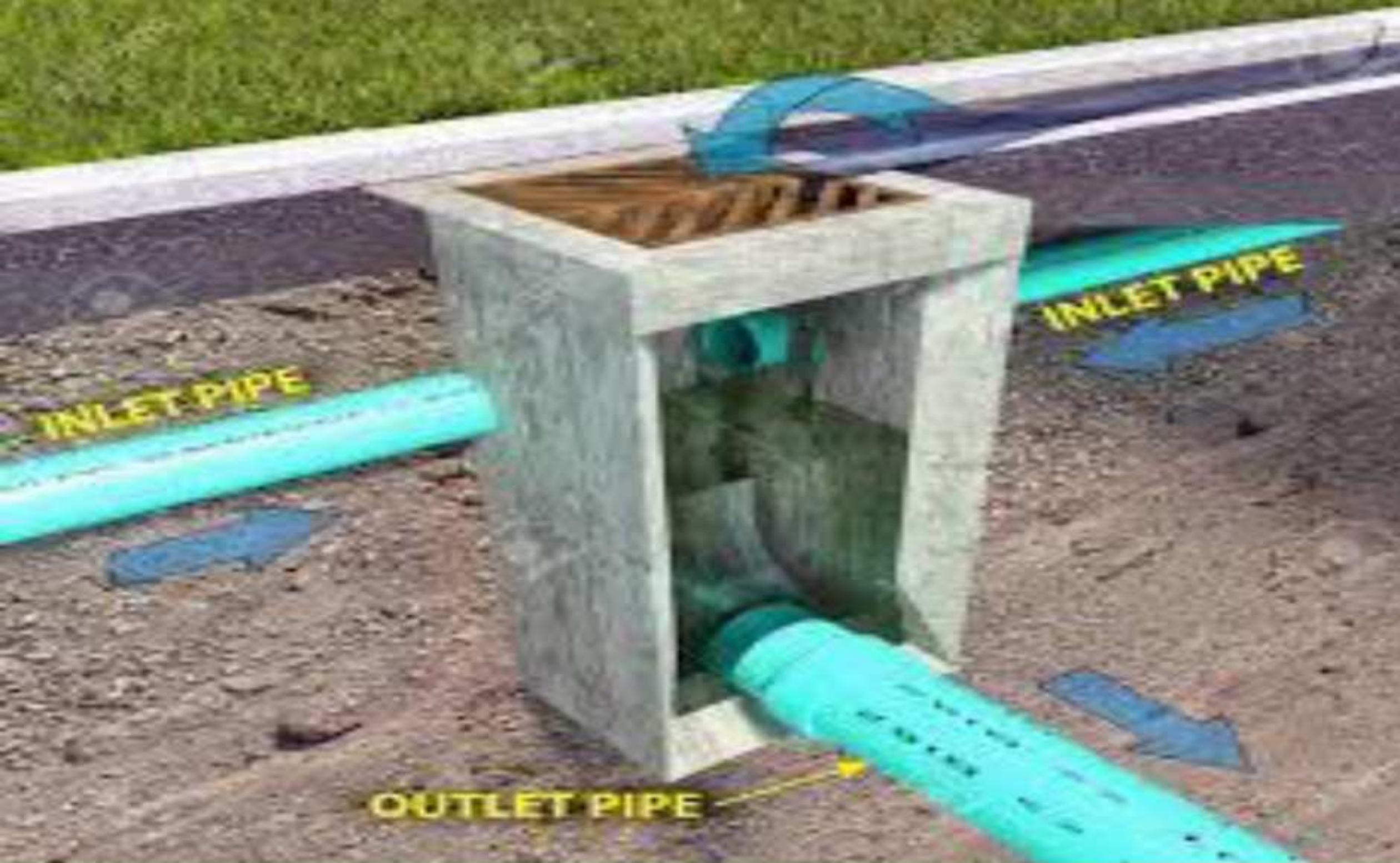


টারবাইন ফ্লিনার





What is a Catch Basin?



ক্যাচ বেসিন

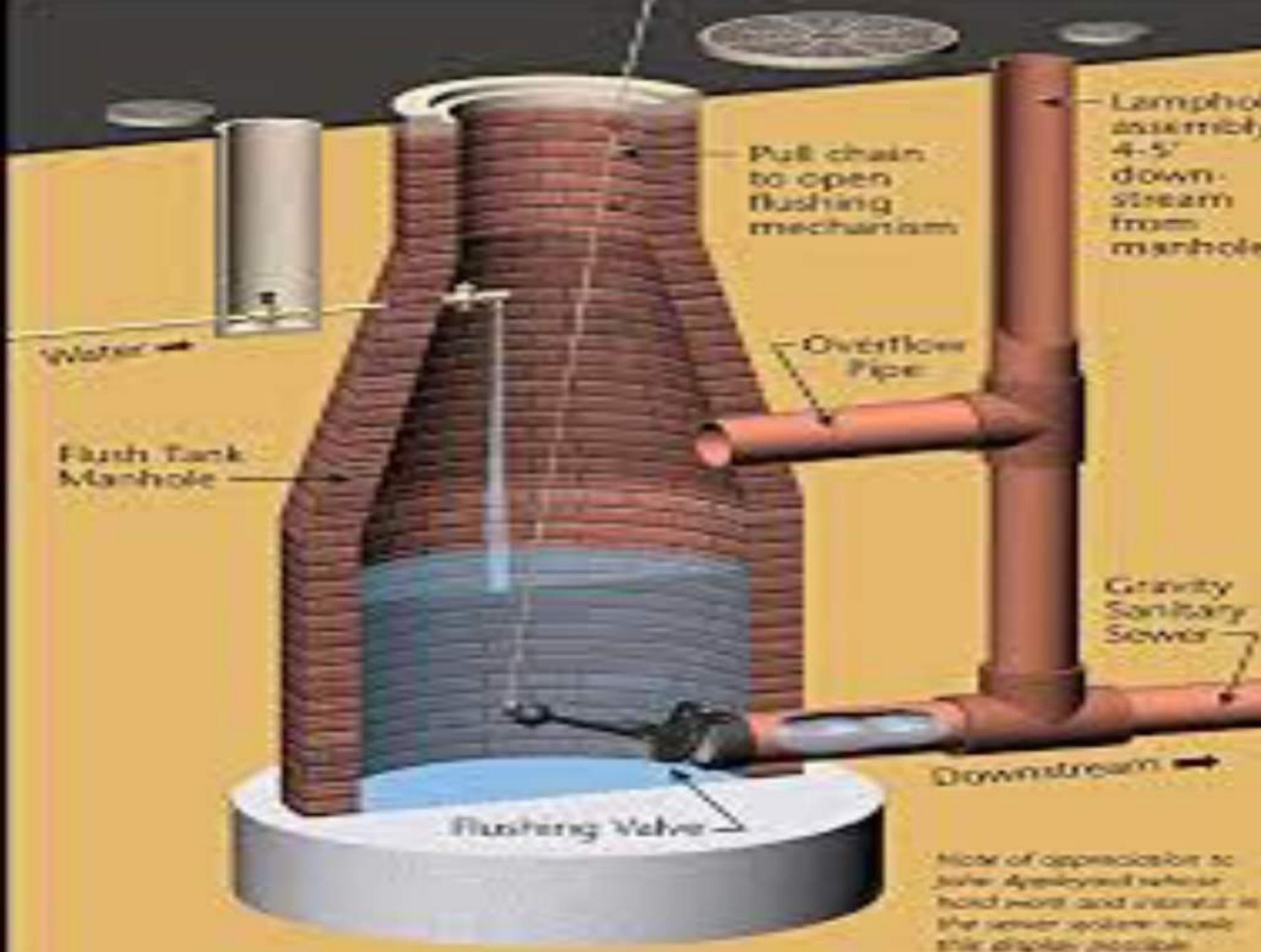




পাইপ



মাস্ক



Pull chain to open flushing mechanism

Lampphoto assembly 4-5' downstream from manhole

Overflow Pipe

Water

Flush Tank Manhole

Gravity Sanitary Sewer

Flushing Valve

Downstream

Note of appreciation to John Apicynski who had most interest in the sewer system made this display possible

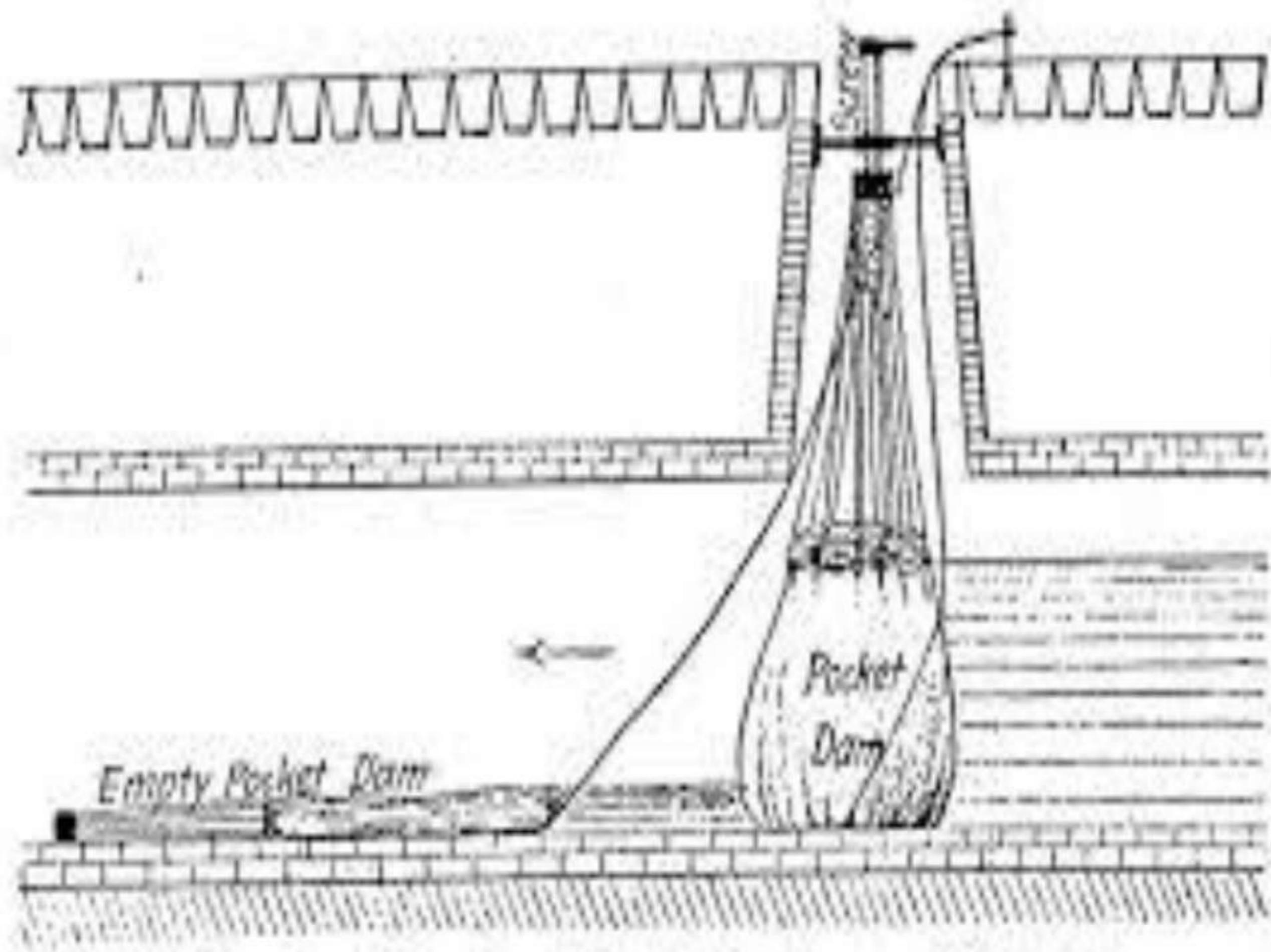
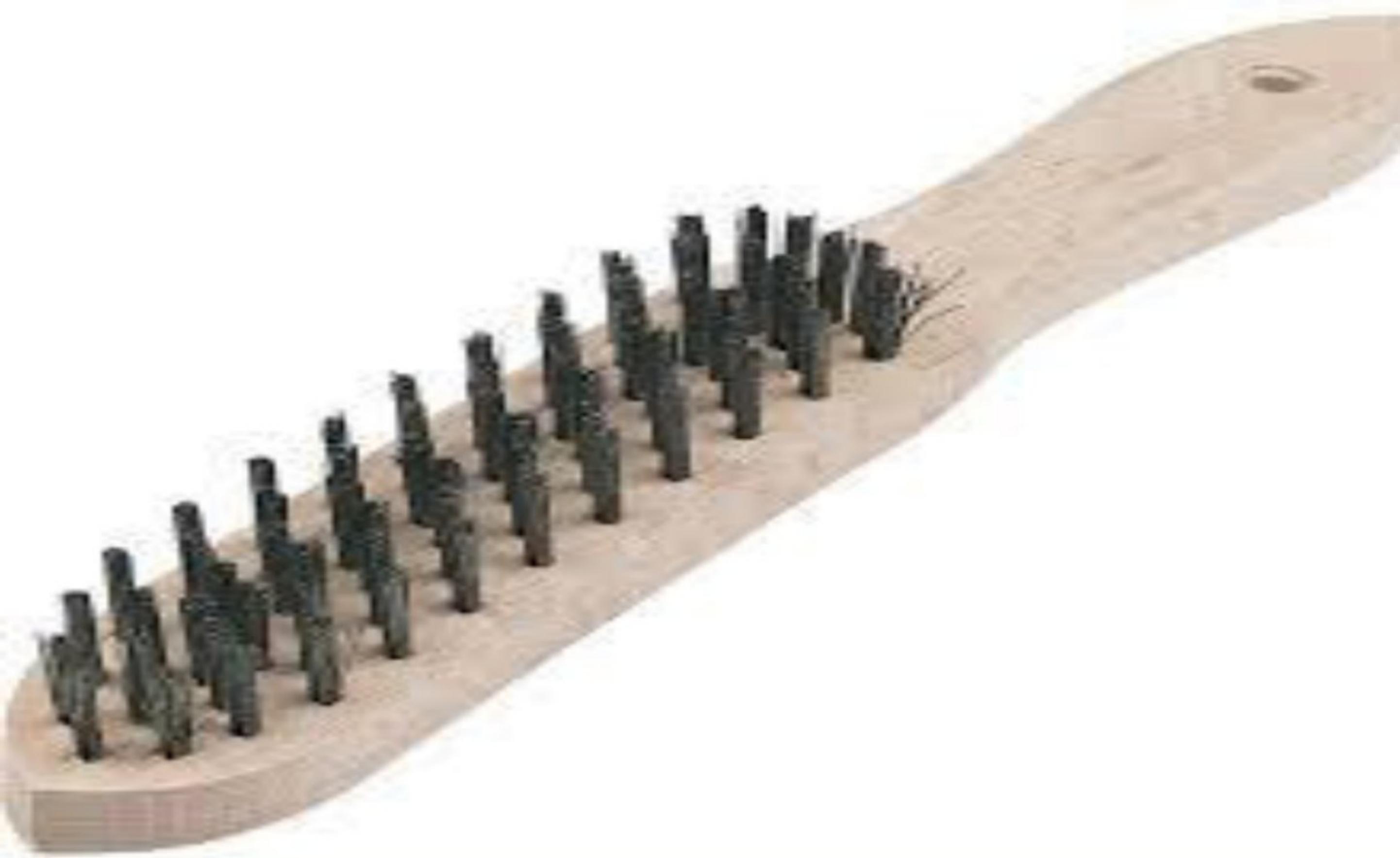


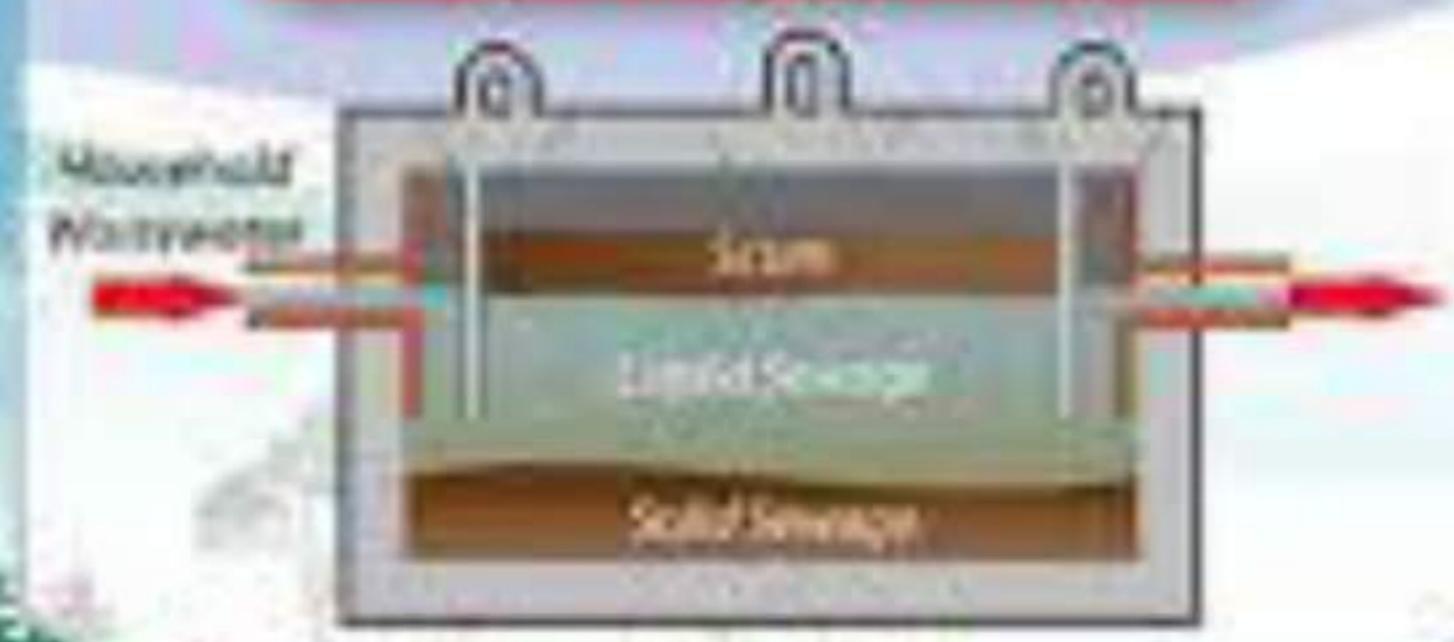
Fig. 2.—Bag for Flushing Large Sewers.





ওয়ার ব্রাশ

TYPICAL DOMESTIC SEPTIC TANK SYSTEM



Household Wastewater

Septic Tank

Non-Perforated Pipe

Distribution Box

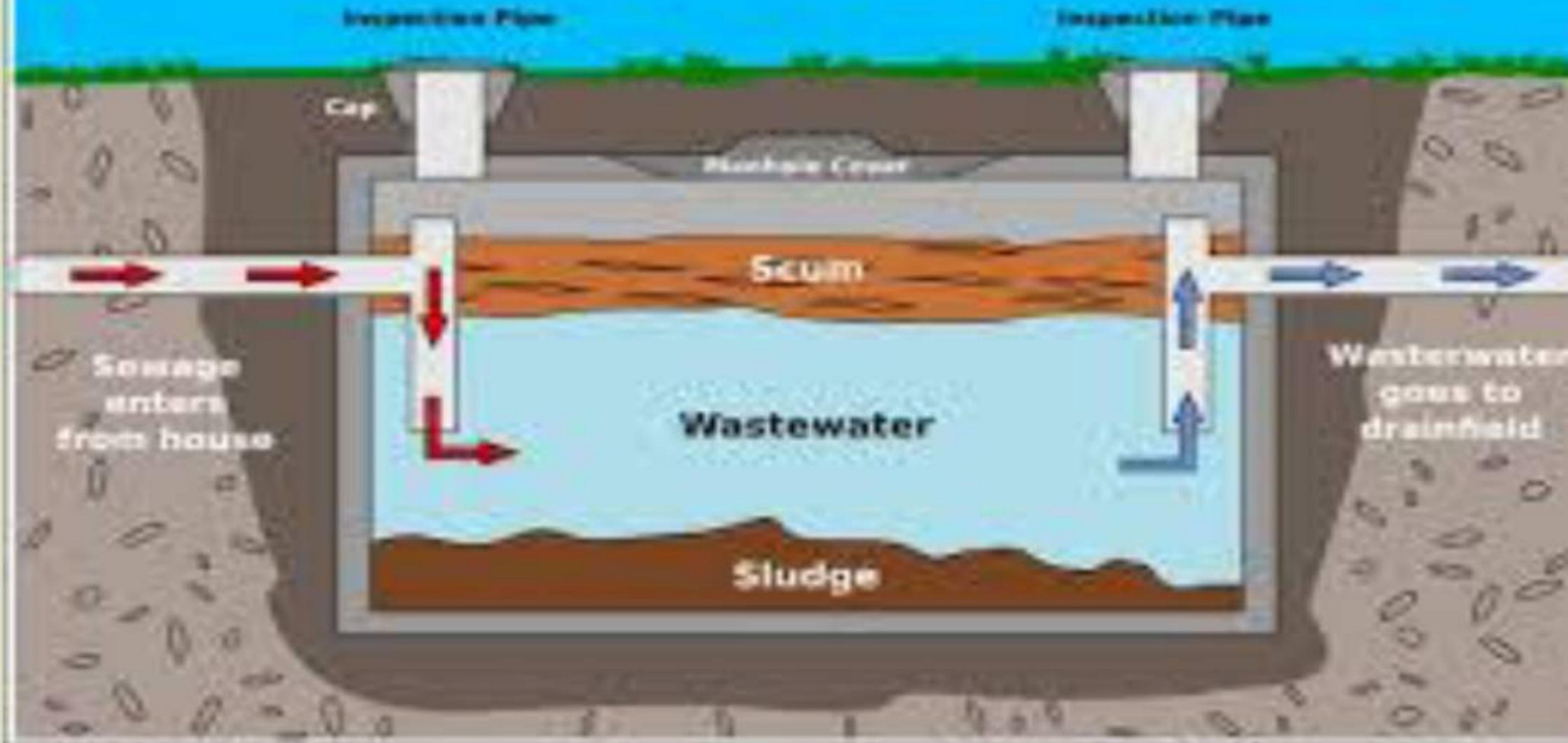
Percolation Area

Perforated

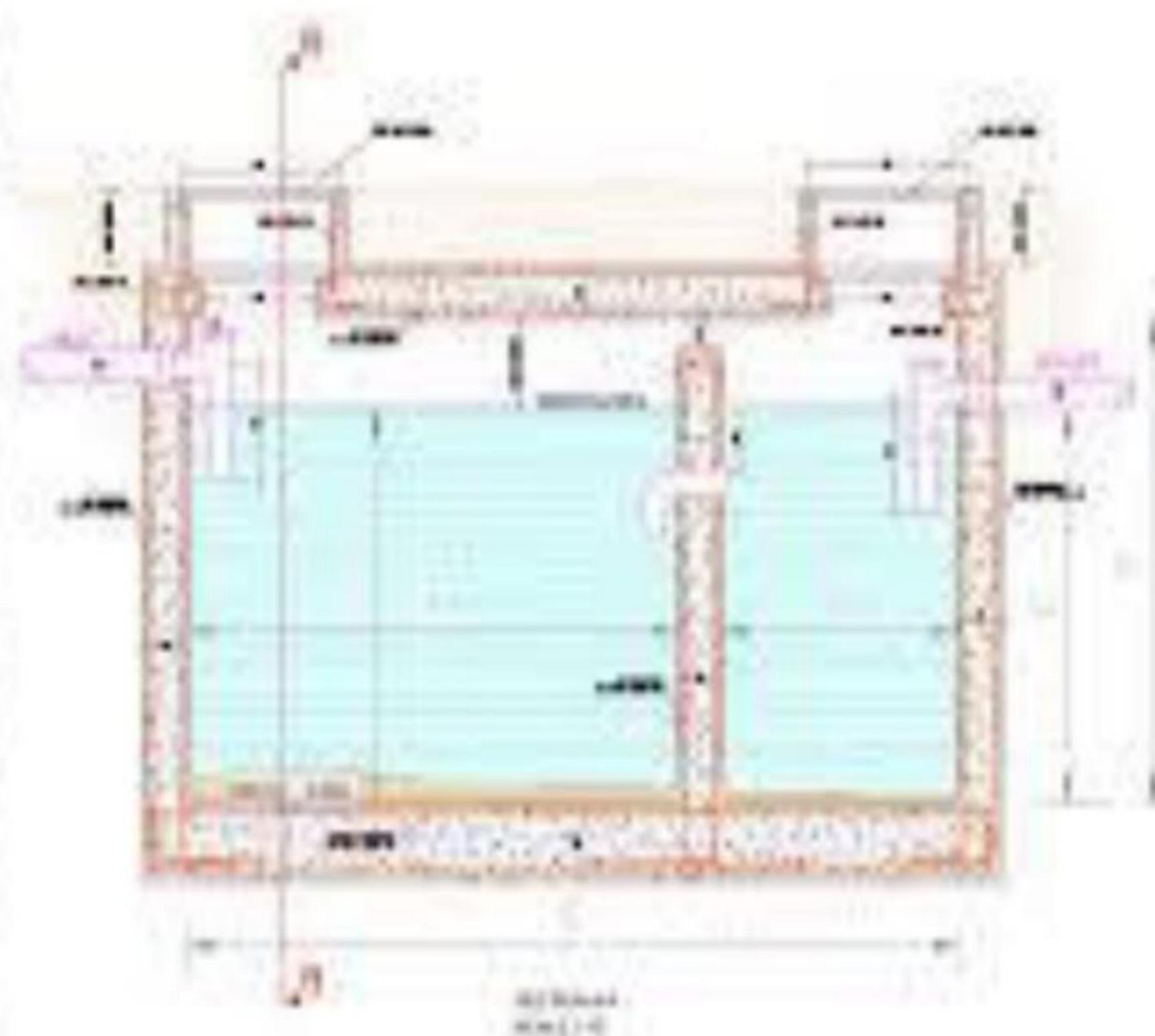
Gravel / Crushed Stone

Air Vent

Septic Tank Diagram

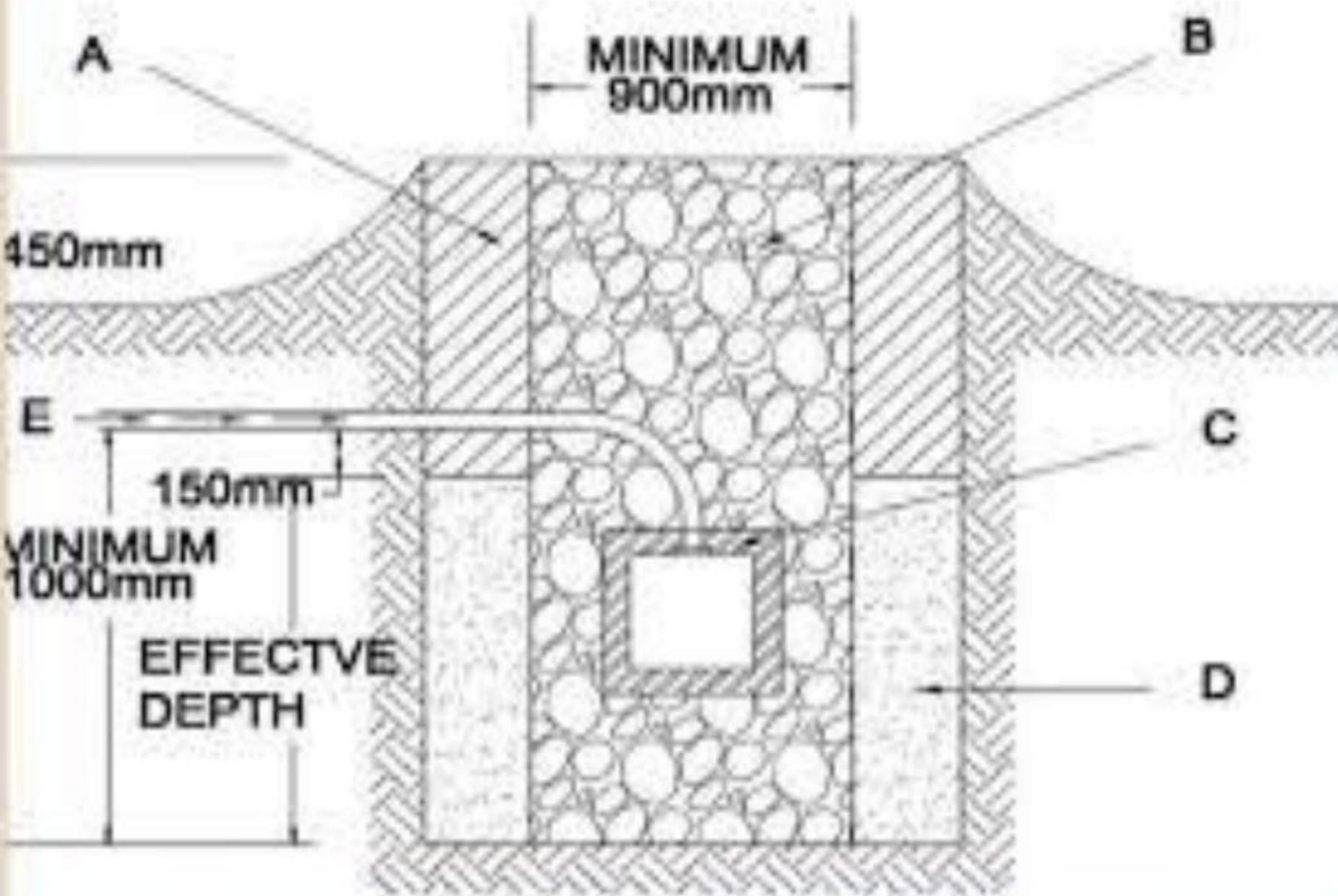


সেপটি ট্রেক ডায়াগ্রাম



1	2	3	4	5
6	7	8	9	10

11	12	13	14	15
16	17	18	19	20

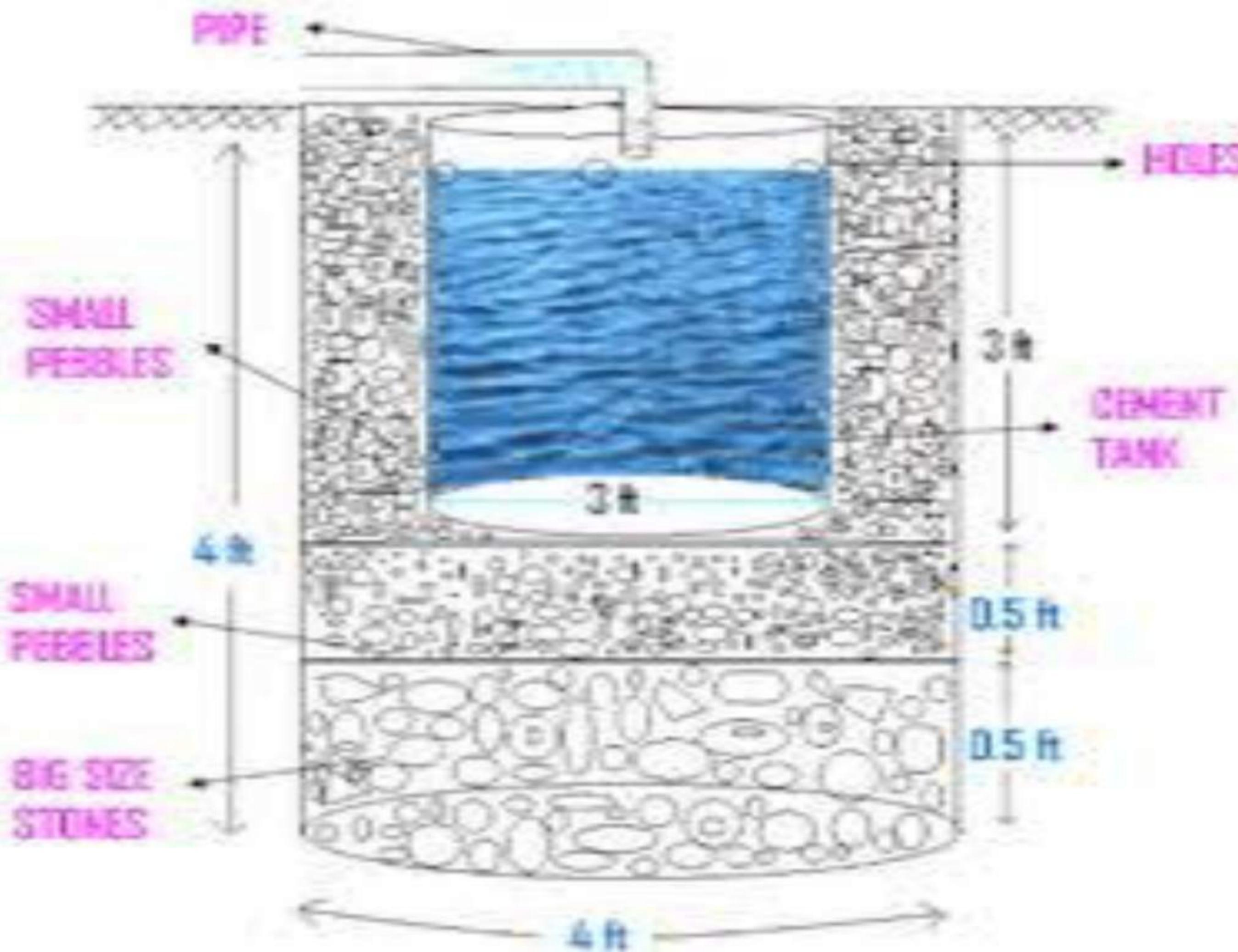




চকপিট

SOAK
PIT







ইরিগেশন



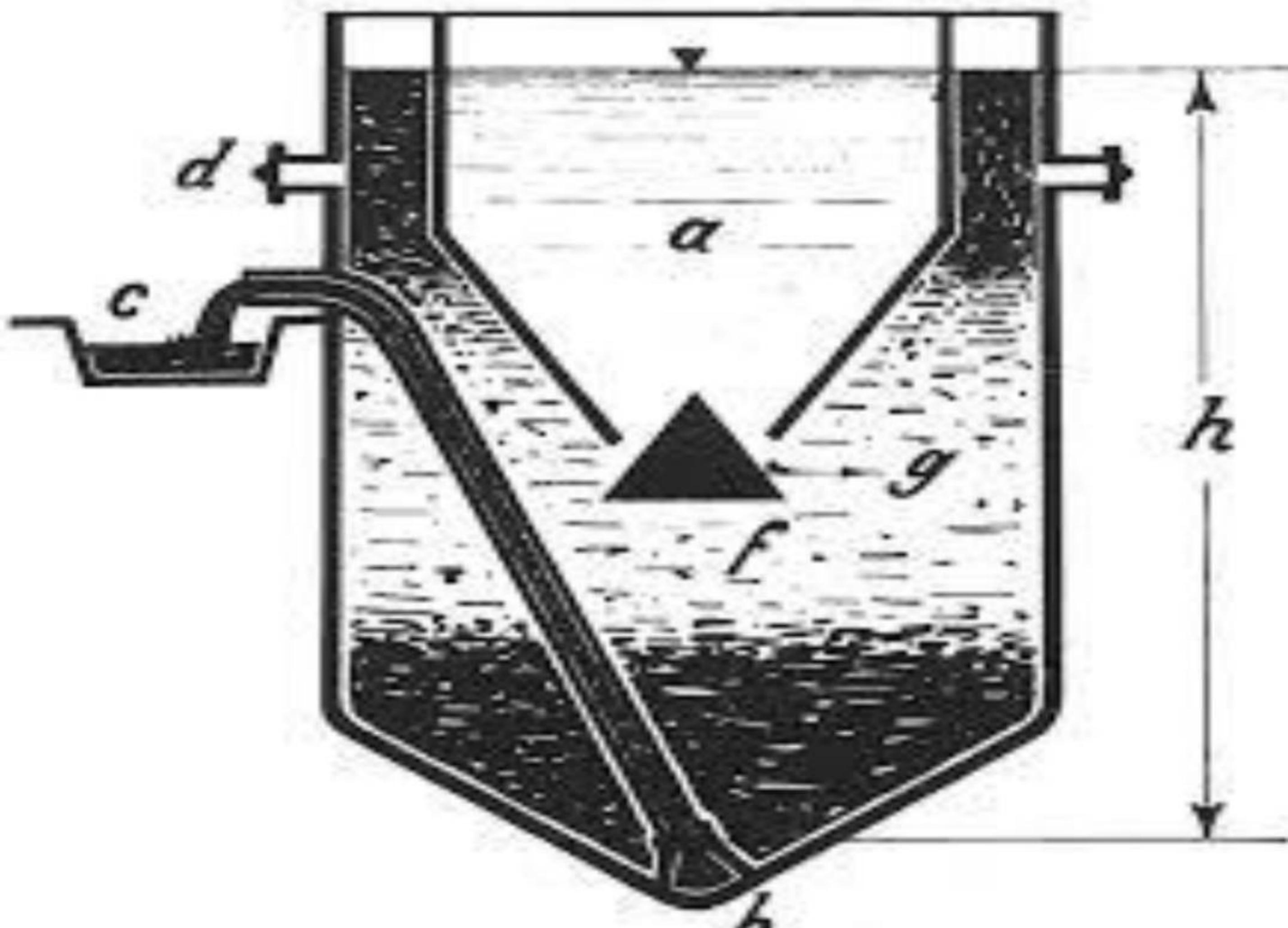


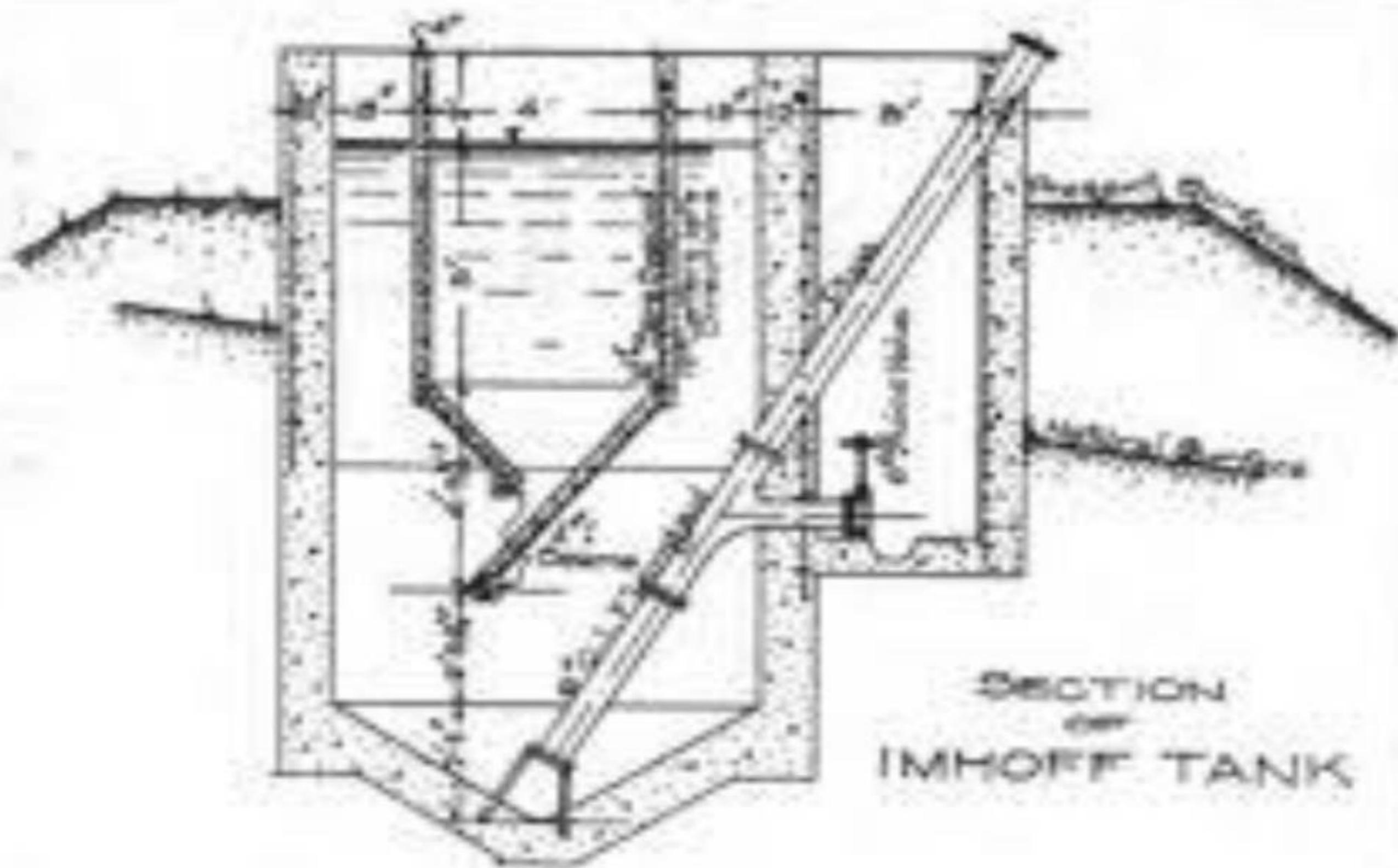


An aerial photograph of a large agricultural field. The field is divided into long, parallel rows of young green plants. Between these rows are wide, shallow channels filled with water, which are used for surface irrigation. The water in the channels is a light, milky color. In the foreground, there are several dark, cylindrical pipes or conduits running across the field, likely part of the irrigation system. The overall scene shows a well-organized and water-intensive farming operation.

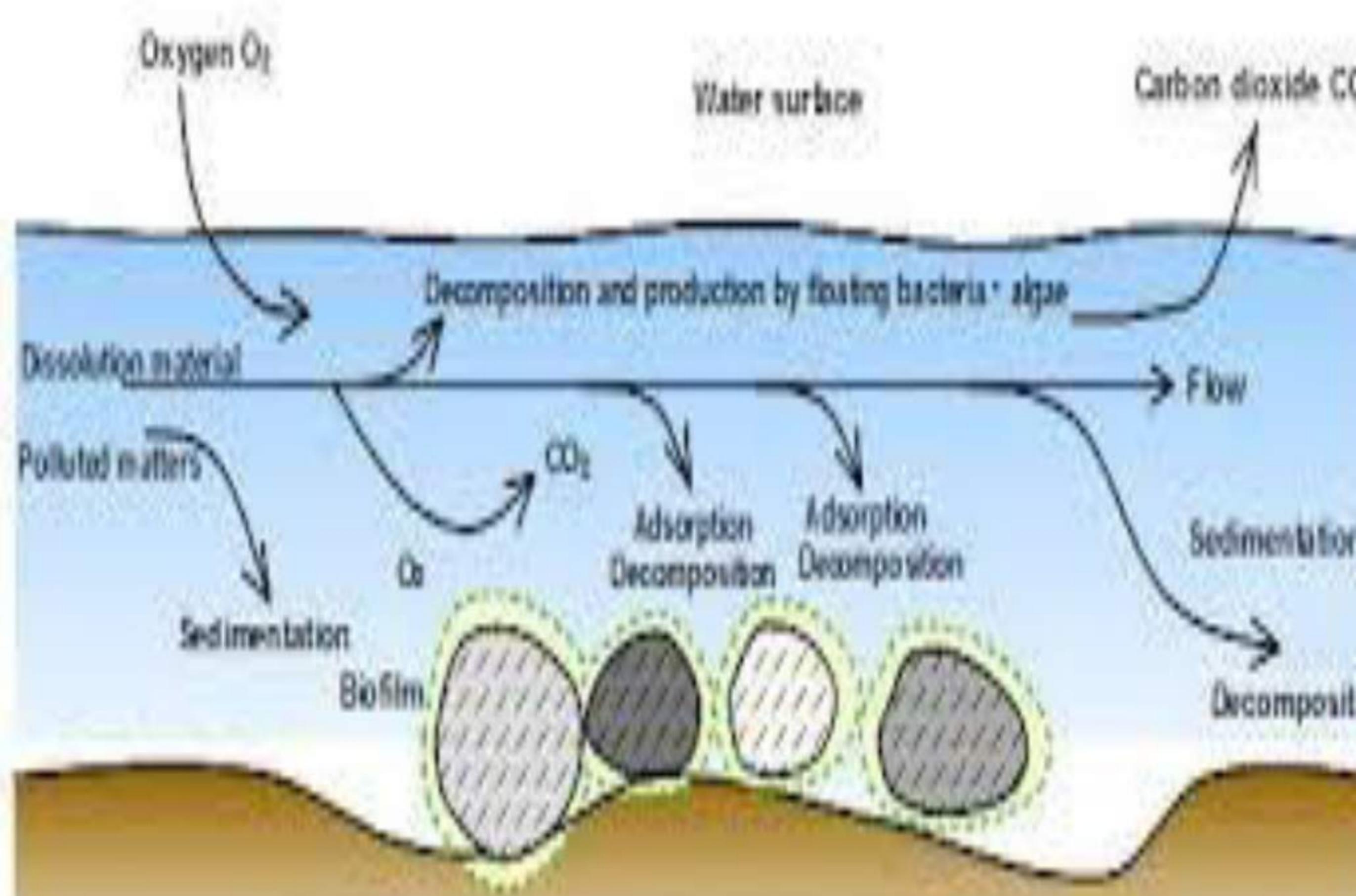
Surface Irrigation

সারফেস ইরিগেশন

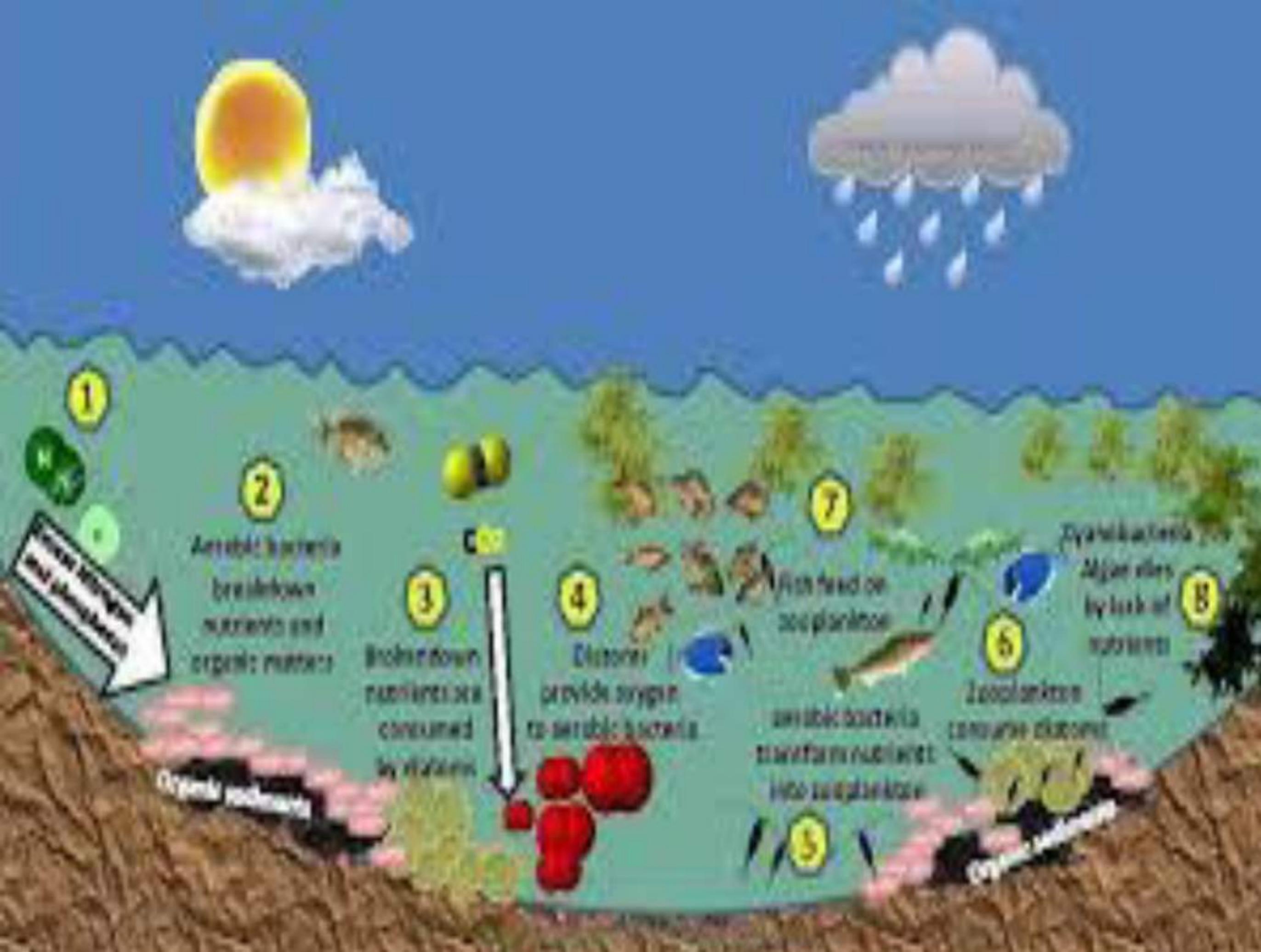




SECTION OF IMHOFF TANK DELAWARE CO. HOVER



Bio film: Bacteria, fungi, algae, protozoists, metazoan animal → Adsorption decomposition with oxygen



1

2

3

4

7

5

8



CO₂

Anaerobic bacteria
breakdown
nutrients and
organic matter

Breakdown
nutrients are
consumed
by plants

Elstones
provide oxygen
to aerobic bacteria

aerobic bacteria
transform nutrients
into zooplankton

Zooplankton
consume elstones

Fish feed on
zooplankton

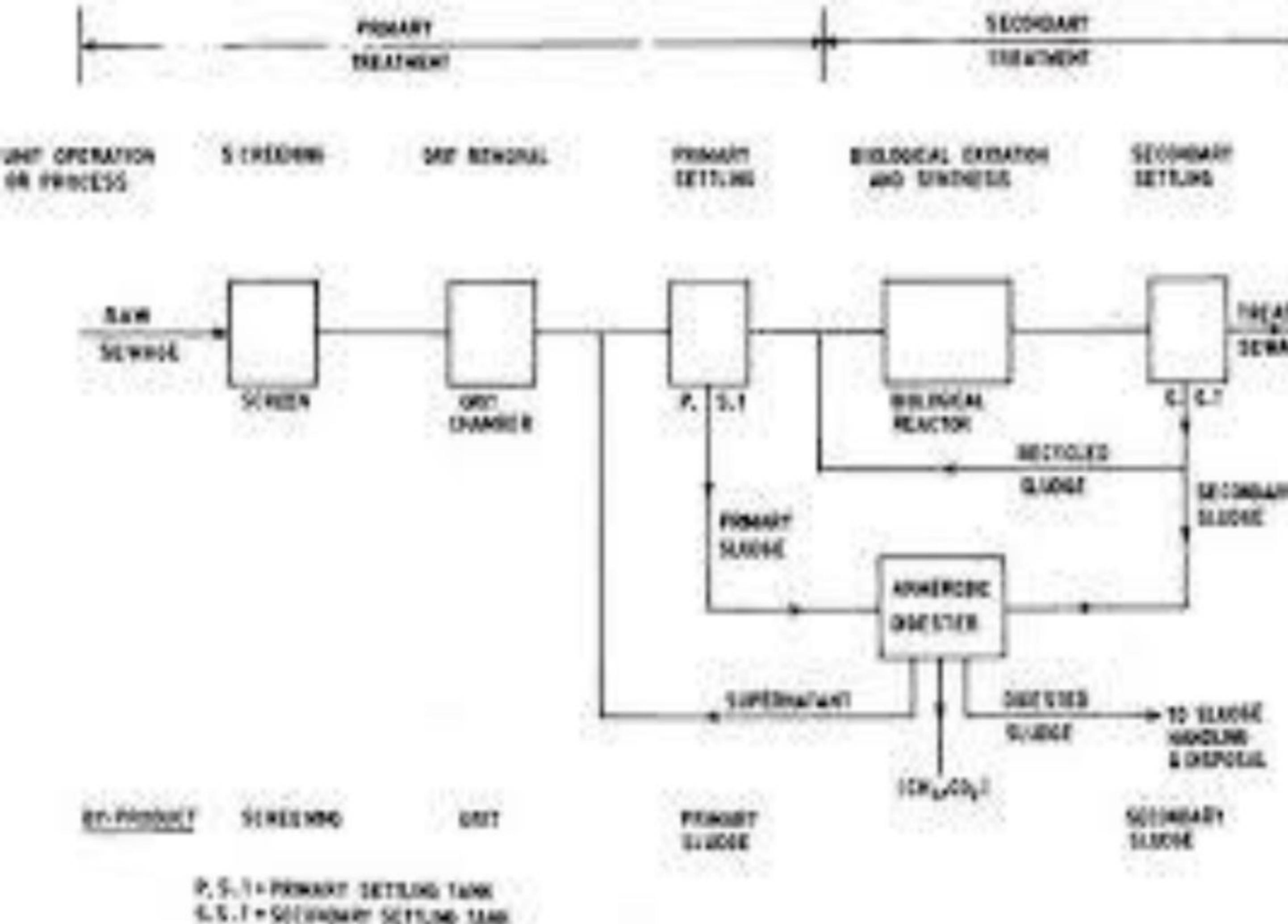
Cyanobacteria
Algae dies
by lack of
nutrients

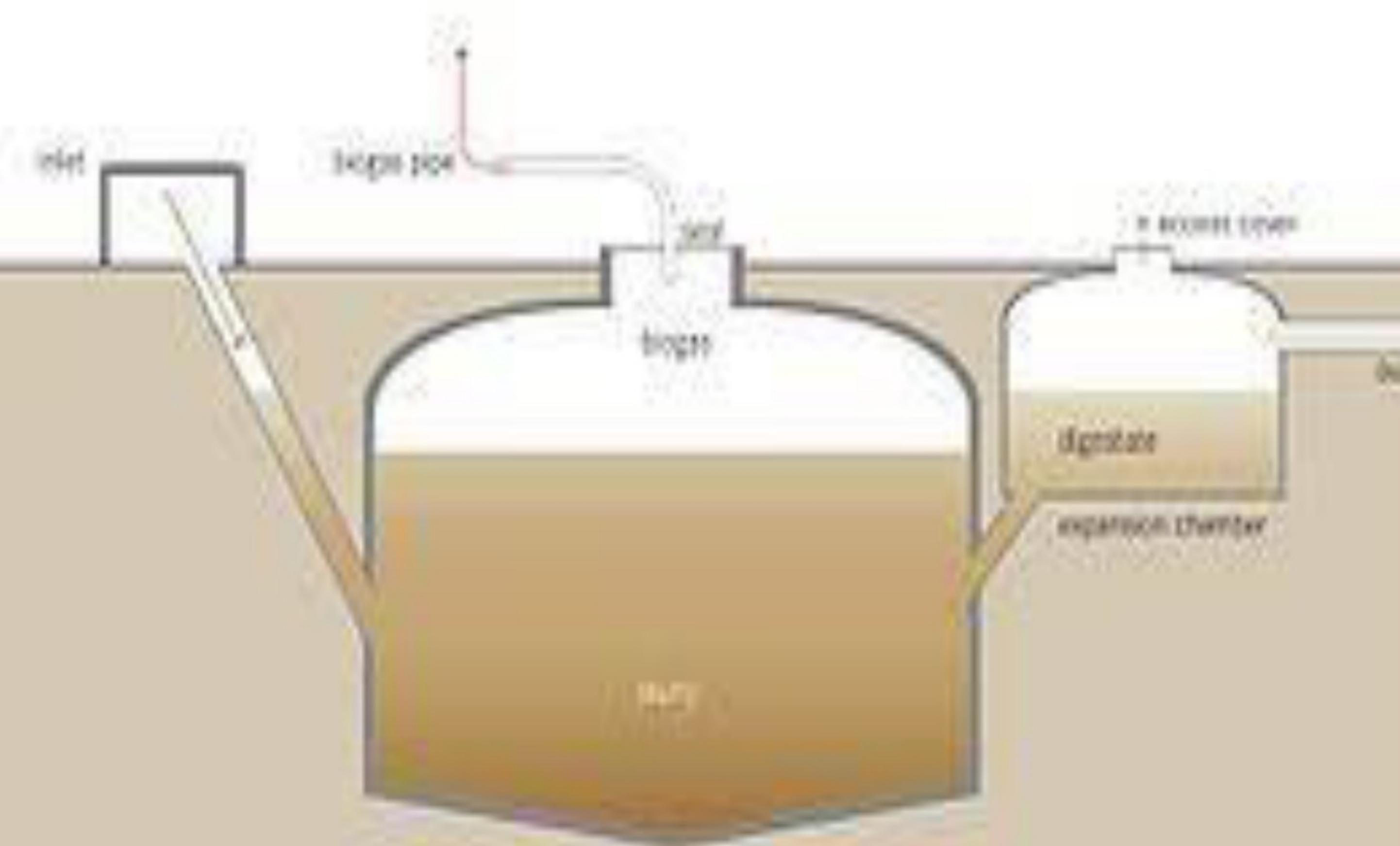
Organic rich mud

CO₂



Судостроение в Енисейске-81. Далитова Тонна. № 20. 21/03/84







Kamerawerkzeug
mit magnetischer
Laser-Abstandsmessung



Stabte mit Dreifach-
halterung,
Stangen bis 18 m



Elektronenführung
zu PansAPC mit
Kanaltabelle-,
oder Inspektions-
software



Sehen Sie selbst - Videos unter:
www.youtube.com/user/MESSE-MWORLD



Thanks for watching