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Internal Assessment Test 1 – Mar. 2018

Sub:	INDUSTRIAL WASTEWATER TREATMENT					Sub Code:	10CV835	Branch:	CIVIL
Date:	14/03/18	Duration:	90 min's	Max Marks:	50	Sem/Sec:	VIII/All		OBE

	Answer for any 50 marks	MARKS	CO	RBT
1 (a)	Write short note on stream sampling of industrial waste water.	[05]	CO1	L2
2 (a)	Explain Dissolved Oxygen Sag curve in industrial wastewater stream.	[10]	CO1	L2
(b)	Explain in detail the natural methods of effluent disposal any one: a. Dilution b. Land Treatment.	[10]	CO1	L2
3 (a)	A town discharges **80** cumecs of sewage into a stream having a rate of flow of **1200** cumecs during lean days, at a 5- days BOD of sewage at the given temperature is **250mg/l**. Find the amount of critical DO deficit and its location in the downstream portion of the stream. Assume saturation DO at given temperature as **9.2mg/l.**	[10]	CO1	L2
(b)	Derive the stream Phelps formulation with its application in stream flow.	[10]	CO1	L2
4 (a)	What are the methods for the volume reduction of industrial waste water and why it is required?	[08]	CO1	L2
(b)	Explain strength reduction techniques in industrial waste water.	[05]	CO1	L2
5 (a)	What are the differences between equalization and neutralization processes for industrial waste?	[05]	CO1	L2

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3 (a)	A town discharges **80 cumecs** of sewage into a stream having a rate of flow of **1200** cumecs during lean days, at a 5- days BOD of sewage at the given temperature is **250mg/l**. Find the amount of critical DO deficit and its location in the downstream portion of the stream. Assume saturation DO at given temperature as **9.2mg/l**.	[10]	CO1	L2
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CMR
INSTITUTE
OF TECHNOLOGY

Department of Civil Engineering

SOLUTION _IAT-1 SUBJECT: INDUSTRIAL WASTE WATER TREATMENT (10CV835)
HELD AT 14/03/18

Q.1 STREAM SAMPLING OF INDUSTRIAL WASTE WATER:

STREAM SAMPLING

Before embarking on designing of any industrial wastewater treatment facility a comprehensive stream-sampling program should be conducted. This will in turn help considerably for efficient operation of facility. The factors to be considered before starting a sampling program are

1. Overall objectives of the program

2. Total number of samples

3. Points of collection

4. Method of collection

5. Data to be obtained

6. Frequency of sample collection

7. Time of the year for sampling

8. Statistical handling of data

9. Care of samples, prior to analysis

A minimum of 4 stream stations is recommended

a) An upstream site where the water is uncontaminated

b) Just below the source of pollution or dilution

c) Where the stream is in worst condition due to the source of pollution

d) A point midway between bottom of oxygen sag & the recovery of oxygen level

Method of collection

Samples should be taken from 0.6 ft depth in streams less than 2 ft. The volume of samples depends on the number and type of analysis to be carried out. A standard type dissolved oxygen sampler is recommended for collecting most samples. Glass bottles with glass caps or polyethylene containers are most widely used. Any doubt about the cleanliness of the sample bottle can usually be dispelled by rinsing it first with some of the actual stream water, but special bottles are required for bacteriological samples.

Data to be collected

The scientific collection of data for stream analysis may be divided into **three major categories** i.e., **hydrologic factors, sources of pollution and water course sampling**.

The type of data to be obtained depends on the objectives of sampling programme and the amount of time and money available for the investigation. For example, if the oxygen resources of a section of a stream is required.

DO, water temperature and stream flow should be measured. If the sampling programme is of general nature, the stream analyst should undertake as many chemical, physical and biological tests as possible. For design of wastewater treatment plants, the rate of flow, temperature, BOD and DO can supply sufficient information. In addition, data on pH, color and turbidity may indicate the general physical condition of the stream. Biological analysis is required when the stream water is used for drinking, bathing or flushing. In this case, the coliform count is usually determined.

Frequency of sample collection

Samples should be collected as frequently as possible to provide a representative of total sample. The master sample should contain individual constituents of variation expected. For ex, if the pH is known to vary from 4 to 10, individual samples with pH values of 4,5,6,7,8,9 and 10 should appear in the composite sample at least once during each sampling period. If the situation requires instantaneous analysis, more individual samples with little or no composting are collected.

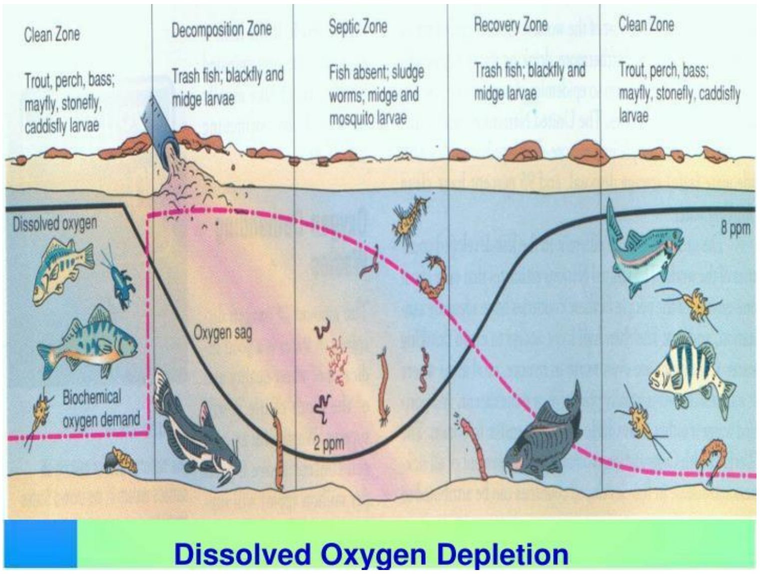
Time of the year for sampling Time of the year is of at most importance when there is a deadline for producing results. In stream studies, dealing with industrial waste treatment is concerned primarily with the critical condition of pollution which generally exists when the environment is at its warmest & its stream flow slowest, & the manmade pollution greatest. But many studies must be undertaken in the spring & autumn seasons due to stream conditions and man power problems. However, many times due to the urgency of the problem or unusual conditions of pollution, the investigations may have to be carried in any of the seasons. The objective of every stream analysis should however to be collect the data during critical stream conditions of temperature, flow and pollution load. It may sometime be necessary to project stream analysis to conditions which might obtain during future critical points.

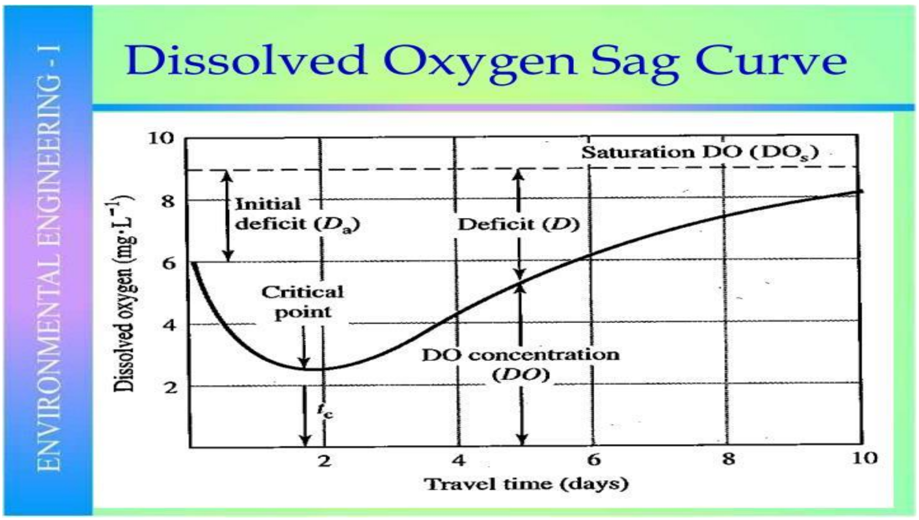
Statistical handling of data: It is a well known fact that data can be manipulated to emphasize that aspect of the survey which the analyst fill the most important. For this the engineer must have a working knowledge of statistic and mathematics in order to convey this information in the best form to the layman.

Care of samples prior to analysis: All samples should be analyzed as soon as possible after collection. It could be advisable to conduct on the river bank analysis whenever it is possible with modern portable testing equipment available.

Q.2a Oxygen sag curve

The curve obtained when the concentration of dissolved oxygen in a river into which sewage or some other pollutant has been discharged is plotted against the distance downstream from the sewage outlet (see graph). Samples of water are taken at areas upstream and downstream from the sewage outlet. The presence of sewage reduces the oxygen content of the water and increases the **biochemical oxygen demand**. This is due to the action of saprotrophic organisms that decompose the organic matter in the sewage and in the process use up the available oxygen.





The oxygen sag or oxygen deficit in the stream at any point of time during self purification process is the difference between the saturation DO content and actual DO content at that time. Oxygen deficit, D = Saturation DO – Actual DO The saturation DO value for fresh water depends upon the temperature and total dissolved salts present in it; and its value varies from 14.62 mg/L at 0o C to 7.63 mg/L at 30o C, and lower DO at higher temperatures. The DO in the stream may not be at saturation level and there may be initial oxygen deficit 'Do'. At this stage, when the effluent with initial BOD load Lo, is discharged in to stream, the DO content of the stream starts depleting and the oxygen deficit (D) increases.

The variation of oxygen deficit (D) with the distance along the stream, and hence with the time of flow from the point of pollution is depicted by the 'Oxygen Sag Curve' (The major point in sag analysis is point of minimum DO, i.e., maximum deficit. The maximum or critical deficit (Dc) occurs at the inflexion points of the oxygen sag curve.

Deoxygenation and Reoxygenation Curves

When wastewater is discharged into the stream, the DO level in the stream goes on depleting. This depletion of DO content is known as deoxygenation. The rate of deoxygenation depends upon the amount of organic matter remaining (Lt) to be oxidized at any time t, as well as temperature (T) at which reaction occurs. The variation of depletion of DO content of the stream with time is depicted by the deoxygenation curve in the absence of aeration. The Time of flow in stream, t, days DO Content, % Point of oxygen demanding waste discharge Saturation DO Dc Dt t tc Do Critical point 100 0 Oxygen Sag Curve Deoxygenation Curve Reoxygenation Curve 4 | Page NPTEL IIT Kharagpur Web Courses ordinates below the deoxygenation curve (Figure 12.1) indicate the oxygen remaining in the natural stream after satisfying the bio-chemical oxygen demand of oxidizable matter.

When the DO content of the stream is gradually consumed due to BOD load, atmosphere supplies oxygen continuously to the water, through the process of re-aeration or reoxygenation, i.e., along with deoxygenation, re-aeration is continuous process.

The rate of reoxygenation depends upon:

i) Depth of water in the stream: more for shallow depth.
ii) Velocity of flow in the stream: less for stagnant water.
iii) Oxygen deficit below saturation DO: since solubility rate depends on difference between saturation concentration and existing concentration of DO.
iv) Temperature of water: solubility of oxygen is lower at higher temperature and also saturation concentration is less at higher temperature.

Mathematical analysis of Oxygen Sag Curve: Streeter – Phelps equation

The analysis of oxygen sag curve can be easily done by superimposing the rates of deoxygenation and reoxygenation as suggested by the Streeter – Phelps analysis. The rate of change in the DO deficit is the sum of the two reactions as explained below:

dDt/ dt = f (deoxygenation and reoxygenation) OR dDt / dt = K'Lt – R'Dt

Where,
Dt = DO deficit at any time t,
Lt = amount of first stage BOD remaining at any time t
K' = BOD reaction rate constant or deoxygenation constant (to the base e)
R' = Reoxygenation constant (to the base e)
t = time (in days) dDt/ dt = rate of change of DO deficit

Now, Where, Lo = BOD remaining at time t = 0 i.e. ultimate first stage BOD

Hence, –K t Lt Lo e to raise to power –kt)

The Streeter–Phelps equation determines the relation between the dissolved oxygen concentration and the biological oxygen demand over time and is a solution to the linear first order differential equation.

This differential equation states that the total change in oxygen deficit (D) is equal to the difference between the two rates of deoxygenation and reaeration at any time.

The Streeter–Phelps equation, assuming a plug-flow stream at steady state is then

Q.2B NATURAL METHODS OF SELF PURIFICATION

SELF PURIFICATION OF NATURAL STREAMS The self purification of natural water systems is a complex process that often involves physical, chemical, and biological processes working simultaneously. The amount of dissolved Oxygen (DO) in water is one of the most commonly used indicators of a river health. As DO drops below 4 or 5 mg/L the forms of life that can survive begin to be reduced. A minimum of about 2.0 mg/L of dissolved oxygen is required to maintain higher life forms. A number of factors affect the amount of DO available in a river. Oxygen demanding wastes remove DO; plants add DO during day but remove it at night; respiration of organisms removes oxygen. In summer, rising temperature reduces solubility of oxygen, while lower flows reduce the rate at which oxygen enters the water from atmosphere.

Factors Affecting Self Purification

1. Dilution: When sufficient dilution water is available in the receiving water body, where the wastewater is discharged, the DO level in the receiving stream may not reach to zero or critical DO due to availability of sufficient DO initially in the river water before receiving discharge of wastewater.

2. Current: When strong water current is available, the discharged wastewater will be thoroughly mixed with stream water preventing deposition of solids. In small current, the solid matter from the wastewater will get deposited at the bed following decomposition and reduction in DO.

3. Temperature: The quantity of DO available in stream water is more in cold temperature than in hot temperature. Also, as the activity of microorganisms is more at the higher temperature, hence, the self-purification will take less time at hot temperature than in winter.

4. Sunlight: Algae produces oxygen in presence of sunlight due to photosynthesis. Therefore, sunlight helps in purification of stream by adding oxygen through photosynthesis.

5. **Rate of Oxidation**: Due to oxidation of organic matter discharged in the river DO depletion occurs. This rate is faster at higher temperature and low at lower temperature. The rate of oxidation of organic matter depends on the chemical composition of organic matter.

Dilution

In the beginning of twentieth century, waste water disposal practices were based on the premise that "the solution to pollution is dilution". Dilution was considered as the most economical means of waste water disposal. In this method relatively small quantities of waste are discharged into large bodies of water.'

Although dilution is a powerful adjunct to self-cleaning mechanism of surface waters, its success depends upon discharging relatively small quantities of waste into large bodies of water. Growth in population and industrial activity, with increases in water demand and wastewater quantities, precludes the use of many streams for dilution of raw or poorly treated wastewaters.

Dilution is a predominant natural method of disposal.

Disposal by dilution is the process whereby the raw or treated (most treated) sewage is discharged into water bodies such as rivers, lakes, sea etc.. The discharge sewage, in due course of time, is purified by the self purification process of the natural waters. The sewage is mainly purified due to oxidation of organic matter by bacteria using the DO present in the water bodies. The degree of the treatment given to the raw sewage before disposing it in to any river will depend not only upon the quality of raw sewage but also on the self purification capacity of river and the intended use of its water at the down stream side. • This method can be used only for the town or city which are located near the river or sea or have a large lake which can be used as a source of disposal.

The Dilution method for disposing of the sewage can favorable by adopted under the following conditions:

• When the sewage is comparatively fresh i.e. it is discharged within 3-4 hours of its collection.

• When the floating matter and settable solids have been removed by primary treatment. When the diluting water has high DO content, so that not only the BOD is satisfied, but sufficient DO remains available for the aquatic life.

Where the dilution waters are not used for the purpose of navigation or water supply for at-least some reasonable distance on the downstream from the point of sewage disposal.

The following are the types of receiving waters into which wastewater or effluent can be discharged for dilution:

• Perennial rivers and streams

• Lakes

• Oceans or Sea

• Estuaries

• Creeks

Land treatment

The process of land treatment is the controlled application of wastewater to soil to achieve treatment of constituents in the wastewater. All three major processes (include slow rate (SR), overland flow (OF), and rapid infiltration (RI)) use the natural physical, chemical, and biological mechanisms within the soil–plant–water matrix. The SR processes use the soil matrix for treatment after infiltration of the wastewater, the major difference between the processes being the rate at which the wastewater is loaded onto the site. The OF process uses the soil surface and vegetation for treatment, with limited percolation, and the treated effluent is collected as surface runoff at the bottom of the slope.
These systems can often be the most cost-effective option in terms of both construction and operation and are therefore, frequently being used in small communities and rural areas[2].
The use of domestic wastewater emanating from these communities on fast growing plant species can be an effective way of wastewater treatment as well as a source of water and nutrients for growing plants. The application of domestic wastewater for irrigation to food crops generally fulfills their nutrient requirement but in other hand make them more vulnerable to the attack of insects and pathogens. Hence, the irrigation of trees with this

wastewater is considered as more economical and eco-friendly method of fertilization. The species like Poplar and Salix have longer growing seasons and deeper, longer lasting root systems than annual crops, which enables them to have a better utilization of the nutrients from wastewater. Secondly, these plant species possess high rate of evapotranspiration which further enhances the LTS treatment efficiency[3].
The technical design of the land treatment system mainly depends on the mode of wastewater application, and characteristics of wastewater and on-site soil profile. The parameters that should be given utmost consideration during land application are dissolved salts, suspended solids, nutrients like nitrogen and phosphorus, organic matter, cations like sodium and magnesium, and toxic substances. The important site conditions include the depth of the soil mantle, depth of ground water table, slope and permeability. The land based treatment of wastewater based on how it is applied over land can be classified as:

1. Slow rate (SR) method

2. Rapid infiltration (RI)

3. Overland Flow (OF)

Types of natural treatment systems
There are three basic types of natural treatment systems. Here we describe each type

Slow Rate Process
Slow rate (SR) land treatment is the controlled application of wastewater to vegetated land surface at a rate typically measured in terms of a few centimeters of liquid per week (see Figure 1).The design flow path depends on infiltration, percolation, and usually lateral flow within the boundaries of the treatment site.

Treatment occurs at the soil surface and as the wastewater percolates through the plant root-soil matrix. Depending on the specific system design, some to most of the water may be used by the vegetation, some may reach the groundwater, and some may be recovered for other beneficial uses. Off-site runoff of any of the applied wastewater is specifically avoided by the system design

The hydraulic pathways of the applied water can include:

- Vegetation irrigation with incremental percolation for salt leaching
- Some vegetative uptake with percolation the major pathway
- Percolation to under drains or wells for water recovery and reuse
- Percolation to groundwater and/or lateral subsurface flow to adjacent surface waters

Wastewater applications can be via ridge and furrow or border strip flood irrigation or with sprinklers using fixed nozzles or moving sprinkler systems. The selection of the application method is dependent on site conditions. The surface vegetation is an essential component in all SR systems.

Slow rate land treatment can be operated to achieve a number of objectives including:

- Treatment of the applied wastewater
- Economic return from the use of water and nutrients to produce marketable crops
- Exchange of wastewater for potable water for irrigation purposes in arid climates to achieve overall water conservation
- Development and preservation of open space and greenbelts

Q.4a.VOLUME REDUCTION METHODS FOR IW.

The first step in minimizing the effects of industrial wastes on receiving streams and treatment plants is to reduce the volume of such wastes.

This may be accomplished by:

(1)Classifying wastes;

(2)Conserving wastewater;

(3) Changing production to decrease wastes

(4) Reusing both industrial and municipal effluents as raw water supplies

(5) Eliminating batch or slug discharges of process wastes.

1. CLASSIFICATION OF WASTES

If wastes are classified so that manufacturing-process waters are separated from cooling waters, the volume of water requiring intensive treatment may be reduced considerably. Sometimes it is possible to classify and separate the process waters themselves so that only the most polluted ones are treated and the relatively uncontaminated ones are discharged without treatment. The three main classes of wastes are as follows:

1). WASTES FROM MANUFACTURING PROCESSES:

These include waters used in i. forming paper on traveling wire machines, ii. those expended from plating solutions in metal fabrication, and iii. those discharged from washing of milk cans in dairy plants, iv. dyeing and washing of textile fabrics, and; v. washing of picked fruits from canneries.

2). WATERS USED AS COOLING AGENTS IN INDUSTRIAL PROCESSES:

The volume of these wastes varies from one industry to another. Cooling waters have been found to be contaminated by small leaks, corrosion products, or the effect of heat; however, these wastes usually contain little, if any, process matter and are generally considered nonpollutional.

Power plants,

However, represent an industry in which cooling waters are segregated and account for a high percentage of total volume of plant wastes, and may contain hazardous contaminants under infrequent malfunctioning conditions.

3). WASTES FROM SANITARY USES:

These will normally range from 90 to 180 lit (25 to 50 gallons) per employee per day. The volume depends on many factors, 1. Including size of the plant, 2. Amount of waste-product materials washed from floors, and 3. The degree of cleanliness required of workers in the process operation.

2. CONSERVATION OF WASTEWATER

Water conservation is waste saved. Conservation begins when an industry changes from an “open” to a “closed” system.

Example:- A paper mill that recycles white water (i.e., water passing through a wire screen upon which paper is formed) and thus reduces the volume of wash waters it uses is practicing water conservation. Concentrated recycled wastewaters are often treated at the end of their period of usefulness, because usually it is impractical and uneconomical to treat the wastewaters as they complete each cycle. The savings are twofold: Water costs and waste-treatment costs are lower.

However, many changes to effect conservation are quite costly and their benefits must be balanced against the costs. If the net result is deemed economical, then new conservation practices can be installed with assurance.

E.g. :- Steel mills reuse cooling waters to quench ingots, and coal processors reuse water to remove dirt and other noncombustible materials from coal.

In materials science, quenching is the rapid cooling of a work piece to obtain certain material properties.

3. **CHANGING PRODUCTION TO DECREASE WASTES**

Changing production to decrease wastes is an effective method of controlling the volume of wastes but is difficult to put into practice.

It is hard to convince plant managers to change their operations just to eliminate wastes. Normally, the operational phase of engineering is planned by the chemical, mechanical, or industrial engineer whose primary objective is cost savings.

The main considerations of the environmental engineer, on the other hand, include the protection of public health and the conservation of a natural resource. Yet, there is no reason that both objectives cannot be achieved.

REUSING BOTH INDUSTRIAL AND MUNICIPAL EFFLUENTS FOR RAW WATER SUPPLIES

Practiced mainly in areas where water is scarce or expensive, reusing industrial and municipal effluents for raw water supplies is proving a popular and economical method of conservation; of all sources of water available to industry, sewage plant effluent is the most reliable at all seasons of the year and the only one source that is actually increasing in quantity and improving in quality.

ELIMINATION OF BATCH OR SLUG DISCHARGES OF PROCESS WASTES

In “wet” manufacturing of a product, one or more steps are sometimes repeated, which results in production of a significantly higher volume and strength of waste during that period. If this waste is discharged in a short period, it is usually referred to as a slug discharge.

There are at least two methods of reducing the effects of these discharges:

(1) The manufacturing firm can alter its practice to increase the frequency and lessen the magnitude of batch dischargers;

(2) Slug waste can be retained in holding basins from which they are allowed to flow continuously and uniformly over an extended (usually 24-hour) period. These are called proportioning and equalization (of slug wastes.

Q. 4b. <u>STRENGTH REDUCTION</u> method for industrial waste water.

Waste Strength Reduction •

It is a second major objective for an industry.

• Reduction in strength will achieve saving in treatment cost. (Sometimes due to limitations of hydraulic loading it may not save cost).

The strength of waste may be reduced by

1. Process changes

2. Equipment modification

3. Segregation of wastes

4. Equalization of wastes

5. By-product recovery

1. Process change: The waste problem of industry can be resolved by process change. e.g. In textile finishing starch is traditionally used as sizing agents before weaving. Replacing starch with carboxy-methyl cellulose can considerably reduce pollution (about 50% BOD reduction is possible). e.g. In metal plating to reduce cyanide pollution. • Change from copper- cyanide plating to acid-copper solution. • Replacing soluble oils and other short-term rust-preservative oils by cold cleaners.

2. **Equipment modification** Changes in equipment can effect a reduction in the strength of the waste by reducing waste- quantity. e.g., dairy milk cans by eliminating sharp corners and also installing drip pans to collect milk which drains from the cans after they have been emptied. e.g., placing traps on the discharge pipelines in poultry plants to prevent emission of feathers and pieces of fats. 3. Segregation of wastes: • Segregation reduces strength of waste and difficulty of treating. • Small volume of strong waste can be handled with methods specific to the problem it present. (e.g. InoTech Pharma, Bromine wastewater separation) •

Segregation results in two wastes (1) One strong with small volume.

(2) Other weaker with similar volume as non-segregated waste.

• **Segregation** of cooling waters from process waste will reduce size of the final treatment plant.

• Some waste like dye can be effectively treated when concentrated. Examples: separation of kiering (scouring) waste from other waste stream in textile industry is effective. In metal plating producing chromium and cyanide waste segregation is effective. • For cyanide waste make alkaline and oxidize • For chromium waste acidified and reduced • Then it can be combined and precipitated in alkaline solution to remove metal. Segregation may not always work- some time combining will be effective e.g. for neutralization/ equalization.

4. Equalization of wastes: ¾ holding of wastes for certain period of time to equalize when many products using different processes are produced. • The detention time of equalization basin will be for complete cycle time of process. • The effluent from equalization basin is much more consistent in its characteristics, than separate influent to the same basin. Stabilization of pH, BOD, SS and heavy metals can be achieved. • Sometimes no treatment may be required after equalization, e.g. when acidic and alkaline waste is a problem from the same industry. 5. by- product recovery:

• The use of waste material for by- product will reduce pollution load and generate revenue through byproducts. e.g. paper mills recovery of caustic soda from cooking liquors, methane recovery, sludge digestion and drying and fertilizer, etc.

• Black strap molasses from sugar to alcohol production

• sulphite waste liquor byproduct from paper mills used as fuel, road binder, insulating compound.

• Waste yeast from brewery as poultry food. • Dried and evaporated butter milk from milk plant used as chicken food. • In dairies materials collected on Oil and grease trap soap manufacturing

Q.5 a) Flow equalization and chemical **neutralization** and are two important components of water and wastewater treatment. Chemical **neutralization is** employed to balance the excess acidity or alkalinity in water, whereas flow **equalization is** a process of controlling flow velocity and flow composition.

S.No.	**Equalization**	**Neutralization**
	Flow equalization is used to minimize the variability of water and wastewater flow rates and composition. Each unit operation in a treatment train is designed for specific wastewater characteristics.	Neutralization is a common practice in wastewater treatment and waste stabilization. If a waste stream is found to be hazardous because of corrosivity, neutralization is the primary treatment used. Moreover, neutralization is used as a pretreatment system before a variety of biological, chemical, and physical treatment processes
	Improved efficiency and control are possible when all unit operations are carried out at uniform flow conditions.	Since many chemical treatment processes, such as metal precipitation, coagulation, phosphorus precipitation, and water softening are pH dependent, the pH of these processes is adjusted to achieve maximum process efficiency.
	Equalization improves sedimentation efficiency by improving hydraulic detention time. 2. The efficiency of a biological process can be increased because of uniform flow characteristics and minimization of the impact of shock loads and toxins during operation	Neutralization is the process of adjusting the pH of water through the addition of an acid or a base, depending on the target pH and process requirements. Some processes such as boiler operations and drinking water standards need neutral water at a pH of 7. Water or wastewater is generally considered adequately neutralized if (1) its damage to metals, concrete, or other materials is minimal; (2) it has little effect on fish and aquatic life; (3) it has no effect on biological matter (i.e., biological treatment systems) pH is the negative logarithm of the H+ ion activity in solution.
	Manual and automated control of flow-rate-dependent operations, such as chemical feeding, disinfection, and sludge pumping, are simplified.	Neutralization can be carried out in either batch or continuous mode. In batch mode, the effluent is retained until its quality meets specifications before release. Influent flow is relatively constant and sudden variations are not expected. • The influent flow characteristics are essentially constant. • Effluent chemistry is not very critical. An example is when the process is a part of

		multistage neutralization process.
	Treatability of the wastewater is improved and some BOD reduction and odor removal is provided if aeration is used for mixing in the equalization basin.	Neutralization tanks should be constructed with a corrosion-resistant material or should be lined to prevent corrosion.
	A point of return for recycling concentrated waste streams is provided, thereby mitigating shock loads to primary settlers or aeration basin. Mixing and Aeration Requirements.	Acidic wastes are neutralized either by adding lime alkalis or by adding sodium alkalis. The most commonly used lime alkalis are quicklime (CaO) and hydrated or slaked lime ($Ca(OH)_2$) (13–15). Sodium alkalis involve the use of caustic soda (NaOH) or soda ash (Na_2CO_3). Calcium and magnesium oxides are considerably less expensive than sodium alkalis and are used more widely used. For alkaline and acidic solution both it can be done.

health

3(c) Numerical

A town discharges 80 m³/sec of sewage into a stream having a rate of flow of 1200 m³/sec during lean days at a given tempr. 5 day BOD of sewage at given tempr is 250 mg/L. Find critical DO deficit & its location in the d/s stream portion of the stream.

Assume deoxyg. coeff k = 0.1 & coeff of self purifi → $f_s = 3.5$

Assume saturation DO at given tempr as 9.2 mg/L.

I/P: DO stream = 9.2 mg/L

DO effluent = 0

$$DO\ mix = \frac{9.2 \times 1200 + 0 \times 80}{1200 + 80} = 8.625\ mg/L$$

Initial DO deficit = D_0 = 9.2 − 8.625 = 0.575 mg/L

After 5 days BOD of the mix

$$y_5 = \frac{0 \times 1200 + 250 \times 80}{1200 + 80} = 15.625\ mg/L$$

papergrid

Date: / /

But $y_5 = L_0\{1-(10)^{-k\times5}\}$

$15.625 = L_0\{1-(10)^{-0.1\times5}\}$

$\boxed{L_0 = 22.85\ mg/L}$

$\therefore t_c = \frac{1}{K(f_s-1)}\log_{10}\left[f_s\left\{1-(f_s-1)\frac{D_0}{L_0}\right\}\right]$ — (1)

$\frac{1}{0.1\times(3.5-1)}\times\log_{10}\left[3.5\times\left\{1-(3.5-1)\times\frac{0.575}{22.85}\right\}\right]$

$= 2.063$ days.

$D_c = \frac{L_0}{f_s}(10)^{-k\cdot t_c} = \frac{22.85}{3.5}\times(10)^{-0.1\times2.063}$

$D_c = 4.06 mg/L$ ~~2.063 mg/L~~ 4.06 mg/L.

also $D_c = x_c = v\times t_c = 0.12\times(2.063\times24\times60\times60)\times10^{-3}$.

$\boxed{x_c = 21.39\ Km}$

Ans.