Industrial Waste Water Treatment

UNIT-I

Sources of Pollution – Physical, chemical, Organic & Biological Properties of Industrial Wastes- Differences between industrial and municipal Waste Waters- Effects of Industrial effluents on Sewers and Natural Water Bodies.

Definition:

Before we get in to the sources of pollution, it is important for us to know the definition of the term "Pollution".

Pollution is basically the introduction of contaminants in to the natural Environment that cause undesirable and adverse changes. the contaminants that cause pollution are These called "pollutants".

Types of Pollution:-

There are Primarily 6 major types of pollution recognized in today's world.

- Air Pollution
- Water Pollution

- Soil / Land Pollution
- Noise Pollution
- Radioactive Pollution
- Thermal Pollution.

Sources of Pollution :-

There are numerous sources that have been studied to cause various forms of pollution today. Sources of pollution can be categorized in to 2 major categories.

- **Natural Sources:**

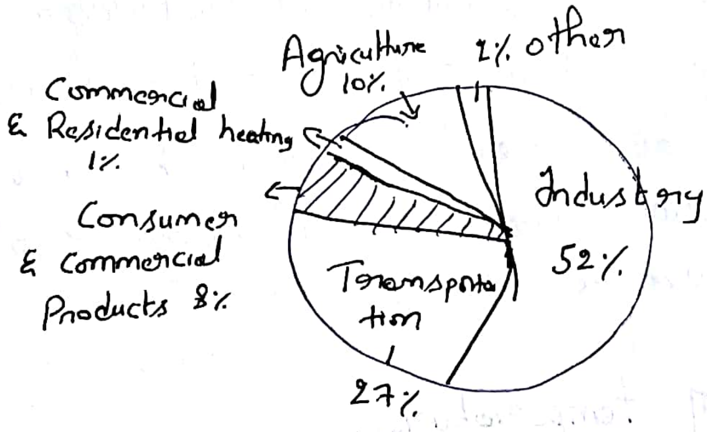
Sources from the natural Environment that release pollutants which contaminate the Environment. These sources are mainly natural calamities like volcanic eruptions and forest fires, that release large amounts of CO_2 and other harmful gases and material in to the Environment.

- **Anthropogenic Sources (Man Made Sources) :-**

These are man made sources (or) activities caused by the humans that release contaminants ~~or~~ and pollutants that harm the environment.

The most common examples of Anthro-Pogenic sources of pollution are

1) Burning of fossil fuels for energy generation. [Thermal Power stations etc]
2) Emissions from Various modes of transportation
3) Agricultural waste run offs
4) Oil spills
5) Improper waste Management & disposal.



Physical characteristics:-

Solids are classified in to three main types:

1. Total solids (TS): All the matter that remains as residue upon evaporation at 103°c to 105°c.

2. Settleable Solids: Settleable Solids are measured as ml/L, which is an approximate measure of the sludge than be removed by Primary Sedimentation

3. Suspended Solids (SS) & Filterable Solids (FS).

II **Odor**:- Odor is produced by gas production due to decomposition of organic matter (or) by substances added to the wastewater.

Detection of Odor - Odor is measured by special instruments such as the portable H_2S meter which is used for measuring the concentration of hydrogen sulfide.

III **Temperature**:- Temperature of wastewater is commonly higher than that of water supply. Depending on the geographic location the mean annual temperature varies in the range of 10 to 21°C with an average of 16°C.

Importance of temperature:-

(i) Affects chemical reactions during the waste water treatment process.

Affects aquatic life (Fish, ...)

(ii) Oxygen solubility is less in warm water than cold water

(iii) Optimum temperature for bacterial activity

(5) Toxic Inorganic Compounds:-

Copper, lead, Silver, chromium, arsenic, boron.

(6) Heavy Metals:-

Nickels, Manganese, lead, chromium, Cadmium, ~~(Iron)~~ Zinc, Copper, iron mercury.

Gases:- The following are the main gases of Concern in wastewater treatment.

N_2, O_2, CO_2, H_2S, NH_3, CH_4.

PH:- The hydrogen-ion concentration is an important Parameter in both natural waters and wastewaters. It is very important factor in ~~both~~ the biological and chemical wastewater treatment. Water and wastewater can be classified as neutral, alkaline (or) acidic acc. to the following ranges

PH = 7 neutral

PH < 7 Alkaline

PH > 7 Acidic.

Biological Characteristics:-

The environmental engineer must have considerable knowledge of the biological of wastewater because it is a very important characteristic factor in wastewater treatment.

The Engineer should know:-

1) The principal groups of microorganisms found in wastewater.
2) the Pathogenic organisms.
3) Indicator organisms (indicate the presence of Pathogens)
4) The methods used to amount the microorganisms
5) The methods to evaluate the toxicity of treated wastewater.

Main groups of microorganisms:-

The main microorganisms of concern in wastewater treatment are Bacteria, Fungi, Algae, Protozoa, Viruses and other Pathogenic microorganisms groups.

Bacteria:-

Types: Spheroid, rod curved, spiral, filamentous.

Some important bacteria.

Pseudomonas:- reduce NO_3 to N_2, so it is very important in biological waste nitrate removal in treatment works.

Zoogloea:- helps through its slime production is in the range of 25°c to 35

(iv) Aerobic digestion and nitrification stop when the temperature rises to 50°c. when the temperature drops to about 15°c, Methane Producing bacteria become inactive

(v) Nitrifying bacteria stop activity at about 5°c.

Density:-

Almost the same density of water when the wastewater doesn't include significant amount of Industrial waste.

Color:-

Fresh waste water —— light brownish grey
With time —— dark grey
More time —— black (Septic)

Some times Pink due to algae (or) due to industrial colors

Turbidity:-

It's a measure of light - transmitting Properties of water.

Chemical characteristics of wastewater:-

Points of concern regarding the chemical chara-cteristics of wastewater are:

- Organic Matter
- Measurements of organic matter
- Inorganic matter
- Gases
- pH

Organic Matter:-

75% SS — organic (Suspended solids)

40% FS — Organic (Filtered Solids)

Organic Matter is derived from animals, plants and man activities.

Protiens (40 - 60%)

Carbohydrates (25 - 50%)

Fats, Oils and Grease (10%)

Measurements of Organic Matter:-

Many Parameters have been used to measure the concentration of organic matter present in

Wastewater. The following are the most Common used methods:

Biochemical Oxygen Demand [BOD] :-

BOD_5 is the oxygen equivalent of organic matter. It is determined by measuring the dissolved oxygen used by microorganisms during the biochemical oxidation of organic matter in 5 days at 20°C.

Chemical Oxygen Demand (COD) :-

It is the oxygen equivalent of organic matter. It is determined by measuring the dissolved oxygen used during the chemical oxidation of organic matter in 3 hours.

Total organic Carbon (TOC) :-

This method measures the organic carbon existing in the wastewater by injecting a sampb of the WW in special device in which carbon is oxidized to Carbondioxide then carbondioxide is measured and used to quantify the amount of organic matter in the waste water. This method is used only for the small concentration of organic matter.

Scanned by CamScanner

Theoretical Oxygen (ThoD):-

If the chemical formula of the organic matter existing in the WW is known the ThoD may be computed as the amount of oxygen needed to oxidize the organic carbon to carbondioxide and other end products.

Inorganic Matter:-

The following are the main inorganic materials of concern in wastewater treatment.

(1) Chlorides:-

- High concentrations indicate that the waterbody has been used for the waste disposal.
- It affects the biological process in high concentrations.

(2) Nitrogen:-

TKN = Total kjeldahl nitrogen
= Organic Nitrogen + ammonia Nitrogen (120 mg/l)

(3) Phosphorus:-

Municipal waste contains (4-15 mg/l)

(4) Sulphur:-

Sulphate exists in waste and necessary for synthesis of Protiens in the formation of flocs in the aeration tanks

Sphaerotilus natans:-
Causes sludge bulking in the aeration tanks

Bdellovibrio:-
destroy Pathogens in biological treatment.

Acinetobacter:-
Store large amounts of Phosphate under aerobic conditions and release it under an-anaerobic condition, so they are useful in phosphate removal

Nitrobacter:- transform NO_2 to NO_3^-

Coliform bacteria:- The most common type is E.coli (indicator for the Presence of Pathogens)

→ Fungi:- Important in decomposing organic matter to simple forms

→ Algae:-
- Cause Eutrophication Phenomena (Negative Effect)
- Useful in oxidation ponds (Positive)

→ Protozoa:-
Feed on bacteria so they help in purification of treated wastewater.

- Some of them are pathogenic

Viruses:- Viruses are major hazard to Public health. Some Viruses can live as long as 41 days in water and wastewater at 20°c. They cause lots of dangerous diseases.

Pathogenic Organisms:-

The main categories of Pathogens are :- Bacteria, viruses, Protozoa, helminthes.

Differences Between Industrial Vs Municipal Wastewater:-

- Domestic waste water is wastewater originating from activities such as rest room usage, washing, bathing, food preparation and laundry.

- Industrial wastewater is process wastewater originating from manufacturing, commercial businesses, mining, agricultural production and processing, and wastewater from cleanup of petroleum and chemical contaminated sites.

Municipal waste water pollution :-

- Municipal waste water treatment has been used to prevent the pollution of a receiving water course.
- The characteristics of a municipal waste water depend on the type of the collection system and types of industrial wastes entering the sewers.
- The location of a typical municipal wastewater treatment plant has been such that waste water was collected and transported to the plant and disposed of by dilution in adjacent rivers, lakes, (or) estuaries.
- The type of municipal waste water ~~system~~ treatment system most commonly ~~used as~~ used has been a ~~waste~~ conventional waste water ~~(system)~~ process that consists of preliminary process of pumping, screening, grit removal, primary settling to remove heavy solids

Industrial waste water

- Wastewater entering a treatment plant may contain organic pollutants, metals, nutrients, sediment, bacteria, and viruses.

- Industrial processes such as steel or chemical manufacturing, produce billions of gallons of wastewater daily

- Some industrial pollutants are similar to those in municipal sewage, but often are most concentrated

- other Industrial pollutants are more exotic and include a variety of heavy metals and synthetic organic compounds

- In sufficient dosages, they may present serious hazards to human health and aquatic organisms.

- Effect of industrial effluents on Sewers and Natural water Bodies:

- The effect of industrial wastes on municipal sewage depends upon their relative volumes and analyses are compared with the volume and composition of the domestic sewage on to which they discharge and further to extent on the time of flow from the entrance of the industrial waste to the sewage disposal point.

- Ordinary Municipal sewage has a diluting and neutralizing effect on BOD and other industrial wastes and consequence it is often practicable to treat sewage containing large quantities of wastes by bacterial processes.

- In general industrial wastes, should not admitted to sewers:

- If they contain substances which will adhere to the walls (or) form deposits.
- If they contain inflammable substances.
- If they contain stream or very hot liquids
- If they contain acids which will ~~require~~ injure the material with sewer.
- If they contain substances which will seriously interfere with the operation of sewage treatment works
- Industrial wastes containing warm fats and greases which upon meeting the cooler sewage collect along the walls and tend to obstruct (or) reduce the capacity of the sewer.
- Wire mill, galvanizing and tannery waste which may react with other ingredients of the sewage to produce troublesome deposits.

UNIT - II

Pre and Primary Treatment - Equalization, Proportioning, Neutralization, oil Seperation by Flotation - Waste Reduction - Volume Reduction - Strength of Reduction.

Preliminary treatment:-

It is the objective of treating wastewater treatment plant. It consists of removal of floa-ting materials like dead animals, tree branches, Papers, Plastics, Wood pieces, Vegetables Peels etc and also the heavy settleable inorganic solids (grit etc). Preliminary treatment of waste water include.

(1) Screening

(2) Comminutors

(3) Grit chamber

(4) Detritus chamber

(5) Skimming tank

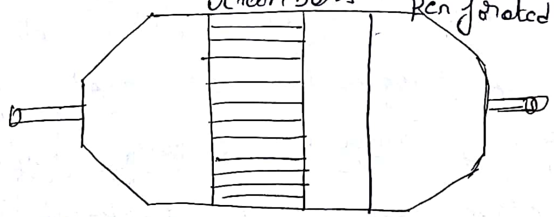
Screening:-

Screening is the removal of large size floating matters by a series of closely spaced bars placed across the flow inclined at 30° - 60°.

These floating materials if not removed, will choke the pipes (or) adversely affect the working of the sewage pumps.

Screens should preferably be placed before the grit chambers, however if the quality of grit is not important, as in case of the land sliding. Screens may be placed after the grit chamber (or) something within the body of grit chamber.

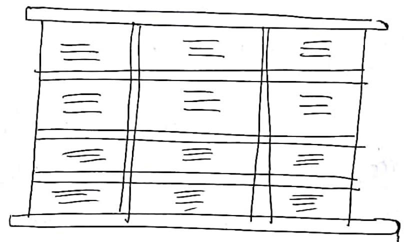
The screens may be cleaned mechanically (or) manually, the waste accumulated is removed periodically which can be disposed of by burial, disintegration (or) used as fertilizers.



Comminutors:-

The larger suspended solids are reduced to smaller size by comminutors rather than removing by screens. The communitors are usually provided in large plants. Communitors

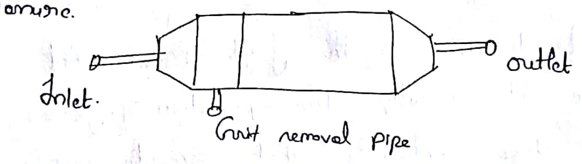
Consists of fixed screen and a moving cutter (or) curved screen with rotating (or) oscillating cutter. A typical ~~commu~~ comminutor shown in the figure consists of rotating hollow cast iron drum about its vertical axis. Comminutors should be installed on the d/s end of grit chamber to avoid its excessive wear.



Grit removal:

Grits are heavy inorganic solids such as sand, metal fragments, egg shells of specific gravity ranging 2-2.65. They cause excessive wear during treatment stages and therefore must be removed. A grit chamber may be horizontal flow (or) vertical flow and is manually (or) mechanically cleaned. Grit of a properly designed and operated chamber is free from organic matters which may be used as landfill. If grit contains organics in high

Proportion, it is disposed of by burial (or) used as manure.

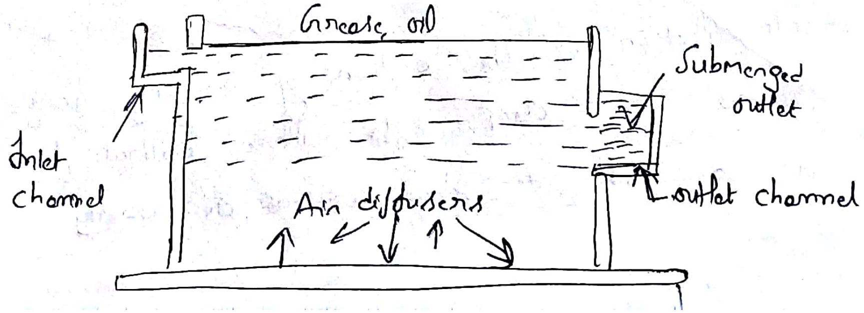


Detritus chamber:-

They are installed to remove finer particles which are left from grit chamber.

Skimming tank:

It is used to seperate grease and oil and other floating matters which may adversely affect the efficiency of the treatment facilities. Grease may tend to trap trickling filter and cloat the biological flock in the activated sludge process. The floating matters may be collected by continuous mechanical process (or) by hand manually. They have baffled entrance and outlet.



Primary Treatment :-

- Primary treatment is the first Process that takes place, its usually the operation Performed to remove those materials that seperate easily
- The removal of substantial amount of suspended matter by using Sedimentation, Flocculation, Screening (or) Similar methods.

Sedimentation :- It takes place in a settling tank (or) clarifier. It allows many suspen-ded Particles to settle out of water (or) ~~wet~~ wastewater while slowing ~~of~~ going thro-ugh the tank, and Providing a source of Purification. A large amount of sludge is usually found at the bottom of the tank and is Periodically removed.

Flocculation:-

Flocculation is the action of binding large Particles in to clumps. It's where colloids form in to flakes (or) floc, colloids are usually dissolved in to a liquid, they do this genitally mixing the coagulated water this is also called hydrodyanamic process. Flocs (or) flakes are supposed to ~~flocs~~ grow to either 0.1 or 2.0 mm ~~so. that~~ so that it can be removed by sedimentation.

Screening:- Screening removes relatively large solids in a primary treatment facility. It is most commonly used by food processing ~~industries~~ plants and reduces the amount of solids being discharged. During the screening treatment, wood, dead animals and rocks get in the way and have to be removed to keep process going.

<u>Equalization:</u>

It is used to minimize (or) control fluctuations in wastewater characteristics in order to provide optimum conditions for subsequent treatment

The purpose of equalization for industrial waste-water treatment facilities is:

- For dampening of organic fluctuations to avoid shock loading on biological wastewater treatment system
- To minimize flow surges to physical chemical treatment systems
- To control pH (or) minimize the chemical requirements for neutralization
- To provide continuous feed to biological systems over periods when the manufacturing plant is not working.
- To controlled discharge of industrial waste to municipal sewers
- To prevent high concentration of toxic chemicals from entering the biological treatment plant

Mixing is normally provide to ensure adequate equalization and to prevent settleable solids depositing in the basin

- Also oxidation of reduced compounds from wastewater (or) reduction of BOD by stripping may be achieved by mixing and aeration.

Methods used for mixing:-

- Distribution of inlet flow & baffling
- Mechanical aeration / Turbine mixing
- Diffused air aeration

Most commonly submerged (or) surface aerators with power level of approx. 0.003 to 0.004 kW/m³ are used. In diffused air mixing air requirement of 3.74 m³/m³ is used.

Equalization basin may be designed as.

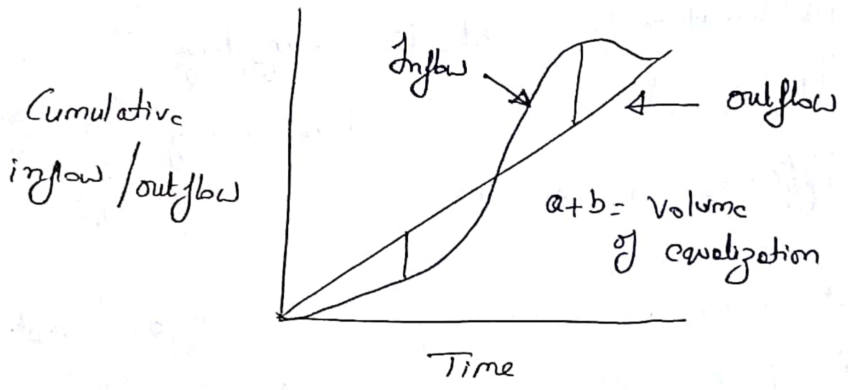
- Variable volume - to provide constant effluent flow used in Industries
- Constant volume
  - Variable effluent flow used in municipal discharge

~~Ate~~ Equalization may be designed online (or) off line

- Equalization basin may be designed to equalize flow, concentration (or) both.

- For flow equalization cumulative flow is plotted

Verses time over equalization period i.e 24 hrs. The Maximum volume with respect to constant discharge line is the equalization volume required.



Neutralization:-

Where ~~acidic~~ wastewater is acidic (or) alkaline, neutralization is required prior to discharge to receiving waters (or) prior to chemical (or) biological treatment.

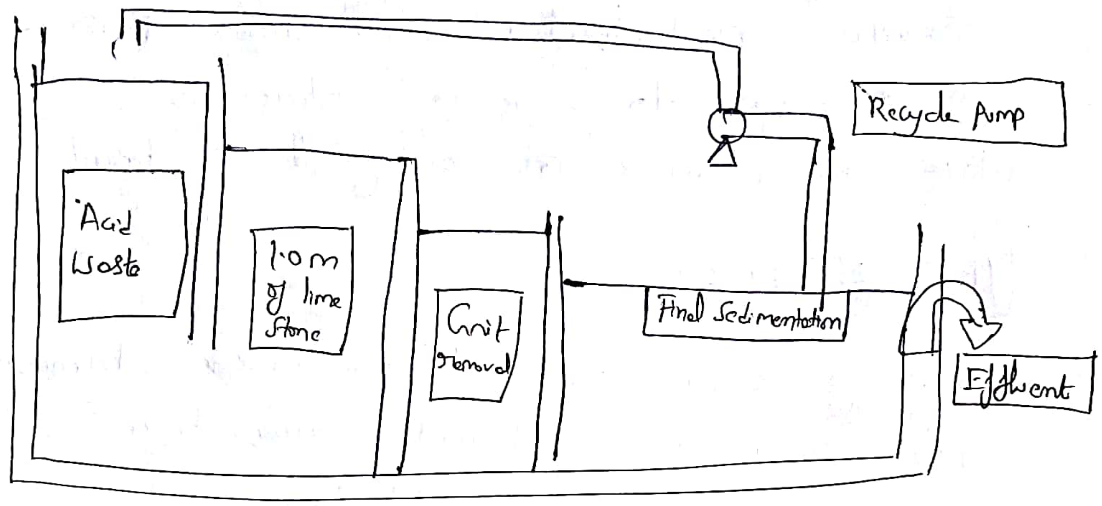
Types of Processes -

(a) Mixing acidic and alkaline waste streams:-
This requires sufficient equalization capacity to effect neutralization

(b) Acid waste neutralization through lime stone beds:-

- can be down flow (or) upflow
- Max. hydraulic load for down flow system 8.5 $m^3/m^2.hr$ to ensure sufficient retention time
- H_2SO_4 conc. should be limited to 0.6% to avoid coating of limestone with nonreactive $CaSO_4$ and excessive CO_2 evolution, which limits neutralization
- Effective for wastewater where relative acidity is fairly constant

- Not very effective where flow and conc. varies with time.



Simplified flow diagram of limestone neutralization

Mixing acid waste with lime slurries

- Depends on the type of lime used
- Magnesium fraction of lime is most reactive below pH of 4.2
- The reactions can be accelerated by heat and agitation (disturbance of liquid)
- Reaction is complete within 5 to 10 min
- Quick lime (CaO) is used as 8 to 15% lime slurry
- Neutralization can also be accomplished by NaOH, Na_2CO_3 and NH_4OH.

- Lime slurries pose practical difficulties due to Variation in quality of lime recieved.

Alkaline Waste:-

- Strong acids are used. H_2SO_4 is preferred for economy. HCl can also be used.
- Reactions are instantaneous
- Flue gases containing 14% CO_2 can be used

Either gases are bubbled (or) spray tower with countercurrent can be used

System for neutralization:-

- Usually stepwise addition is preferred for all above for better results with two (or) even three stages.
- Batch treatment is used up to flows of $38 m^3/d$.
- Air is used for mixing (min. rate 0.3 to $0.9 m^3/m^2$. min at depth of 2.7m).
- When mechanical mixers are used, 0.04 to 0.08 kW/m^3 is required power.

Control of Process:-

The pH control is troublesome for the following reasons

1) For strong acid - strong base neutralization is highly non linear, particularly when close to neutral.

2) The influent pH change can be fast per pH unit per min.

3) Variation in wastewater incoming flow.

4) Small amount of reagent must be thoroughly mixed with larger liquid volume in short time.

5) Hence for biological treatment bicarbonate addition is preferred to maintain neutral pH.

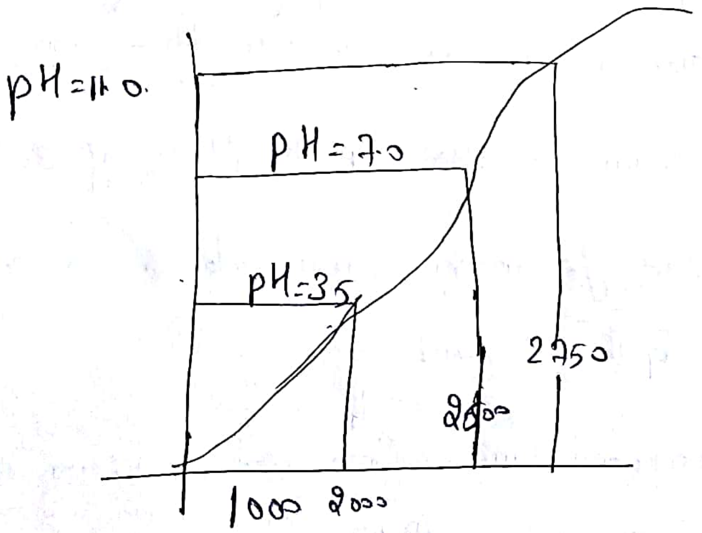


Fig: Lime waste titration curve for strong acid

Hence, Stepwise addition is advantageous

eg: Tank 1 - pH 3 to 4

Tank 2 - pH 5 to 6

Tank 3 - further correction to desired pH (neutral)

Oil Seperation

Plate Seperator

- Free oil is floated to the surface of the tank and skimmed off.
- Plate seperators including parallel plates and corrugated plates (CPS) that can be used for seperating oil droplets larger than 0.006 cm.
- This is capable to produce effluent less than 10 mg/L free non emulsified oil when the influent oil content is less than 1%.
- Efficiency reduces under high oil loading (due to shear of oil droplets and reentrainment)

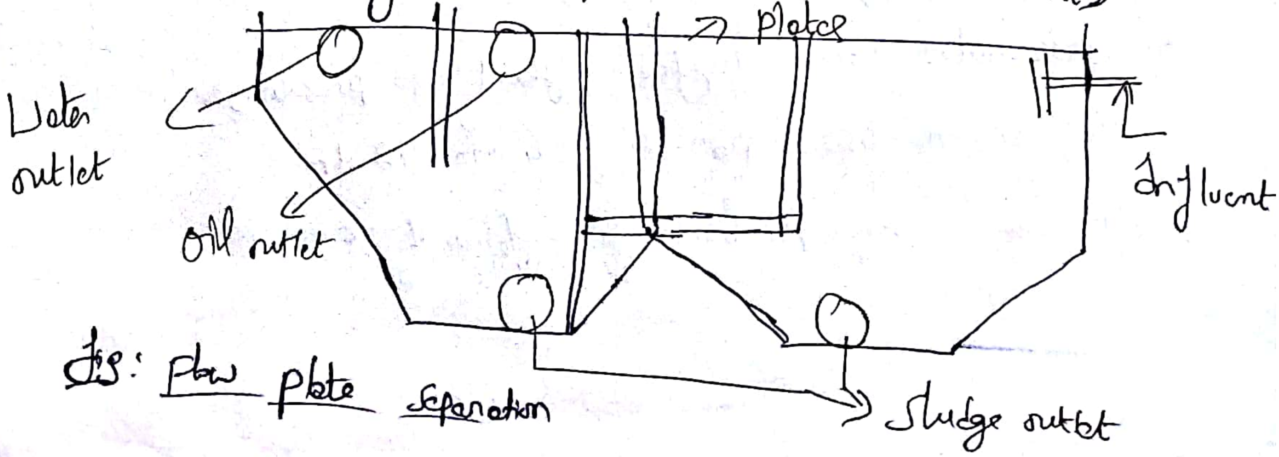


fig: Flow plate Separation

- Plat angle 45° & 10mm spacing is used
- A hydraulic loading of 0.5 $m^3/h.m^2$ of actual Plate area is used
- A safety factor of 50% is normally used in design
- Emulsified oily materials requires treatment, to break the emulsion to make free oily material.
- Emulsions can be broken by detergents, alum (or) iron salts, acidification (or) emulsion breaking Polymers.
- Disadvantage of iron salts (or) alum ~~salt~~ is large sludge generation

Flotation:-

- Used for the removal of suspended solids, oil and grease
- Wastewater (or) Clarified effluent is pressurized to 345 to 483 k Pa (or) 34 to 48 atm Pressure, in Presence of sufficient air to

Reach saturation

- When this pressurized air liquid mixture is released to atmospheric pressure in flotation unit, fine air bubbles are released from solution.
- The sludge flocs, SS, oil, globules are floated by these minute air bubbles
- The air solids-mixture ~~raised~~ rises to the surface, where it is skimmed off.
- The clarified liquid is removed from the bottom of the flotation unit.
- Effluent may be recycled to yeild a superior effluent quality

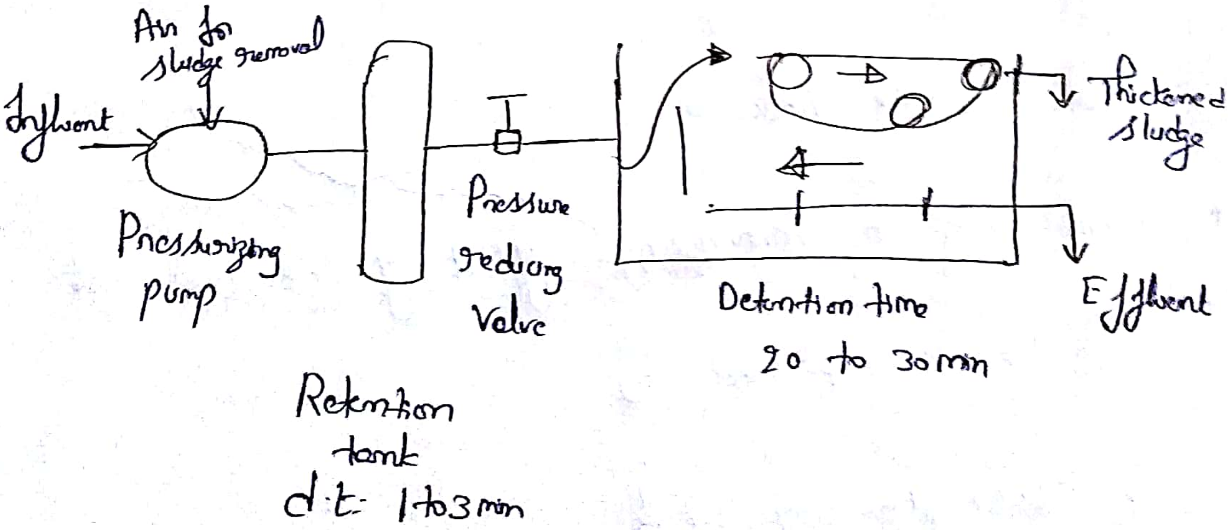


Fig Flotation system without recirculation bubble size = 30 to 100 µm.

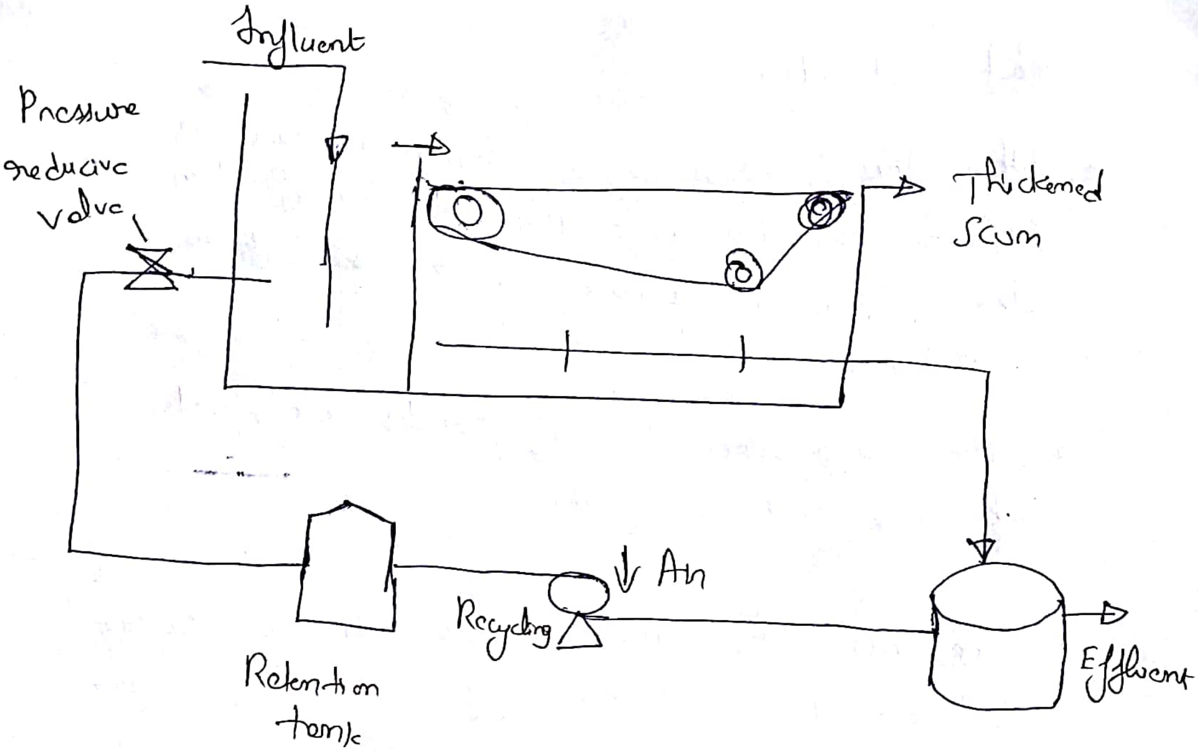


Fig Flotation system with recirculation.

~~Air~~

Waste Reduction;

Waste Volume Reduction

* First step in minimizing effect of industrial waste. This is accomplished by

(1) Classification of waste

(2) Conservation of waste water

(3) Changing production to decrease wastes.

(4) Reusing both industrial and municipal Effluents for raw water supplies

(1) Classification of wastes:-

By classifying the waste the Unpolluted waste stream can be seggreg-ated from the polluted, thus reducing total volume of wastewater

• Three general classes of waste from Industry are

(a) Wastes from manufacturing process:-

eg: waste from milk can washing, discarded plating solution, spent wash from destelleries etc.

(b) Wastes used as cooling agents in industrial Processes:

• Volume varies from industry to industry

eg: large refinery discharges 150 MGD of waste out of which only 5 MGD is process waste, remaining cooling water with slight contamination due to small leaks, corrossion products, and little organic matter

(c) Waste from sanitary uses:

- Range from 100 to 200 L per person per day
- Depends on size of plant, amount of waste product washed from floors.
- In most plant all these waste are mixed together.

UNIT-III

Wastewater treatment methods:-

Phosphorus removal from waste water:-

Controlling phosphorus discharged from the municipal and industrial wastewater treatment plant is a key factor in preventing eutrophication of surface waters.

Eutrophication: The enrichment of waters by inorganic plant nutrients is called eutrophication. It has effects on water bodies, the main are algal blooming, oxygen depletion.

Phosphorus is one of the major nutrients contributing in the increased eutrophication of ~~surface waters~~ lakes and natural waters. Its presence causes many water quality problems including increased purification costs, decreased recreational and conservation value of an impoundments, loss of livestock and the possible lethal effect of legal algal toxins on drinking water.

Phosphate removal is currently achieved largely by chemical precipitation, which is expensive and causes an increase of sludge volume by up to 40%. An alternative is the biological

Phosphate removal (BPR)

Phosphorus in wastewaters:-

Municipal wastewaters may contain from 5 to 20 mg/L of total phosphorus, of which 1 to 5 mg/L is organic and the rest is inorganic. The usual forms of phosphorus found in aqueous solution include

- Orthophosphates : available for biological metabolism without further breakdown.
- Polyphosphates: Molecules with 2 or more phosphorus atoms, oxygen and in some cases hydrogen atoms combine in a complex molecule.

Normally secondary treatment can only remove 1- 2mg/L, so a large excess of phosphorus is discharged in the final effluent, causing eutrophication in surface waters.

Phosphate Precipitation

Chemical Precipitation is used to remove the inorganic forms of phosphate by the addition of a coagulant and a mixing of wastewater and coagulant.

- The multivalent metal ions most commonly used are calcium, aluminium & iron

<u>Calcium</u>:

① usually added in the form of lime $Ca(OH)_2$.

② It reacts with the natural alkalinity in the wastewater to produce calcium carbonate.

$$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 \downarrow + 2H_2O.$$

③ As the pH value of wastewater increases beyond about 10, excess calcium ions will then react with the phosphate, to precipitate in hydroxylapatite;

$$10Ca^{2+} + 6PO_4^{3-} + 2OH^- \leftrightarrow Ca_{10}(PO_4) * 6(OH)_2$$

④ Because the reaction is between the lime and the alkalinity of the wastewater, the quantity required will be, in general independent of the amount of phosphate present. It will depend primarily on the alkalinity of wastewater.

⑤ The lime dose required can be approximated at 1.5 times the alkalinity as $CaCO_3$

(6) Neutralization may be required to reduce pH before subsequent treatment of (or) disposal.

(7) Recarbonation with carbon dioxide (CO_2) is used to lower the pH value.

Aluminium & Iron :-

(1) Alum (or) hydrated aluminium sulphate is widely used precipitating phosphates and aluminium phosphates ($AlPO_4$). The basic reaction is

$$Al^{3+} + H_n PO_4^{3-n} \leftrightarrow AlPO_4 + nH^+$$

(2) The dosage rate required is a function of the phosphorus removal required.

(3) The efficiency of the coagulation falls as the concentration of phosphorus decreases.

(4) In practice, an 80-90% removal rate is achieved with at coagulant dosages rates between 50 and 200 mg/l.

(5) Dosages are generally established on the basis of bench-scale tests and occasionally by full-scale tests, especially if polymers are used.

(1) Aluminium coagulants can adversely affect the microbial population in activated sludge, especially protozoa

and rotifers at dosage rates higher than 150 mg/l

(7) Ferric chloride (or) sulphate and ferrous sulphate also known as copperas, are all widely used for phosphorus removal. The basic reaction is

$$Fe^{3+} + H_n PO_4^{3-n} \leftrightarrow FePO_4 + nH^+$$

(8) Ferric ions combine to form ferric phosphate.

Strategies :-

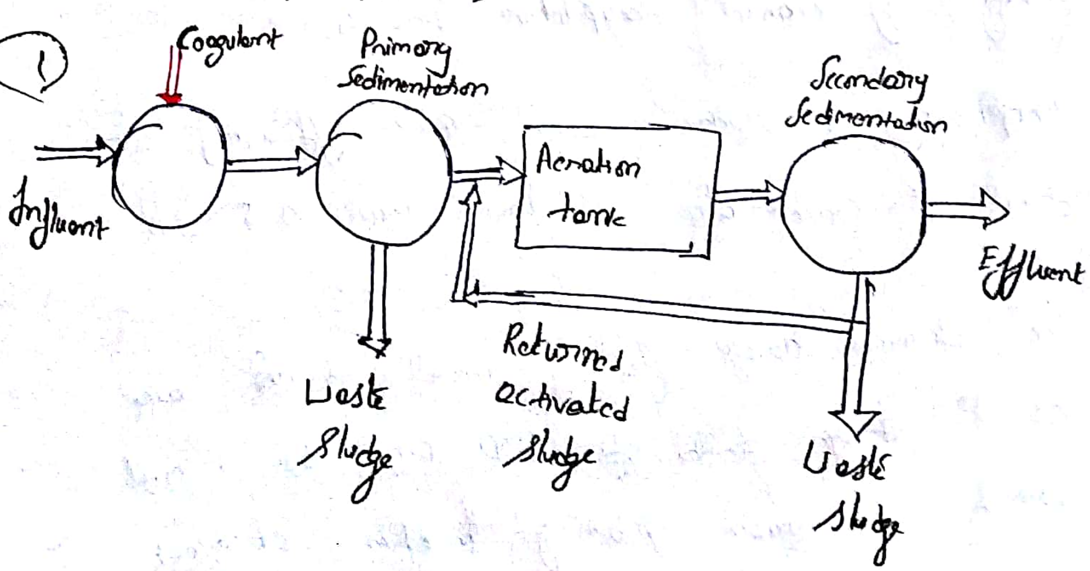
The main phosphate removal processes are

(1) Treatment of raw/Primary wastewater

(2) Treatment of final effluent of biological plants (Post-Precipitation)

(3) Treatment contemporary to the secondary biologic reaction (coprecipitation)

(1)



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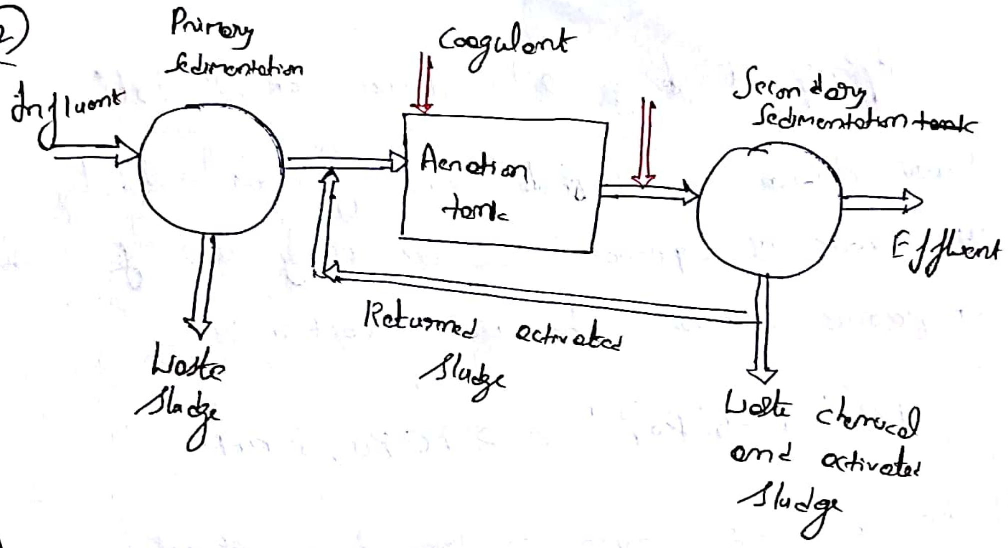

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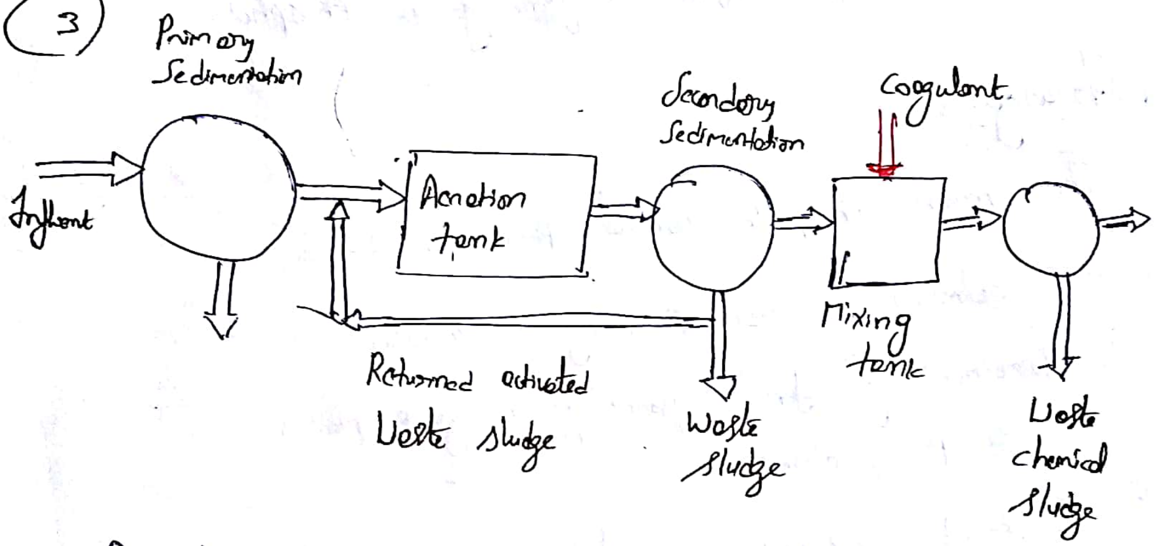


⇒ The first Process is included in the general category of chemical Precipitation processes.

⇒ Phosphorus is removed with 90% efficiency and final P concentration is lower than 0.5 mg/l.

⇒ The chemical dosage for P removal is the same as the dosage needed for BOD and SS removal which uses main part of the chem chemicals

⇒ The Postprecipitation is a standard treatment of secondary effluent, usually using only metallic reagents

⇒ It is the process that gives the highest efficiency in phosphorus removal

⇒ Efficiency can reach 95% and P concentration in the effluent can be lower than 0.5 mg/l

⇒ Postprecipitation gives also a good removal of the SS that escapes the final sedimentation of the secondary process

⇒ Its advantage is also to give a guarantee Purification efficiency at certain extent even if biological process is not efficient for some reason.

⇒ Disadvantages are high costs for the treatment Plant and sometimes a too dilute effluents.

⇒ Using ferric salts there is also the risk of having some iron in the effluent with residual coloration

⇒ The metallic ions dosage is about 1.5 to 2.5 ions for every phosphorus ion.

⇒ The coprecipitation process is particularly suitable for active sludge plants, where the chemicals are fed directly in the aeration tank (or) before it.

⇒ The costs for the plant are lower, since there is no need for big postprecipitation ponds

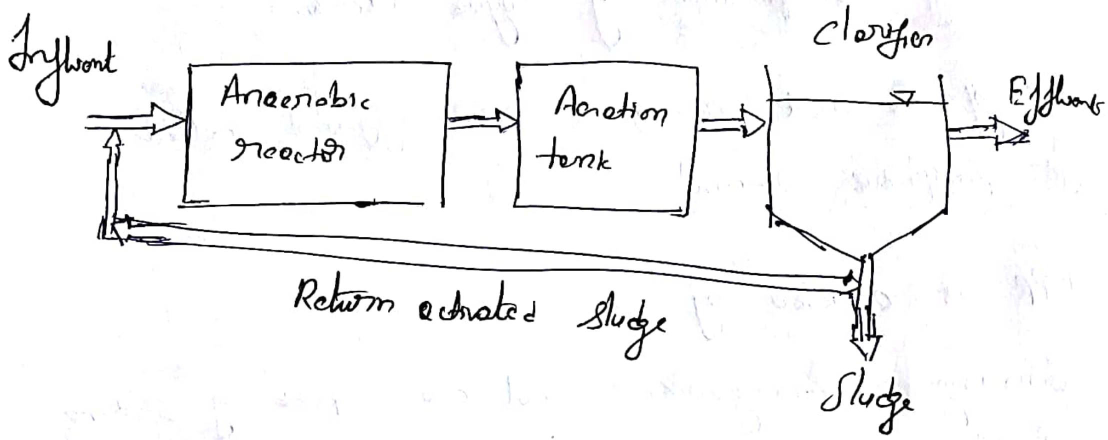
⇒ In this process the chemical added are only iron and aluminium, lime is added only for pH correction.

⇒ Phosphorus removal efficiency lower than with postprecipitation (below 85%). The phosphorus concentration in the final effluent is about 1mg/L.

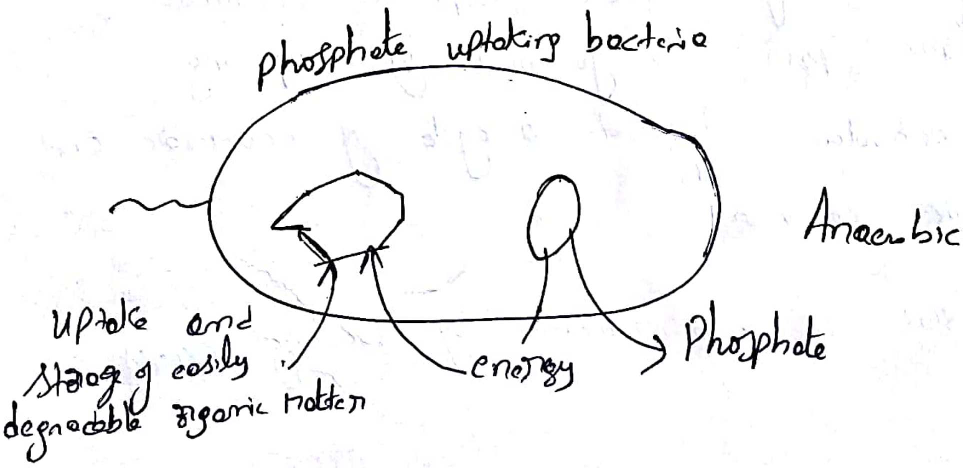
⇒ Another disadvantage is that biological and chemical sludge are mixed, so they cannot be used seperately in next stages

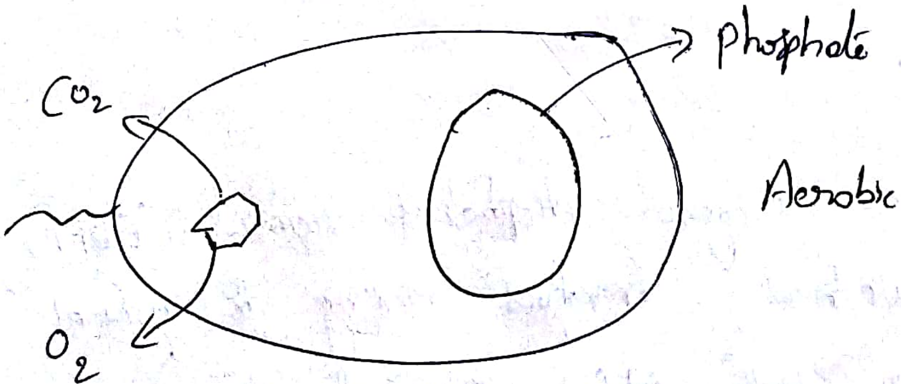
⇒ Mixed sludges need bigger sedimentation tanks than activated sludge.

→ Biological Phosphorus removal



Biological phosphorus removal





→ Biological phosphorus removal (BPR) from domestic and industrial wastewater is a key factor in preventing eutrophication of surface watersand,

→ one of the most economical and efficient methods for phosphorus removal.

⇒ BPR is achieved by

- Growing microorganisms that are capable of storing phosphorus intracellularly as polyphosphate.
- The growth of ~~phosphate~~ phosphorus-accumulating organisms (PAOs) is favoured by subjecting the activated sludge to a cycle of anaerobic and aerobic conditions.
- Phosphorus is then removed by wasting excess sludge

Process:-

- Enhanced biological phosphorus removal (EBPR) from wastewater involves mixing the influent wastewater with settled microbial biomass enters the anaerobic selector where chemically bound oxygen in the form of nitrates is removed.

- The microorganisms have the ability to store energy in the form of polyphosphate chemical ~~bounds~~ bonds.

- Some of these microorganisms are called polyphosphate accumulating organisms (PAOs)

- In the anaerobic zone, where substrate (BOD) concentration is high, the absence of oxygen causes the micro organisms to release the stored intracellular polyphosphates by decomposition to simple orthophosphate.

- The decomposition of polyphosphate to orthophosphate results in an increase of soluble phosphorus in the mixed liquor and also releases energy

- The energy is used by the microorganisms to transport soluble BOD through the cell wall and to store the soluble BOD inside the cell.

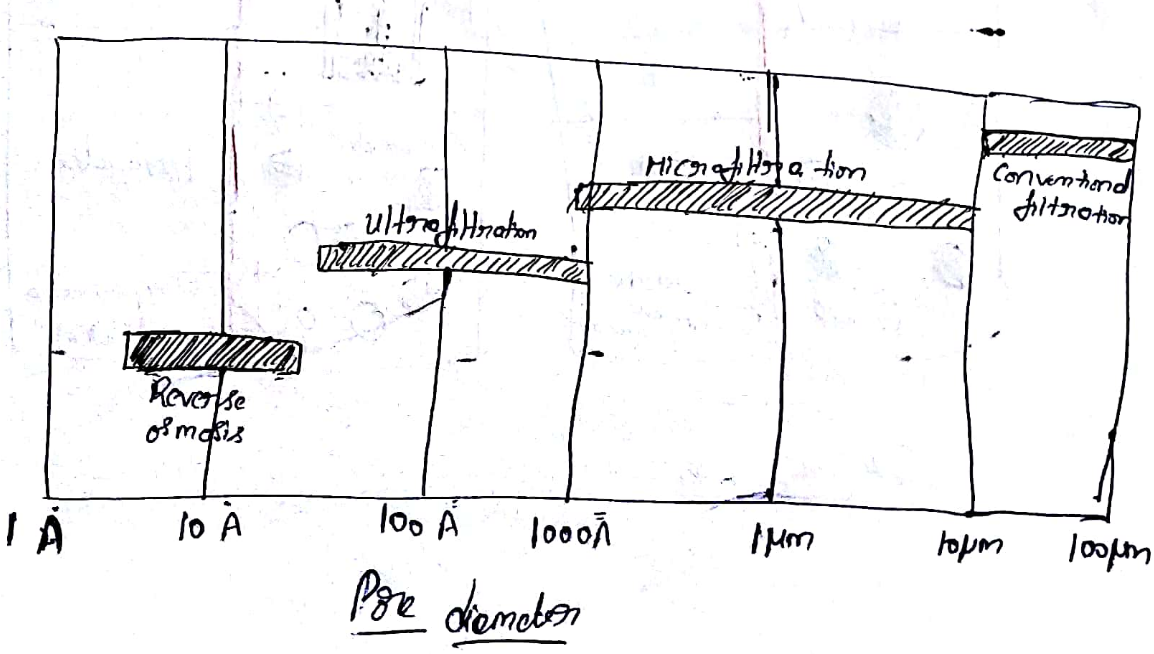
- Thus the BOD concentration in the mixed liquor is reduced without the use of oxygen.
- In the oxic phases of the process, the organisms in the presence of dissolved oxygen:
  - → Convert the stored BOD to CO_2, water
  - → and increased cell mass.
- A portion of the energy from this reaction then goes to recreating the intracellular phosphate polyphosphate using the orthophosphate released in the anaerobic zone.
- Since new cells are grown, the amount of phosphate removed from the solution is greater than that previously solubilized in the anaerobic zone, thus providing for a net phosphate removal.
- Phosphorus is removed from the system as a fixed biological material in the waste sludge.
- The amount of phosphorus in the sludge will be dependent upon the amount of BOD and phosphate in the ~~effluent~~ influent and the volume of sludge produced

⇒ Membrane Seperation Process:-

1) Membrane ~~Seperation~~ filteration includes a broad range of seperation processes from filtration and ultrafilteration to reverse osmosis

2) Generally these processes defined as filtration refer to system in which discrete holes (or) pores exist in the filter medium, generally in the order of 10^2 to 10^4 nm (or) larger.

3) The efficiency of this type of filtration depends entirely on the differences in size between the pore and particle to be removed.



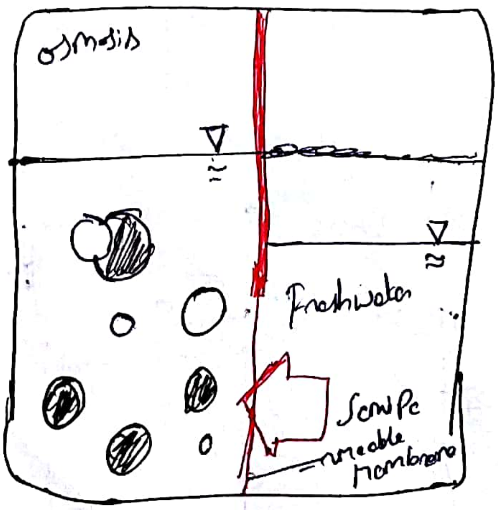
4) Reverse osmosis employs a semipermeable membrane and a pressure differential to drive freshwater to one side of the cell, concentrating salts on the input or rejection side of the cell. In this process freshwater is literally squeezed out of the feedwater solution.

5) The Reverse osmosis process can be described by considering the normal osmosis.

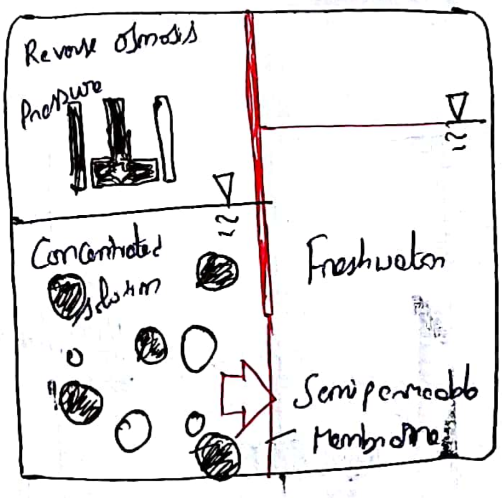
6) In osmosis, a salt solution is prepared separated from a pure solvent in to a solution of less concentration by a semipermeable membrane.

7) The semipermeable membrane is permeable to the solvent and impermeable to the solute.

8)



Osmosis



Reverse osmosis

8) The chemical potential of the pure solvent is greater than that of the solvent in solution, and therefore drives the system to equilibrium.

9) If an imaginary piston applies an increasing pressure on the solution compartment, the solvent flow through the membrane will continue to decrease

10) When sufficient pressure has been applied to bring about the thermodynamic equilibrium the solvent flow will stop.

11) The pressure developed in achieving equilibrium is the osmotic pressure of the solution (or) the difference in the osmotic pressure between the two solutions. If a less concentrated salt solution is used instead of pure solvent in the right chamber of the cell

12) If a pressure in excess of the osmotic

pressure is now applied to the more concentrated solution chamber,

13) pure solvent is caused to flow from this chamber to the pure solvent side of membrane, leaving a more concentrated solution behind. This phenomenon is the basis of reverse osmosis process.

⇒ <u>Air Stripping Process</u>

- Sometimes volatile compounds (generally VOC's) can be removed from the aqueous phase by stripping the VOC's with an air flow.
- This air stripping is usually accomplished in air stripping towers.
- The towers serve to breakup the water in to droplets and allow contact between the water and air with subsequent

transfer of voc to air phase.

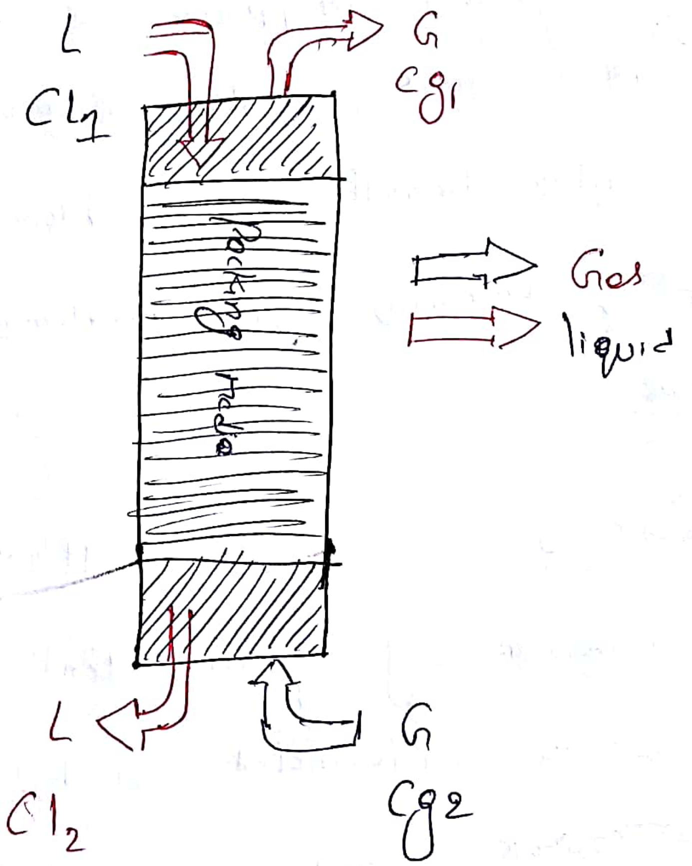
- The premise is that the atmosphere can handle the voc's

- Packed tower air stripping is commonly used to remove volatile contaminates (eg: tetrachloroethylene, trichloroethylene, benzene, ammonia) from contaminated waters.

- Increasingly, it is being applied to the renovation of groundwaters that have become contaminated with volatile organic carbon (voc) compounds from leaking underground storage tanks, spills or improper disposal practices

- Two approaches to designing a stripping tower are equilibrium and dynamic.

- First consider the equilibrium approach. This will only give an estimate of performance but it is fairly easy to perform.



G = gas flow rate (m^3/sec)

L = water flow rate (m^3/sec)

Cg 1,2 = gas phase concentration of volatile substance at top and bottom of column respectively (moles/m^3)

$C_{l1,l2}$ = Water phase concentration of volatile substance at top and bottom of column, respectively (moles/m³)

- If equilibrium is attained at every point in the tower then "henry's law predicts:

$$C_g = H_c C_l$$

- A mass balance on the volatile material in the column gives

$$L\{(C_{l1} - C_{l2}) = G(C_{g1} - C_{g2})\}$$

- C_{g2} is generally zero

- Again at equilibrium

$$C_{g1} = H_c C_{l1}$$

therefore

$$L(C_{l1} - C_{l2}) = G(H_c \cdot C_{l1})$$

then:

$$\frac{G}{L} = \left\{ \frac{C_{l1} - C_{l2}}{C_{l1}} \right\} \cdot \frac{1}{H_c}$$

Since $C_{g2} = C_{l2} = 0$ (By Henry's law)

$$\frac{G}{L} = \frac{1}{H_c}$$

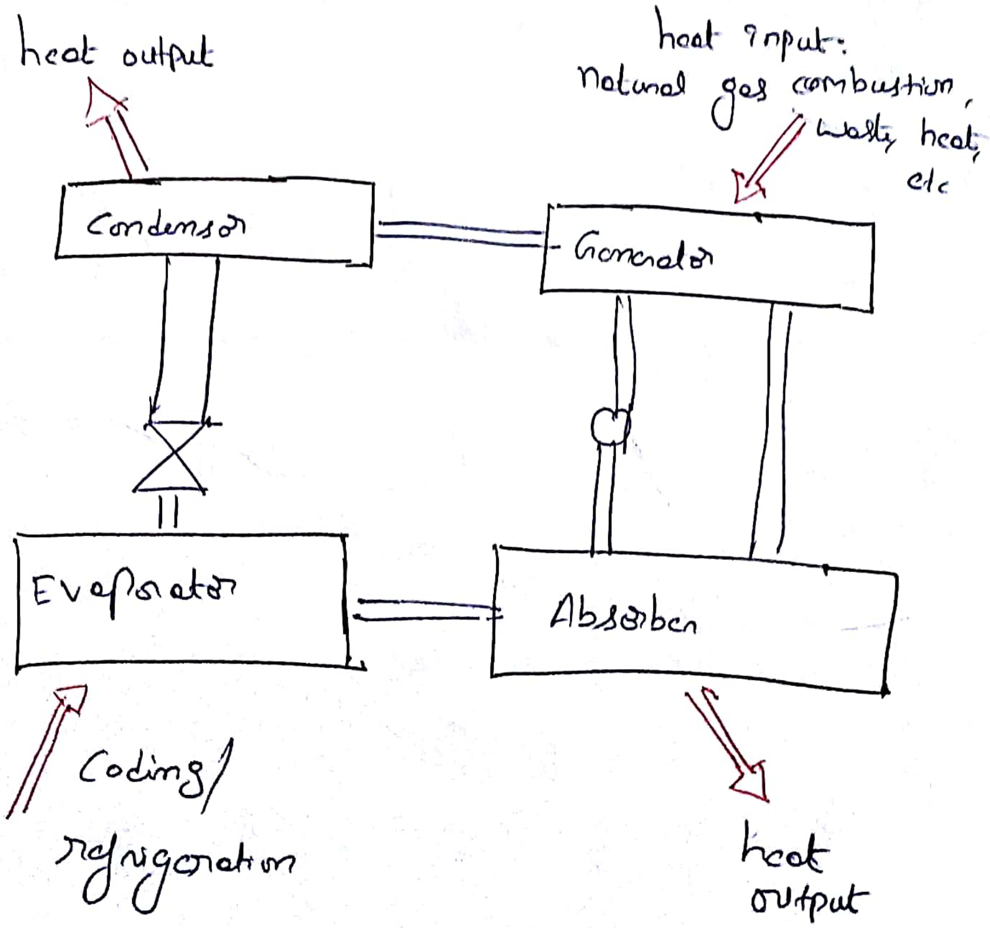
- This G/L ratio predicts gas to liquid flows required to get removal of the volatile material.

- However, equilibrium (Henry's law) is never attained in a typical stripping column.

- This ratio is only an estimate of actual gas/liquid flow rates required.

Absorption process

- Gas absorption (also known as scrubbing) is an operation in which a gas mixture is contacted with a liquid for the purpose of preferentially dissolving one or more components of the gas mixture and to provide a solution of them in the liquid.



UNIT - IV

=> Sugar Mill Manufacturing Process:-

- The sugar cane is normally harvested manually in India, which eliminates the carriage of soil and trashes to the factory along with the sugar canes.

- The sugar canes are cut in to pieces and crushed in a series of to extract the juice, in the mill house.

- The milk of lime is then added to the juice and heated, when all colloidal and suspended impurities are coagulated.

- The coagulated juice is then clarified to remove the sludge.

- The clarifier sludge is further filtered through filter presses, and then disposed off as solid waste.

- The filtrate is recycled to the process, and the entire quantity of clarified juice is treated by passing sulphur dioxide gas through it.

- The process is known as "sulphitation process". Colour of the juice is completely bleached out due to this process.

- The clarified juice is then preheated and concentrated in evaporators and Vaccum pans known as 'massecuite'.

- Then transferred in to crystallizers. where complete crystallisation of sugar occurs

- The massecuite is then centrifuged to separate the sugar crystals from the mother liquor.

- The spent liquor is discarded as 'black strap mollases'. The sugar is then dried and bagged for transport.

- The fibrous residue of the mill house known as 'bagasses' may be burnt in the boilers, or may be used as rawmaterials for the production of the paper products
- The black strap molasses may be used in the distilleries

Sources & characteristics of wastes:-

- Wastes from the mill house include the water used as splashes to extract minimum amount of Juice.
- As such the mill house waste contains high BOD due to presence of sugar and oil from the machineries
- The filter cloths used for filtering the juice need occasional cleaning.
- A large volume of water is required in the barometric condensers of the multiple effect evaporators and vaccum pans

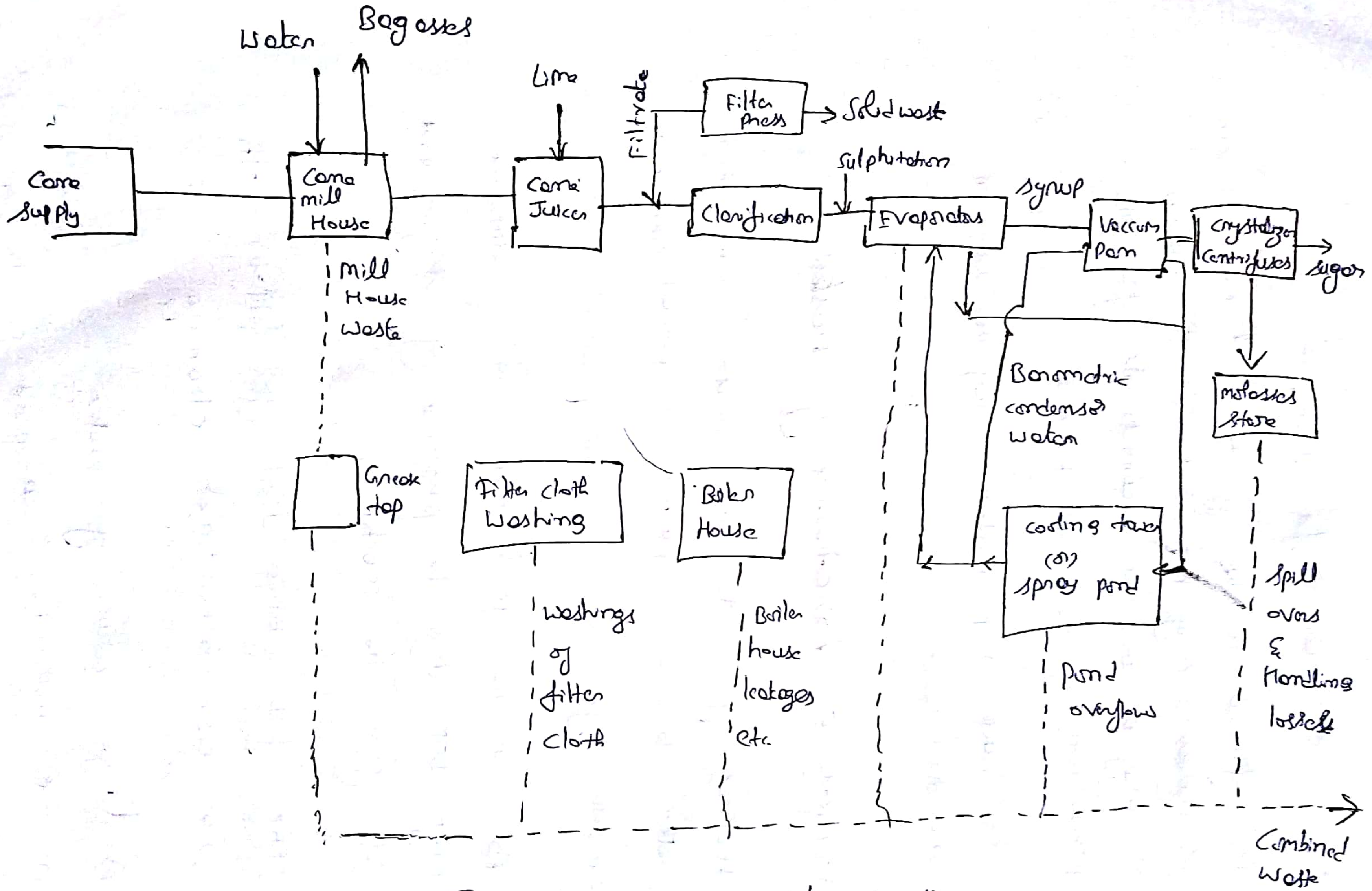


Fig: Sugar Manufacturing Process

- The water is usually partially (or) fully recirculated, after cooling through a spray pond.
- This cooling water gets polluted as it picks up some organic substances from vapour of boiling syrup in evaporators and vaccum pan.
- The water from spray pond when overflows, becomes a part of the waste water, and usually of low BOD in a properly operating sugar mill.
- The discharge contribute substantially to the waste volume and moderately to BOD in many sugar mills
- Additional waste originates due to the leakages and spillages of juice syrup and mollasses in different sections, and also due to the handling of mollasses.
- The periodical washings of the floor also

contributes a great lot to the pollution load

- Though these wastes are small in volume and are discharged intermittently, they have got a very high BOD.

Effects of the waste on receiving water:-

- The fresh effluent from the sugar mill, decom-poses rapidly after few hours of stagnation.

- The rapid depletion of oxygen due to the biological oxidation followed by anaerobic stabilization of waste causes a secondary pollution. of offensive odour, black colour, and fish mortality.

- It has been found to cause considerable difficulties when their effluent gas gets an access to the water courses, particularly the small and non-perennial streams in the rural areas.

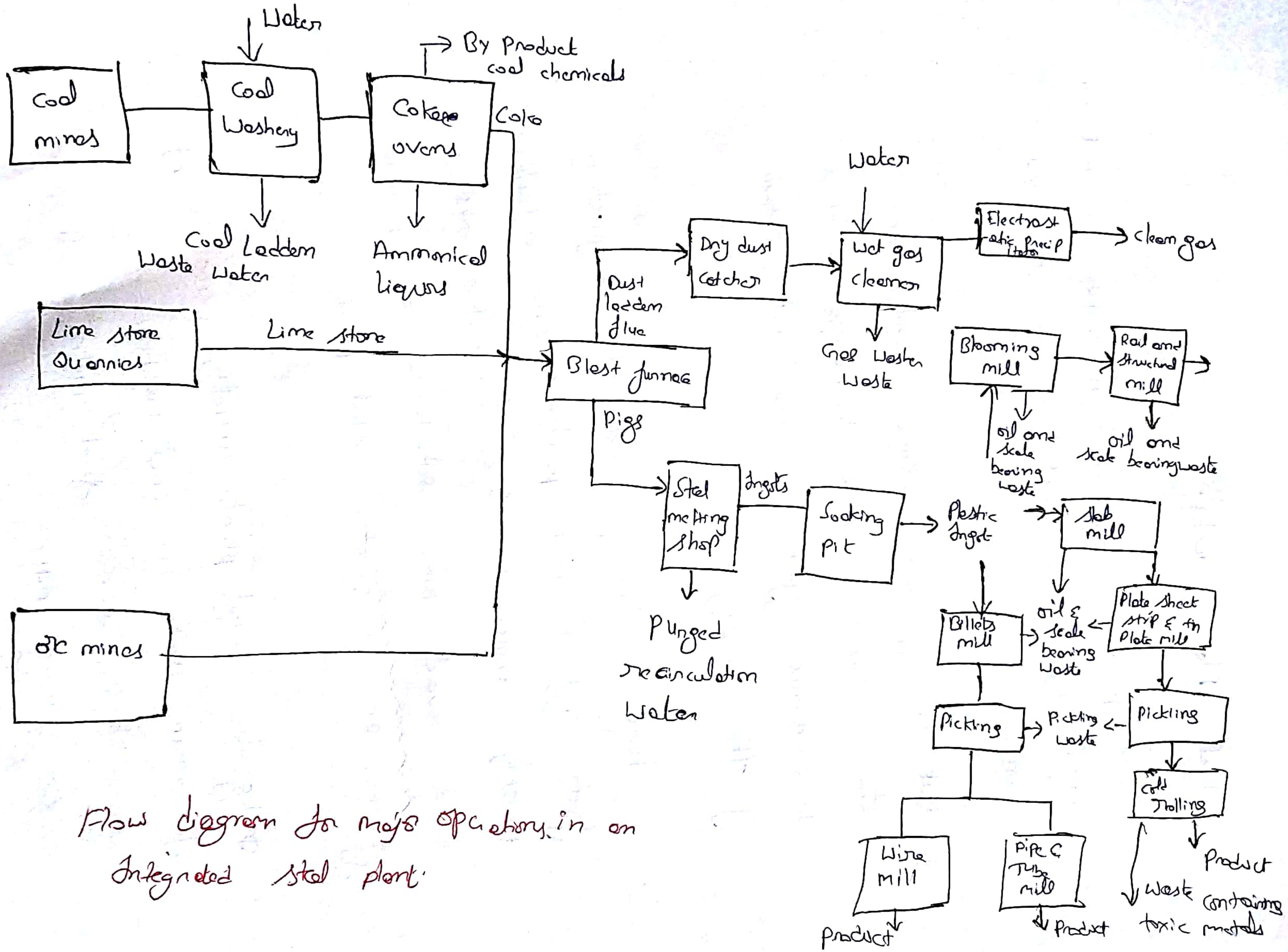
- Steel Plant wastes:

- The production of steel in India, is not so high compared to that in other advanced countries

- But use of large volume of water and the consequent waste discharges induces a tremendous effect on the water resources of the locality.

- A large volume of waste water, originating from different unit operations and containing mostly suspended solids, lubrication oils and several toxic substances are produced from an integrated steel plant.

- Integrated steel plants usually consists of five main units ie coal washery, coke oven, blast furnace, steel melting shop and rolling mills.



Flow diagram for major operations in an Integrated steel plant.

Coal washery & its waste water:-

- The coal needs some processing to make it suitable for use in coke ovens.
- The main objective of such treatment is the removal of solid foreign matter present in the coal.
- Generally the processes in coal washery include crushing, screening, and wet washing of coal.
- In wet process, the coal is seperated from the impurities using the principle of differential settling.
- Water used for washing is recycled and re-used after sedimentation.

Coke ovens & their waste water:-

- The production of coke involves carbonization of bituminous coal by heating in the absence of air at a temperature range of 900 - 1100°c in an oven, which drives off all volatile portions in the coal.

- The gas, which is evolved containing the volatile portions in matters is collected through the stand pipes and is cooled in stages.

- In the first stage the gas is cooled to about 80°c by spraying cold liquor over the gas, thereby producing mainly tar as the condensate.

- In the second stage, by a further cooling to about 30°c, condensate containing additional tar, and ammonia liquor is produced.

- These two condensate liquors liquors after the separation of tar in a tar - decantor are recycled as sprays in the first stage.

- After the second stage of cooling; ie, in the third stage the gas is compressed and cooled for further recovery of chemicals.

- The coal after being carbonized, is removed from the oven and quenched by cold water.
- About 30% of the quenching water is evaporated while the remaining water containing coke fines comes out as waste.

Blast furnace and its waste water:

- Blast furnace is a basic unit in an integrated steel plant.
- Essentially the blast furnace process ~~consisting~~ consists of charging iron ore and coke as fuel, limestone and dolomite as fluxing material in to the top of the furnace and blowing heated (blast) in to the bottom.
- Pig iron is the metallic product of this unit.
- Appreciable quantity of water is used in blast furnace for the purpose of cooling and gas cleaning operations. ~~How~~
- However, the cooling water normally remains

uncontaminated and is reused after cooling.

- The entire quantum of waste water originates from the gas cleaning operations.

- The blast furnace gas, which is heavily loaded with the flue dust, is cleaned in three stage process.

- The major portion of the flue dust which comes out along with blast furnace gas is recovered by dry dust catchers.

- The remaining is removed by washing with water by 'wet scrubbing'.

- The portion which escapes wet scrubber may be removed by electrostatic precipitator.

- The wash water used in electrostatic precipitators adds very little to the waste volume, but increases the concentration of finer particles in the flow.

[The main objective of such treatment is the removal of solid foreign matter present in the coal.

- Generally the processes in a coal washery include crushing, screening and wet washing of coal.

Steel melting shop and its waste

- In steel melting shops, the pig iron obtained from the blast furnace is further treated to produce ignots.

- The basic principle involved is the oxidation of unwanted impurities in the pig iron which lead to the production of steel ingots

- Water requirement in the steel melting processes lies in keeping the furnace body cool.

- A portion of water from the water recirculation system is often wasted.

- But it never poses a pollution control problem as the same is used for different secondary purposes

Rolling mills and their wastes:

- The steel ingots obtained from the steel melting shop are rolled to different products in the rolling mills.

- However, the ingots are heated first in the soaking pits until those are plastic enough for economic reduction by rolling.

- Ignots are usually rolled in to blooms, billets or slabs, depending upon the final product.

- These rolled blooms, billets, and slabs are then cooled and stored and subsequently sent to another mill, where these are re-rolled to produce finer products

- ~~The~~ During the processes of rolling of ~~of~~ ingots, blooms, billets, and slabs, lots of scales are given off and are collected in the scale flume, below the roll tables.

- These scales are flushed down with high pressure water and are collected at the scale pit.

⇒ Oil Refineries:

- A large amount of water is used in the refinery processes and a big fraction of it comes out as waste after getting polluted by oil and other toxic substances

- Major amount of water used in a refinery, is for cooking. Like any other industry, the extent of recirculation and reuse of this water will determine the volume of the effluent discharge

- Second to cooling, the major use of water is for boiler feed

- The steam obtained is utilized for different operations like desalting for crude oil, distillation and stream- stripping in topping process and in catalytic cracking.

- Stream is also used for the stripping of spent catalyst before the later is sent for regeneration.

Scanned by CamScanner

- Water is also required to wash the produ-cts like gasoline to remove the traces of chemical reagents used in earlier operation.

- The process waste water includes the condensates and wash waters which come into contact with petroleum ~~con~~ products at some stage of the processing.

- So the waste water contains free or emulsified oil, spent caustic and acid solutions, impurities of petroleum products like hydrogen sulphides, ammonia, mercaptans, phenols and spent catalysts.

- The next operation of dewatering and drying of coke produces a waste cont-aining large amount of coke fines.

- Oil enters in to the waste water from leaks, spills etc at various stages.

- It is not possible to generalise on the characteristics of waste water from the Petroleum refineries.
- These characteristics vary widely with the size of the refinery, type of crude oil used, complexity of processing, water economy adopted etc.

Characteristics of oil refineries wastes

Free oil	2000 - 3000 mg/l
Emulsified oil	90 - 120 mg/l
H_2S and RSH	10 - 220 mg/l
Phenolic compounds	12 - 30 mg/l
5 day 20°C BOD	100 - 300 mg/l
Suspended solids	200 - 400 mg/l.

Food Processing Industries

- Like a other industries food industries playing a big role in society
- The demand of pre-processing and processing of food for the use food items in home has been increased day by day
- The demand for uniformity of quality food and high standards based at the remote areas.
- Food processing regardless of the type of the food can be divided in to three classes.

1) Separation
2) Assembly
3) preservation

These occur at food processing plant for sale point of view.

Seperation :-

- Seperation include rendering, skimming, boning, caning, defeathering, husking, peeling, shelling.

Assembly :-

Assembly include coating, enrobing, baking, homogenization, roasting, pelleting, stuffing

Preservation :-

To preserve the food stuff.

- Food is categorized as live tissue and non-live tissue.

- Live tissue food includes fresh fruits, vegetable meat, grains.

- Non-living tissue include bevrages, milk, cheese, button, etc.

- During the process control the taste, color, nutritive value, cell structure as fresh food.

- Qualities of food is achieved by use of enzyme, food should not be in the approach of insects, bruising, chemical degradation.

- The intensity of processing operation is limited by tissue itself in term of temperature range, water activity, respiratory gas composition, mechanical stress, and concentration of chemicals. Certain fruits are stored at 0°C.

- Non-living tissue food includes is determined for preservation food so that final quality food can be determined including vitamins, fats, butter etc. these are free from the defects and good nutrition value.

UNIT-V

Textile mill waste:

- An integrated cotton textile mill produces its own yarn from the raw cotton.
- production of yarn from raw cotton includes steps like, opening and cleaning, picking, carding, drawing, spinning, winding and warping.
- All these sequences are dry operations, and as such do not contribute to the liquid waste of the mill.
- The entire liquid waste from the textile mills comes from the following operation of slashing, scouring, and desizing, bleaching, mercerizing, dyeing and finishing.
- In slashing, the yarn is strengthened by loading it with starch (or) other sizing / substances.
- waste originates from this section due to spills and the floor washings at the weak end.

- The substitution of low-BOD sizes for high BOD starch reduces the total BOD of mill effluent by 40-90%

- After slashing the yarn goes for weaving.

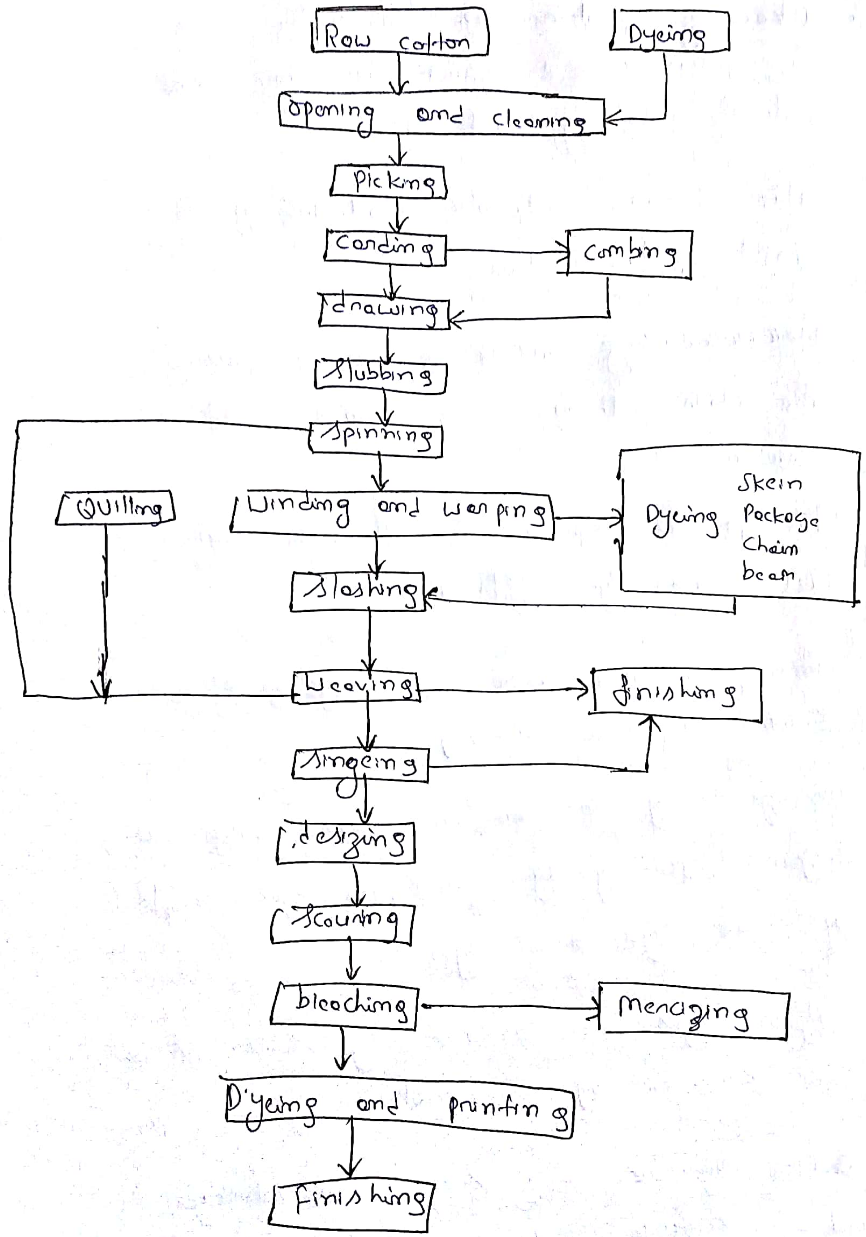
- The prepared cloth now requires scouring and desizing to remove natural impurities and the slashing compounds.

- Enzymes are usually used in India to hydrolyze the starch; acids may also be used for this purpose.

- Caustic soda, soda ash, detergents etc are used scouring in kier boilers

- Replacement of soap used in scouring by low-BOD detergents may reduce BOD load by 35%

- About 50% of the total pollution load of the mill is contributed by this section.



Flow diagram of an Integrated cotton textile mill.

- Bleaching operations use oxidizing chemicals like peroxides and hypochlorites to remove natural colouring materials

- This section contributes about 10% of the total pollution load.

- ~~Mat~~ Mercerising consists of ~~plasting~~ passing the cloth through 20% caustic soda solution.

- The process improves the strength, elasticity, lustre and dye affinity.

- Waste from this section is recycled after sodium hydroxide recovery

- Dyeing may be done in various ways using different types of dyes, developing dyes, napthol dyes, basic dyes, direct dyes etc.

- Sulfur dyes are reduced by sodium sulfide and oxidized by chromate

- Indigo dyes are also similar to vat dyes, but ~~so~~ require only air oxidation

- When naphthol is applied first to the fabric, dried, and then passed through a developer for chemical coupling to produce dye, the process is called naphthol dyeing.

- Developing dyes require acid and sodium nitrite and the colour is developed by treating with a developer.

- Colour from the dyes vary widely and although those are not usually toxic they are esthetically objectional when they impart colour in the drinking water supplies.

- Certain chemicals used in dyeing such as chromium are toxic and they are treated seperately

- Thickened dyes, along with printing gums and necessary auxilitaries, are used for printing and subsequent fixation.

- After fixation of the prints, the fabric is given a thorough wash to remove unfixed dyes.
- The finished section of the mill imports various finishes to the fabrics.
- Various types of chemicals are used for various objectives.
- These includes starches, dextrines, natural and synthetic waxes, synthetic resins etc.

Composition of composite cotton textile mill waste

Characteristics	Value
pH	9.8 - 11.8
Total alkalinity	17.35 mg/l as $CaCO_3$
BOD	760 mg/l
COD	1418 mg/l
Total Solid	6170 mg/l
Total chromium	12.5 mg/l

Tannery waste

- Tannery wastes are characterized by strong colour, high BOD, high pH and high dissolved salts

• The tanning process consists of three basic stages

1) Preparation of the hides for tanning
2) tanning proper &
3) finishing.

• In the first stage the hides are washed to remove dirt and preservative salts used earlier and then soaked in fresh water containing sodium chloride and preservative chemical called "Antimucin". for one to five days

• The soaked hides are then washed again with sufficient running water.

- The washed hides are then limed with a paste of lime and sodium sulphide
- Limed hides are then mechanically cleaned of hairs and fleshings in wooden vats with running fresh water.
- Bating prepares the hides for tanning by reducing the pH, reducing the swelling and removing the protein degradation products in it.
- An additional treatment known as "Pickling" is required for preparing the hide for chrome tanning which involves the treatment of hides with sodium chloride and acid
- The second stage of leather making, the tanning proper, involves the treatment of the hides to make them non putrescible and soft even when dried.

- The use of synthetic tanning materials in place of vegetable tanning materials or chromium salts is expensive.

- Vegetable tanning is used for heavy leathers, while chrome tanning is used for light leathers.

- After four hours of tanning, the leather is bleached with a dilute solution of sodium thio-sulphate and sodium carbonate in the same bath.

- The chrome tanned leather is then pulled out and half of the spent liquor is thrown out and remaining is reused along with a fresh volume of water.

- The third stage of finishing consists of stuffing and fat liquoring followed by dyeing. In the former process the tanned leather incorporates oil and grease and thus becomes soft, pliable and resistant to tearing.

- Dyeing can be done using synthetic dyestuffs.

Sources and Characteristics

- The wastewater originates from all the operation in the tanning process.
- The waste may be classified as continous flow waste and intermittent flow waste.
- Continous flow waste after various processes and comprise of large portion of the total waste, and are relatively less polluted than the other one.
- Spent liquors belonging to the soaking, liming, bating, pickling, tanning and finishing operations are discharged intermittently.

- Although these are relatively small in volume they are highly polluted and contain varieties of soluble organic and inorganic substances.
- The spent soak liquor contains soluble proteins ~~and~~ of the hides, dirt and a large amount of common salt when salted hides are processed.
- The growth of pathogenic anthrax bacteria in this waste is also reported.
- The spent lime liquor contains dissolved and suspended lime, colloidal proteins and their degradation products, sulphides, emulsified fatty ~~products~~ matters.
- As such, the spent lime liquor has a high alkalinity, moderate BOD and a high ammonia nitrogen content.
- The spent bate liquor contains high amount of organic and ammonia nitrogen due to the presence of soluble skin proteins and ammonium

salts used in bating.

- Tannins are high COD but relatively low BOD values, while non-tannins including inorganic salts, organic acids and salts and sugar, are high both in COD and BOD.

- The spent vegetable tanning liquor is the strongest individual waste in the vegetable tanneries, having the highest BOD and very strong dirty brown colour.

- It contains organic tannic compounds, carbohydrates, albuminous compounds, organic acids, inorganic salts etc and is slightly acidic.

- When mixed with spent lime liquor the spent vegetable tanning waste yields a bulky precipitate

- The spent pickling and chrome-tanning waste comprise a small volume, have a low BOD, and contains traces of protenic impurities, sodium chloride, mineral acids and chromium salts.

- Chromium is known to be highly toxic to the living aquatic organisms in the hexavalent form and somewhat less toxic in trivalent form

- When the waste is mixed with spend lime liquor most of the trivalent chromium are precipitated and the rest get diluted to a great extent in the combined waste.

- The average concentration of chromium in combined waste in one chrome tannery is reported to be 180 mg/l.

Joint treatment of Raw Industrial and domestic Waste water :-

- A common Effluent treatment plant generally consists of the following units

1) pretreatment systems in tanneries
2) Collection and conveyance system
3) Recieving sump
4) Screens and grit removal
5) Equalisation tank
6) Chemical dosing

7) Primary clarifier
8) Anaerobic / Aerobic treatment (or) two stages of aerobic treatment
9) Secondary clarifier
10) Sludge thickener
11) Sludge drying
12) Discharge of effluent

Common problems in CETPs

- The efficiency of a CETP depends on the efficiency of each individual unit.
- If any of these units does not work properly it will be reflected in the operation of other units and overall efficiency of the plant.
- The following have been identified as common problems
- ~~The~~ frequent disruptions in the conveyance

system resulting in overflow of effluent.

- Shock loading and overloading of the CETP
- Corrosion of Machinery and equipment, breakdowns, below rated - capacity performance of pumps, aerators etc.
- Inefficient performance of various treatment units of a CETP much below the designed capacity.
- Inconsistent results in the effluent discharged after treatment.
- Difficulty in management and disposal of sludge generated
- Higher cost of treatment than anticipated.

Design of plant:-

- The key to successful operation of a CETP is its proper design.
- proper design of the CETP calls for the accurate

data with regard to the quality and quantity of effluent generated in the cluster.

- Invariably it has been found that the tanners have either ~~understood~~ understated (or) overstated such ~~as~~ figures for their own reasons
- The result has been a CETP of either under. (or) over capacity.
- This has been responsible for overloading of the CETP in some instances
- Besides hydraulic load, the data relating to the characteristics of effluent have also not been faithfully reported
- This data has a direct bearing on the design of the plant and choice of equipment.
- In the initial stages, the designers tended to design the plant based on the data provided without critical analysis (or) cross verification.

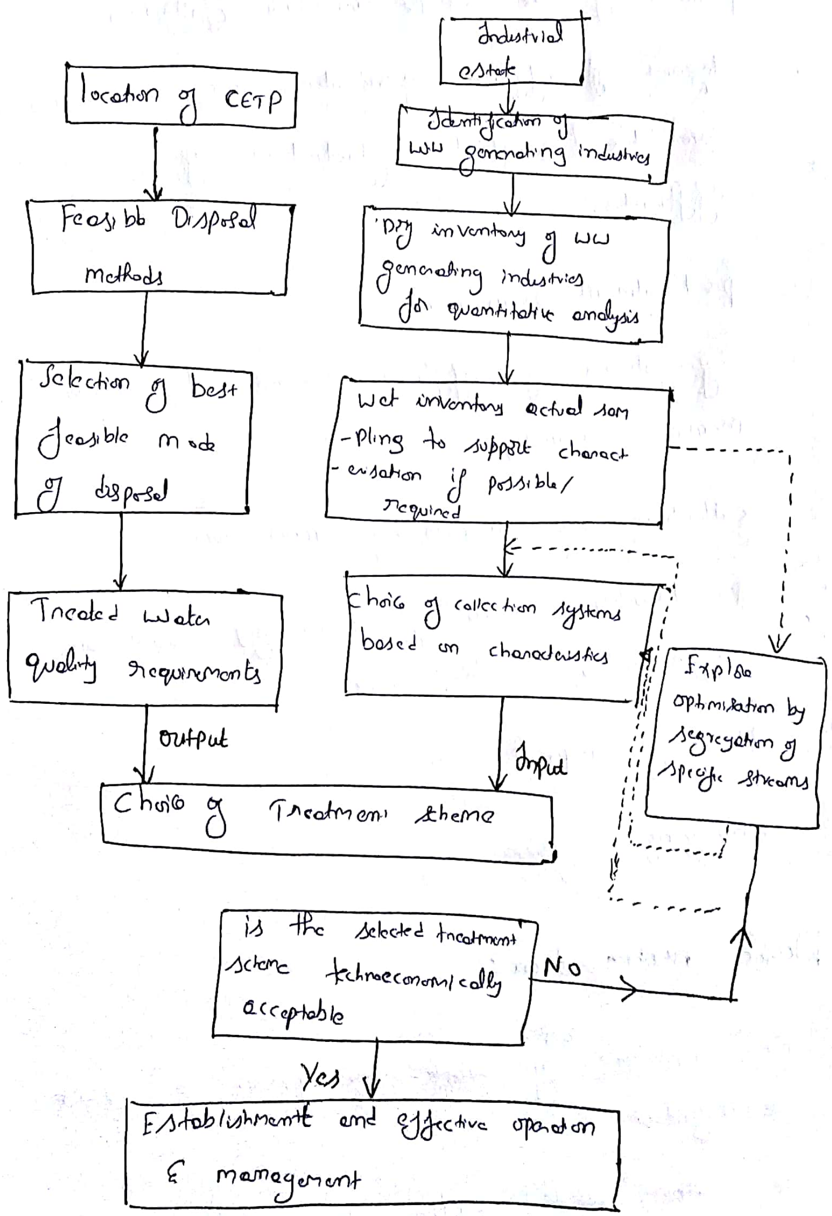


Fig: Planning process of a CETP.

- Factors, which influence the proper planning and operations of the CETPs include following
- Categories of effluent generating member industries
- qualitative / quantitative fluctuations of effluent
- pretreatment requirements
- Segregation of effluent streams at individual member industry
- Collection and monitoring mechanism
- treatability choice of technology and bio-degradability, interferences
- Mode of disposal and
- Charging system

Waste minimization :-

- An important aspect of waste management is waste minimization.
- In other words, rather than attempting

to treat the wastes as they are produced, maximum efforts can be made in avoiding minimizing and / or using the byproducts.

- The basic principles of waste minimization consid-ering the order of acceptability are as follows

- Avoiding (or) eliminating the production of waste can be carried out by choosing an alternative process when designing a production unit.

- Reduction and minimization of waste within the industry - can be achieved by conside-ring all the processes and activities which may lead to production of waste.