Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere – 577 004
Department of Civil Engineering

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Revised Academic Calendar of VTU, Belagavi for ODD Semester of 2020-21 (Tentative)

	I Sem B. E. / B. Tech. / B. Arch./B.Plan	I sem M.Tech./MBA /MCA/M.Arch.	III, V B. E. /B. Tech./B.Plan/ B.Arch & VII sem BPlan /BArch & IX Sem B. Arch.	VII Sem B. E. /B. Tech	III & V Sem MCA	III Sem MBA	III Sem M. Tech.	III Sem M. Arch.
Commencement of ODD Semester	14.12.2020	Will be announced later	01.09.2020	01.09.2020	01.09.2020	01.09.2020	01.09.2020	01.09.2020
Last Working day of ODD Semester	25.03.2021		16.01.2021	16.01.2021	16.01.2021	16.01.2021	16.01.2021	16.01.2021
Practical Examinations	29.03.2021 Onwards#		21.01.2021 Onwards#	21.01.2021 Onwards#	08.02.2021 Onwards#	--	21.01.2021 Onwards#	--
Theory Examinations	12.04.2021 To 30.04.2021		08.02.2021 To 27.03.2021	08.02.2021 To 27.03.2021	21.01.2021 To 06.02.2021	21.01.2021 To 19.02.2021	28.01.2021 To 13.02.2021	21.01.2021 To 06.02.2021
Internship			---	29.03.2021 To 10.04.2021	---	---	---	---
Internship Viva-Voce			---	---	---	---	15.02.2021 To 22.02.2021	---
Professional training / Organization study			---	---	---	22.02.2021 To 03.04.2021	---	---
Commencement of EVEN Semester	03.05.2021		29.03.2021	12.04.2021	15.02.2021	05.04.2021	23.02.2021	08.02.2021

NOTE:

- VII Semester B. E. / B. Tech. students shall have to undergo **Internship** as per circular of University **VTU/Aca/2019-20/85, dated 12.05.2020**.
- I Semester B. E/ B. Tech / B. Arch Students shall compulsorily undergo **Induction Program** for 01 Weeks.
- The classroom sessions for all the semesters would be in **ONLINE mode/blended mode** until further orders.
- The Institute needs to function for **six days** a week with additional hours (**Saturday is a full working day).**
- The faculty/staff shall be available to undertake any work assigned by the university.
- If any of the above dates are declared to be a holiday then the corresponding event will come into effect on the next working day.
- (#) Notification regarding the Calendar of Events relating to the conduct of **University Examinations** will be issued by the Registrar (Evaluation) from time to time.
- Academic Calendar may be modified based on guidelines/directions issued in the future by MHRD/UGC/AICTE/State Government.
- Revised Academic Calendar is also applicable for **Autonomous Colleges.**
- The MBA students are permitted to carry out **project work** in blended mode (ONLINE/OFFLINE). More emphasis on OFFLINE mode wherever feasible.

04.12.2020

REGISTRAR

Bapuji Institute of Engineering and Technology, Davangere-577004

CALENDER OF EVENTS - ODD SEMESTER: SEPTEMBER-JANUARY- 2020-21 (Tentative)

PARTICULARS	I sem BE/B.Tech	III, V BE/B.Tech	VII sem BE/B.Tech	III & V sem MCA	III sem MBA	III sem M.Tech
Commencement of ODD Sem	14-12-2020	01-09-2020	01-09-2020	01-09-2020	01-09-2020	01-09-2020
Last Working Day	25-03-2021	16-01-2021	16-01-2021	16-01-2021	16-01-2021	16-01-2021
1st CIE Series	——	19-10-2020 To 24-10-2020	19-10-2020 To 24-10-2020	19-10-2020 To 24-10-2020	15-10-2020 To 17-10-2020	19-10-2020 To 24-10-2020
2nd CIE Series	——	07-12-2020 To 09-12-2020	07-12-2020 To 09-12-2020	07-12-2020 To 09-12-2020	26-11-2020 To 28-11-2020	07-12-2020 To 09-12-2020
3rd CIE Series	——	11-01-2021 To 13-01-2021	11-01-2021 To 13-01-2021	11-01-2021 To 13-01-2021	7-01-2021 To 9-01-2021	11-01-2021 To 13-01-2021
Practical Examination	29-03-2021 Onwards #	21-01-2021 Onwards #	21-01-2021 Onwards #	08-02-2021 Onwards #	——	21-01-2021 Onwards #
Theory Examination	12-04-2021 To 30-04-2021	08-02-2021 To 27-03-2021	08-02-2021 To 27-03-2021	21-01-2021 To 06-02-2021	21-01-2021 To 19-02-2021	28-01-2021 To 13-02-2021
Internship	——	——	29-03-2021 To 10-04-2021	——	——	——
Internship Viva-Voce	——	——	——	——	——	15-02-2021 To 22-02-2021
Professional Training/Organization Study	——	——	——	——	22-02-2021 To 03-04-2021	——
Commencement of Even Semester	03-05-2021	29-03-2021	12-04-2021	15-02-2021	05-04-2021	23-02-2021

Notification regarding the calendar of events relating to the conduct of University Examination will be issued by the Registrar (Evaluation) from time to time.

Vision of BIET

To be a center of excellence recognized nationally and internationally, in distinctive areas of engineering education and research, based on a culture of innovation and invention.

Mission of BIET

BIET contributes to the growth and development of its students by imparting a broad based engineering education and empowering them to be successful in their chosen field by inculcating in them positive approach, leadership qualities and ethical values

VISION OF THE DEPARTMENT

To train the students to become Civil Engineers with leadership qualities, having ability to take up professional assignments and research with a focus on innovative approaches to cater to the needs of the society.

MISSION OF THE DEPARTMENT

1. To provide quality education through updated curriculum and conducive teaching learning environment for the students to excel in higher studies, competitive examinations and professional career.
2. To impart soft skills, leadership qualities and professional ethics among the graduates to handle the projects independently with confidence.
3. To deal with the contemporary issues and to cater to the socio-economic needs.
4. To build industry-institute interaction and to establish good rapport with alumni.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1: Core Competence: Graduates will be able to plan, analyse, design and construct sustainable Civil Engineering Infrastructure.

PEO 2: Professional Skills: Graduates will be professional engineers with a sense of ethics, creativity, leadership, self-confidence and independent thinking to cater to the needs of the society.

PEO 3: Societal Needs: Graduates will be able to contribute effectively for the development of industry and professional bodies.

PEO 4: Cognitive Intelligence: Graduates will be able to take up competitive examinations, higher studies and involve in research and entrepreneurship activities.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Students after the completion of the Program will be able to

1. Apply the fundamental concepts, software and codal provisions in the analysis, design and construction of sustainable civil engineering infrastructure.
2. Inculcate professional and leadership qualities, sense of ethics and confidence related to civil engineering.

Faculty will be able to

3. Contribute to the overall development of civil engineering community through the professional bodies and offer services to the society.

Name of the Faculty : Kum. Jyothi S H

Time / Day	8 – 9	9 – 10	10.30 – 11.30	11.30 – 12.30	2 – 3	3 – 4	4 – 5
Mon	17CV71 – B						
Tue			17CV561 – PS		18CVL38 – A3 (JSH + MNS)		
Wed		17CV561 – PS		17CV71 – B			
Thu		17CV71 – B		17CV561 – PS	17CVL58 – PS (JSH + SBP)		
Fri		17CV71 – B					
Sat		18CVL57 – B3 (NKS + JSH)					

Time Table Coordinator HOD Principal

Course Title: MUNICIPAL AND INDUSTRIAL WASTE WATER ENGINEERING

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VII

Subject Code	**17CV71**	**IA Marks**	**40**
Number of Lecture Hours/Week	**04**	**Exam Marks**	**60**
Total Number of Lecture Hours	**50**	**Exam Hours**	**03**
CREDITS –04		**Total Marks- 100**	

Course objectives: This course will enable students to:

4. Understand sewerage network and influencing parameters.
5. Understand and design different unit operations involved in conventional and biological treatment process.
6. Apply the principles of Industrial effluent treatment process for different industrial wastes.
7. Evaluate self purification of streams depending on hydraulic and organic loading of sewage into receiving waters.

Module -1

Introduction, need for sanitation, methods of sewage disposal, types of sewerage systems, dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system, estimation of storm flow, time of concentration flow, material of sewers, shape of sewers, laying and testing of sewers, ventilation of sewers. low-cost waste treatment: oxidation pond, septic tank, Sewer appurtenances, manholes, catch basins, basic principles of house drainage, typical layout plan showing house drainage connections.

L1,L2

Module -2

Design of sewers, hydraulic formula for velocity, effects of variation on velocity, regime velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions, disposal of effluents by dilution, self purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness, numerical problems on disposal of effluents, Streeter-Phelps equation

L2,L3

Module -3

Waste water characteristics, sampling, significance and techniques, physical, chemical and biological characteristics, flow diagram for municipal waste water treatment, unit operations: screens, grit chambers, skimming tanks, equalization tanks

Suspended growth and fixed film bio process, design of trickling filters, activated sludge process, sequential batch reactors, moving bed bio reactors, sludge digesters.

L1,L2,L3

Module -4

Difference between domestic and industrial waste water, effect of effluent discharge on streams, methods of industrial waste water treatment: volume reduction, strength reduction, neutralization, equalisation and proportioning, Removal of organic, inorganic and colloidal solids, combined treatment methods; merits, demerits and feasibility, principles of discharge of raw, partially treated and completely treated wastes in to streams

L1,L2

Module -5

Process flow chart, sources and characteristics of industrial waste water, treatment methods, reuse and recovery and disposal: cotton and textile industry, tanning industry, cane sugar and distilleries, dairy industry, steel and cement industry, paper and pulp industry, pharmaceutical and food processing industry.

L1,L2,L3

Course outcomes: After studying this course, students will be able to:

4. Acquires capability to design sewer and Sewerage treatment plant.
5. [illegible]

disposal of effluents, Streeter-Phelps equation

L2,L3

Module -3

Waste water characteristics, sampling, significance and techniques, physical, chemical and biological characteristics, flow diagram for municipal waste water treatment, unit operations: screens, grit chambers, skimming tanks, equalization tanks

Suspended growth and fixed film bio process, design of trickling filters, activated sludge process, sequential batch reactors, moving bed bio reactors, sludge digesters,

L1,L2,L3

Module -4

Difference between domestic and industrial waste water, effect of effluent discharge on streams, methods of industrial waste water treatment; volume reduction, strength reduction, neutralization, equalisation and proportioning. Removal of organic, inorganic and colloidal solids, combined treatment methods; merits, demerits and feasibility, principles of discharge of raw, partially treated and completely treated wastes in to streams

L1,L2

Module -5

Process flow chart, sources and characteristics of industrial waste water, treatment methods, reuse and recovery and disposal; cotton and textile industry, tanning industry, cane sugar and distilleries, dairy industry, steel and cement industry, paper and pulp industry, pharmaceutical and food processing industry.

L1,L2,L3

Course outcomes: After studying this course, students will be able to:

4. Acquires capability to design sewer and Sewerage treatment plant.
5. Evaluate degree of treatment and type of treatment for disposal, reuse and recycle.
6. Identify waste streams and design the industrial waste water treatment plant
7. Manage sewage and industrial effluent issues.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

Text Books:

1. Metcalf and Eddy, "Wastewater Engineering - Collection, Treatment, Disposal and Reuse", McGraw Hill Pub.Co., 2009.
2. Nelson Leonard Nemerow, "Industrial Waste Treatment", Butterworth-Heinemann, 2007.
3. Patwardhan A.D. "Industrial Waste Water Treatment", PHI Learning Private Limited-New Delhi
4. Hammer, M.J. and Hammer, M.J., "Water and Wastewater Technology", 7th Ed., Prentice Hall of India

Reference Books:

1. Manual on Waste Water Treatment: CPHEEO, Ministry of Urban Development, New Delhi
2. Fair, Geyer and Okun , "Water and Wastewater Engineering" Vol-II, John Willey Publishers, New York.

Course Title: DESIGN OF RCC AND STEEL STRUCTURES

As per Choice Based Credit System (CBCS) scheme]

SEMESTER:VII

Title & Code	Municipal and Industrial Waste Water Engineering (17CV71)
CO	**Statement**
17CV71.1	**Estimate** the factors affecting the design of sewers
17CV71.2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
17CV71.3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
17CV71.4	**Describe** the characteristics of sewage and industrial effluents
17CV71.5	**Describe** the combined issues of sewage and industrial effluents
17CV71.6	**Design** industrial waste water treatment plant

Course Title	Municipal & Industrial Waste Water Treatment											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
17CV71.1	2	2		1		2	2	1				2
17CV71.2	2	2	2	1		2	2	1				2
17CV71.3	2	2	2	1		2	2	1				2
17CV71.4	2	2		1		2	2	1				2
17CV71.5	2			1		2	2	1				2
17CV71.6	2	2	2	1		2	2	1				2
Average	2	2	2	1		2	2	1				2

CO	PSO1	PSO2
17CV71.1	2	2
17CV71.2	2	2
17CV71.3	2	2
17CV71.4	2	2
17CV71.5	2	2
17CV71.6	2	2
Average	2	2

LESSON PLAN

Subject: MIWWE   Subject Code: 17CV71   Class: 7th (B)

Period	Date	Topics Planned	Date	Topics Covered	Remarks
1	5/11/20	Introduction, need for sanitation. Methods of disposal	5/11/20	Introduction, Need for sanitation. Methods of disposal	
2	6/11/20	Types of sewerage system, Dry weather flow, wet weather flow	6/11/20	Types of sewerage system, Dry weather flow, wet weather flow	
3	9/11/20	Factors affecting DWF & WWF on design of sewerage system	9/11/20	Factors affecting DWF & WWF on design of sewerage system	
4	10/11/20	Estimation of storm flow time of concentration of flow	13/11/20	Estimation of storm flow time of concentration of flow	
5	13/11/20	Materials of sewers, shape of sewers, laying & testing of sewer	13/11/20	Materials of sewers, shape of sewage, laying & testing of sewer	
6	18/11/20	Ventilation of sewers low-cost waste treatment	18/11/20	Ventilation of sewers low-cost waste treatment	
7	19/11/20	Oxidation Pond, septic tank	19/11/20	oxidation pond, septic tank	
8	20/11/20	Sewer appurtenances, Manholes	20/11/20	Sewer appurtenances, Manholes	
9	23/11/20	Catch basins, basic Principle of house drainage	23/11/20	Catch basins, basic Principles of house drainage	
10	25/11/20	Typical Plan showing house drainage connection	25/11/20	Typical plan showing house drainage connections	
11	26/11/20	Module-2, Design of sewers, Hydraulic formula for velocity	26/11/20	Module-2, Design of sewers. Hydraulic formula for velocity	
12	27/11/20	Effects of variation on velocity Regime velocity	27/11/20	Effects of variation on velocity Regime velocity	
13	30/11/20	Design of hydraulic elements for circular sewers for full flow	30/11/20	Design of hydraulic elements for circular sewers for full flow	
14	2/12/20	and Partial Flow in circular sewers	2/12/20	and Partial Flow in circular sewers	
15	3/12/20	Disposal of effluents by dilution, self purification phenomenon	3/12/20	Disposal of effluents by dilution, self purification Phenomenon	
16	4/12/20	Oxygen sag curve, Zone of purification	4/12/20	Oxygen sag curve, Zone of purification	
17	[illegible]	Sewage farming, sewage	[illegible]	sewage farming, sewage	

LESSON PLAN

Subject: MIWWE   Subject Code: 17CV71   Class: 7th 'B'

Period	Date	Topics Planned	Date	Topics Covered	Remarks
18	11/12/20	Numerical problems on Disposal of effluents	11/12/20	Numerical problems on Disposal of effluents	
19	14/12/20	Design problems on sewers	14/12/20	Design problems on sewers	
20	16/12/20	Problems on Streeter Phelps equation	16/12/20	Problems on Streeter Phelps equation	
21	17/12/20	Module-3 Waste water characteristics, Sampling	17/12/20	Module-3 Waste water characteristics, Sampling	
22	18/12/20	Significance and technique of sampling	18/12/20	Significance & technique of sampling	
24	21/12/20	Physical & chemical characteristics	21/12/20	Physical & chemical characteristics	
25	23/12/20	Biological characteristics Flow diagram for MWWT	23/12/20	Biological characteristics Flow diagram for MWWT	
26	24/12/20	Unit operations; screens, grit chambers	24/12/20	unit operations; screens, grit chambers	
27	28/12/20	Skimming tank, equalization tank, suspended growth & fixed bio process	28/12/20	Skimming tank, equalization tank, suspended growth & fixed bio process	
28	30/12/20	Design of trickling filters, Activated sludge process,	30/12/20	Design of trickling filters, Activated sludge process.	
29	31/12/20	Sequential batch reactors Moving bed bio reactors	31/12/20	Sequential batch reactors moving bed bio reactors	
30	1/1/21	Sludge digesters & Numericals problems	1/1/21	Sludge digestion & Numerical problems	
31	4/1/21	Module-4 Difference b/n Domestic & Industrial waste water	4/1/21	Module-4 Difference b/n Domestic & Industrial waste water	
32	6/1/21	Effect of effluent discharge on streams.	6/1/21	effect of effluent discharge on streams	
33	7/1/21	Methods of Industrial waste water treatment: volume reduction	7/1/21	Methods of Industrial waste water treatment: volume reduction	
34	8/1/21	Neutralization, equalization & proportioning	8/1/21	Neutralization, equalization & proportioning	
[illegible]	[illegible]	Removal of [illegible]	[illegible]	Removal of organic [illegible]	

LESSON PLAN

Subject : m.JIAWE Subject Code : 17CV71 Class : 7th (B)

Period	Date	Topics Planned	Date	Topics Covered	Remarks
36	11/1/21	Colloidal solids Combined treatment Methods	11/1/21	Colloidal solids. Combined treatment Methods	
37	11/1/21	Merits, demerits & feasibility	11/1/21	Merits, demerits & feasibility	
38	11/1/21	Principle of discharge of Raw	11/1/21	Principle of discharge of Raw	
39	11/1/21	Partially treated waste to the streams	11/1/21	Partially treated waste to the streams	
40	12/1/21	Fully treated waste to the streams.	13/1/21	Fully treated waste to the streams	
41	12/1/21	Module-5 Process Flow chart, Sources	13/1/21	Module-5, Process Flow chart, Sources	
42	13/1/21	Characteristics of Industrial Waste Water	13/1/21	Characteristics of industrial waste water	
43	13/1/21	Treatment Methods, Reuse	13/1/21	Treatment Methods, Reuse	
44	15/1/21	Recovery and Disposal	15/1/21	Recovery & Disposal	
45	15/1/21	Cotton & textile Industry	15/1/21	Cotton & textile Industry	
46	15/1/21	Tanning industry, Cane sugar industry	15/1/21	Tanning industry, Cane sugar industry	
47	15/1/21	Distilleries, Dairy industries.	15/1/21	Distilleries, Dairy industries	
48	16/1/21	Steel & Cement industry	16/1/21	Steel & Cement industry	
49	16/1/21	Paper & Pulp industry	16/1/21	Paper & pulp industry	
50	16/1/21	Pharmaceutical & Food Processing industry	16/1/21	Pharmaceutical & Food Processing industry	[signature]

LESSON PLAN

Period	Date	Topics Planned	Date	Topics Covered	Remarks

Text Books :

1. Metcalf & Eddy "Waste water engineering"
2. WasteWater Engineering Dr. B.C Punmia

Reference Books :

1. "Waste Water Treatment" M.N Rao, A.K Datta
2.
3.
4.
5.

[signature]

Class: 7th 'B' Subject Code: 17CV71 Subject: Municipal & industrial waste water engg. Total No. of Classes:

Sl No.	USN 4BD	NAME	5/11/20	6/11/20	9/11/20	11/11/20	12/11/20	13/11/20	18/11/20	19/11/20	20/11/20	23/11/20	25/11/20
1	15CV064	Md. Shahnawaz aminbhavi	1	2	3	A	4	5	6	7	8	A	A
2	15CV098	Sharath M	1	2	3	A	4	5	6	7	A	8	A
3	16CV040	Karthick G.S	1	2	3	A	A	5	6	7	8	9	10
4	16CV064	Nithin S	1	2	3	A	A	4	5	6	7	A	A
5	16CV098	Shivu R.S	1	2	3	4	A	5	6	7	8	A	9
6	16CV131	Prajwal S	1	2	3	4	5	6	7	8	9	10	11
7	17CV434	Yekanth P Emmiganar	1	2	3	4	5	6	7	8	9	10	11
8	17CV420	Ranjan K.P	1	2	A	A	3	4	5	6	7	8	9
9	17CV410	Irshad Ahmed Bhavikatti	1	2	3	4	A	5	6	7	A	8	9
10	17CV006	Anil Raj	1	2	3	4	5	6	7	8	9	10	A
11	17CV008	Anusha. A. Doddamani	1	2	3	4	5	6	7	8	9	10	A
12	010	Apeksha B.U	1	2	03	4	5	6	7	8	9	10	11
13	012	Adif Ahemed Nizami	1	2	3	4	5	6	A	A	A	7	8
14	014	Bharath K.A	A	1	2	3	4	5	A	6	7	8	A
15	016	Bharghav G.T	A	1	2	3	4	5	6	7	8	9	A
16	018	Bindushree R	1	2	3	4	5	6	7	8	9	A	10
17	020	Chetan N.G	1	2	3	4	5	6	7	8	A	A	9
18	022	Chetana M.P	1	2	3	4	5	6	7	8	9	10	A
19	024	Darshankumar M.H	1	2	3	4	5	6	7	8	9	10	11
20	026	Divya H	1	2	3	4	5	6	7	8	9	10	11
21	028	Ganavi K.V	1	2	3	4	5	6	7	8	9	10	11
22	030	Gaurav R	1	2	3	4	5	6	7	8	9	10	11
23	032	Harini K.P	1	2	3	4	5	6	A	A	7	8	9
24	034	Hdehraj R Kapler	A	A	A	2	3	4	5	6	7	8	9
25	036	Jayalakshmi. V	1	2	3	4	5	6	7	8	9	10	11
26	038	Kashish V Parmar	1	2	3	4	5	6	A	A	7	8	A
27	042	Kushaal. K.B	1	2	3	4	5	6	A	7	8	A	9
28	046	Mallikarjun G Kugar	A	A	A	1	2	3	4	5	6	7	8
29	048	Manjula M.G	1	2	3	4	5	A	6	7	8	9	A
30	050	Manoj M	1	2	3	4	5	6	7	8	9	10	11
31	056	Nandeesh K.N	1	2	3	4	5	6	7	8	9	10	11
		Initials of Teacher											

Sl No.	26/11/20	27/11/20	30/11/20	[illegible]	2/12/20	3/12/20	4/12/20	10/12/20	11/12/20	14/12/20	15/12/20	17/12/20	18/12/20	21/12/20	22/12/20	24/12/20	28/12/20	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
1	9	10	11	0	12	13	14	15	16	17	18	19	20	21	22	23	24	35	87	10	10	10	5	15
2	9	10	11	5	A	12	13	14	15	16	17	18	19	20	21	22	A	35	87	26	26	26	10	38 48
3	A	11	12	6	A	A	13	14	15	16	17	A	A	18	19	20	21	32	80	24	24	24	10	34
4	8	9	10	3	11	12	13	14	15	A	A	16	17	18	A	A	19	32	80	27	28	28	10	33
5	10	A	11	4	12	A	13	14	A	15	16	17	18	19	20	21	22	35	87	24	25	27	9	35
6	12	A	13	9	A	14	15	16	17	A	18	19	20	A	A	21	22	35	87	26	24	28	10	36
7	A	12	13	9	A	14	15	16	17	A	18	19	20	A	A	21	22	34	85	29	27	30	10	36-18
8	10	A	11	2	12	A	13	14	15	16	17	18	19	20	A	21	22	35	85	15	15	15	3	18
9	A	10	11		12	A	13	14	15	16	17	18	19	20	A	21	22	35	85	15	15	15	3	18
10	11	A	12		A	13	14	15	16	17	18	19	20	21	A	A	22	35	85	23	24	24	9	33
11	11	12	13	4	14	15	16	17	18	19	20	21	22	23	24	25	26	37	92	28	29	27	10	38
12	A	A	10	12	13	14	15	16	17	18	19	20	21	22	23	24	A	35	85	28	29	27	10	38
13	A	10	11		12	13	14	15	16	17	18	A	A	19	20	21	22	35	87	26	22	24	10	34
14	9	10	11	11	12	13	14	15	A	16	17	A	18	19	A	A	20	32	80	26	24	28	10	37
15	10	11	12		13	14	15	16	A	17	18	A	19	20	A	A	21	34	85	29	26	24	10	35
16	11	12	13	5	14	15	A	16	17	18	19	20	21	22	A	23	24	35	87	25	26	26	10	36
17	10	11	A	3	12	13	14	15	16	17	18	19	20	21	A	22	23	34	85	26	26	24	9	35
18	11	12	13	13	14	15	16	17	18	19	20	21	22	23	24	A	A	35	87	27	26	27	10	37
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21	12	A	13	1	14	15	16	17	18	19	20	A	21	A	A	22	23	34	85	24	20	24	10	33
22	12	13	A	5	14	15	16	17	18	19	20	21	22	23	24	A	A	34	85	27	23	25	10	35
23	10	11	12	13	13	14	15	16	17	18	19	A	20	21	22	A	A	35	87	28	24	26	10	36
24	10	11	12	12	13	14	15	16	17	18	19	20	A	21	A	22	23	36	90	28	27	26	10	37
25	12	13	13	9	14	15	16	17	18	19	20	21	22	23	24	25	26	39	97	27	25	26	10	36
26	9	10	11		12	13	14	15	16	17	18	19	20	21	22	23	24	36	90	25	27	28	9	36
27	10	A	11	11	12	A	13	14	15	A	A	16	17	18	19	20	21	34	85	26	24	28	9	36
28	9	10	11		12	A	13	14	A	15	16	17	18	A	A	19	20	34	85	29	29	29	8	37
29	10	11	12	5	13	A	14	15	16	17	18	19	20	21	22	23	24	37	92	29	27	27	10	38
30	12	13	14	2	15	16	17	18	19	20	21	22	A	A	23	24	25	34	85	27	23	23	10	35
31	12	13	14	10	15	16	17	18	19	20	21	22	A	A	23	24	25	35	87	29	20	28	10	30
Initials of Teacher																								

Class : 7th B   Subject Code : 17CV71   Subject : Municipal & Industrial Waste Water Engineering   Total No. of Classes :

Sl No.	USN 4BD	NAME	5/11/20	6/11/20	9/11/20	11/11/20	12/11/20	13/11/20	18/11/20	19/11/20	20/11/20	23/11/20	25/11/20	26/11/20	27/11/20	30/11/20	2/12/20	3/12/20	4/12/20	10/12/20	11/12/20	14/12/20	16/12/20	17/12/20	18/12/20	21/12/20	23/12/20	24/12/20	28/12/20	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
32	17CV058	Nandini G.L	1	2	3	4	A	A	5	6	7	8	9	10	11	12	13	14	16	16	A	17	18	19	20	21	22	23	A	34	85	24	24	24	10	34
33	060	Nihal Raj G.J	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	A	A	20	21	22	23	24	25	35	87	25	20	24	10	33
34	062	Nisha Y Shet	1	2	3	4	5	6	7	8	9	10	A	11	12	13	14	15	16	17	18	19	A	A	20	21	22	23	24	35	87	29	28	28	9	38
35	064	NVV Sathyanarayana	1	2	3	4	A	A	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	37	92	24	26	24	10	35
36	066	Pavithra E.G	1	2	3	4	5	A	6	7	8	9	10	11	12	13	14	15	16	A	17	18	19	20	21	22	23	24	25	36	90	24	24	28	10	36
37	068	Pooja K.G	1	2	3	4	5	6	A	7	8	9	A	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	34	85	28	28	28	10	38
38	072	Rahul K.S	1	2	3	4	5	6	7	A	8	9	10	A	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	35	87	24	25	27	9	35
39	074	Rakesh A.C	1	2	3	4	5	6	7	8	A	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	A	24	34	85	26	26	24	10	36
40	076	Rakshitha A.M	1	2	3	4	6	6	7	8	9	10	A	11	12	A	13	14	15	16	17	18	19	20	21	22	23	A	24	34	85	26	27	28	10	37
41	078	Rakshitha Y J N	1	2	3	4	5	6	7	8	9	10	11	A	12	13	14	15	16	17	18	19	20	21	22	23	24	25	A	36	90	26	25	28	10	37
42	082	Sahana K	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	16	17	18	19	20	21	22	23	24	25	26	35	87	26	26	27	10	37
43	084	Sai Pratheek K.S	1	2	3	A	A	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	A	20	21	22	23	24	34	85	24	24	26	8	35
44	086	Sandeep R.H	1	2	3	4	5	6	7	A	8	9	A	10	11	12	13	14	15	16	17	18	19	A	20	21	22	23	24	34	85	26	28	24	10	36
45	090	Shankar T R	1	2	3	4	5	6	A	A	7	8	9	10	11	12	13	14	15	16	17	18	19	20	A	21	22	23	24	34	85	25	26	25	8	34
46	092	Shashikumara M	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	39	97	28	28	28	10	38
47	094	Shreenidhi S.V	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	37	92	26	22	24	10	34
48	096	Siddaraju R.Y	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	37	92	20	24	24	10	33
49	098	Suhas J.S	1	2	3	4	5	6	7	8	9	10	11	12	13	A	14	15	16	17	18	19	20	21	22	23	24	25	26	34	85	26	28	26	10	37
50	104	Tejas V	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	A	16	17	18	19	20	21	22	23	A	24	33	85	27	24	25	10	36
51	108	Varsha V Arekal	1	2	3	4	5	6	7	8	9	10	11	12	13	14	A	15	16	17	18	19	20	21	22	23	24	25	26	34	85	27	22	28	10	36
52	110	Varshitha S	4	2	3	4	5	A	A	6	7	8	9	10	11	12	13	14	15	16	17	18	A	19	20	21	22	23	A	34	85	26	25	26	10	36
53	112	Vignesh M	1	A	A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	34	85	25	27	24	10	36
54	114	Vinay C J	1	2	3	4	5	6	7	8	9	10	11	12	19	20	A	A	21	22	23	24	25	26	27	A	A	28	29	38	95	26	27	25	10	36
55	118	Yashavanth	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	A	A	34	85	24	28	27	10	37
56	120	Monica R.S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	A	34	85	28	24	24	09	35
57	18CV400	Ajay B.M	1	2	3	4	5	6	7	8	9	10	11	12	13	14	A	A	15	16	17	18	19	20	21	22	23	24	25	34	85	26	24	24	10	35
58	401	Akash U	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	A	A	23	24	25	36	90	27	26	27	10	36
59	402	Athish M Berkar	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	A	23	24	25	26	37	92	25	24	25	10	35
60	404	Devaraj Aloor	1	2	3	4	5	6	7	8	9	10	11	12	13	A	14	15	16	17	18	19	20	21	22	23	24	25	A	35	87	27	25	22	10	35
61	406	H Vijayakumar	1	2	3	4	5	6	7	8	9	10	11	12	13	14	A	15	16	17	18	19	20	21	22	23	24	25	A	34	85	27	24	23	10	35
62	407	Halesh P	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	22	23	24	25	26	34	85	27	27	25	9	36
		Initials of Teacher																																		
		Initials of H.O.D.																																		

Class: Subject Code: Subject: Total No. of Classes: 40

Sl No.	USN 4BD	NAME	5/11/20	6/11/20	9/11/20	11/11/20	12/11/20	13/11/20	18/11/20	19/11/20	20/11/20	23/11/20	25/11/20	26/11/20	27/11/20	30/11/20	2/12/20	3/12/20	4/12/20	10/12/20	11/12/20	14/12/20	16/12/20	17/12/20	18/12/20	21/12/20	23/12/20	24/12/20	28/12/20	No. of Days Present	%	Test Marks I	Test Marks II	Test Marks III	Average	Remarks
63	18CV410	Kotresh H.S	1	2	3	4	5	6	7	8	9	10	11	12	13	A	14	15	16	17	18	19	20	A	21	22	A	23	24	34	85	24	22	24	10	34
64	411	Krishna NT	1	A	A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	22	23	24	33	83	28	26	26	10	37
65	412	Lohith S	1	2	3	4	5	6	7	8	A	A	9	10	11	12	13	14	15	16	17	18	A	A	19	20	21	22	23	34	85	25	24	24	10	35
66	414	Manjunath B	1	2	3	4	5	6	7	A	A	8	9	10	11	12	A	13	14	15	16	17	18	A	A	19	20	21	22	32	83	29	24	25	10	36
67	415	Manjunath K.C	1	A	A	2	3	4	5	6	7	8	9	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	34	85	26	25	26	10	36
68	416	Mohammed Aftab	1	A	A	A	2	3	4	5	6	7	8	9	10	11	12	13	14	15	A	A	A	16	17	18	19	20	21	34	85	26	22	24	10	34
69	418	Niranjan B	1	2	3	4	5	6	7	8	A	A	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	A	35	87	25	26	24	10	35
70	422	Ranjith Kotlad	1	2	3	4	5	6	A	7	A	A	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	35	87	26	22	24	10	34
71	424	Sagar A.M	1	2	3	4	5	6	A	A	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	A	A	22	23	36	90	27	26	24	9	35
72	425	Shankar S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	A	A	A	23	24	34	85	20	22	27	10	33
73	426	Srikanth Gowda Patil S	1	2	3	4	5	6	7	8	9	10	11	12	A	A	13	14	15	16	17	18	19	20	21	22	A	23	24	35	87	25	26	26	10	36

Initials of Teacher

Initials of H.O.D.

Module - 1

Need for Sanitation :

* Every Community produces both liquid & solid wastes
* If Proper arrangements for the collection, treatment & disposal are not made they Will go on accumulating & create foul condition

Importance of Sanitation

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Module 1 ;

Definations

1) Refuse ; This is the most general term to indicate the waste which include all the rejects left as worthless, Sewage - Sullage all comes under this

2) Garbage ; It's a Dry refuse which includes waste papers, sweeping from streets and markets, vegetable peelings etc. Per day usually 14 to 24 kg grarbage will be produced in our country.

3) Rubbish ; Sundry wastes from residencies, offices and other buildings broken furniture, Paper rags etc. are included in this usually these are combustible.

4) Sullage ; It is the discharge from bathrooms, Kitchens, wash basins etc. it does not include discharge from the lavatories, hospitals, operation theaters slaughter houses which has high organic matter.

5) Sewage ; It is a diluted mixture of the wastes of various types from the residential, public and industrial places. It includes sullage water and foul discharge from the water closets, urinals, hospitals, stables, etc.

6) Storm Water ; It is the surface runoff obtained during and after the rainfall which enters sewers through inlet. storm water is not foul as sewage and hence it can be carried in the open drains and can be disposed off in the natural rivers without any difficulty

①

Sanitary Sewage : It is the sewage obtained from the residential buildings & industrial effluents establish-ments. being extremely foul it should be carried through underground conduits.

Domestic sewage : It is the sewage obtained from the lavatory basins, urinals & water closets of houses, offices. & institutions It is highly foul on account of night soil and urine contained in it. Night soil starts putrefying & gives offensive smell. it may contain large amount of bacteria due to the excremental wastes of patients this sewage requires great handling & disposal

Industrial sewage : It consists of spent water from industries and commercial areas. the degree of foulness depends on the nature of industry concerned & processes involved.

Sewers : Sewers are underground pipes which carry the sewage to a point of disposal

Sewerage : the entire system of collecting, carrying & disposal of sewage through sewers is known as sewerage.

Bacteria : These are microscopic organisms.

* Aerobic bacteria : oxygen & light for their survival
* Anaerobic bacteria : do not required free oxygen and Light for survival.
* Facultative bacteria : they can exist in the presence or absence of oxygen they grow more in absence of air

(9) **Methods of domestic Waste water (Sewage) disposal** (9)

After Waste water is treated it is disposed in the nature in the following 2 principal methods.

a) Disposal by Dilution where large receiving water bodies are available.

b) Land disposal where sufficient land is available

Sanitary engineering starts at the point where water supply engineering ends.

Waste

- Dry
  - Rubbish
  - Ashes
  - Garbage
- Semi liquid
  - Human Excreta / Night soil
  - Hospital & Slaughter house waste
- Liquid
  - Sullage
  - Sewage
  - Storm Water

Sewage Disposal:

- Natural Method
  - Dilution into Water
  - Land treatment
- Artifical Method
  - Primary treatment
  - Secondary treatment

Disposal by Dilution:

* Suitable for the areas situated near large rivers or sea.
* Disposal of sewage by discharging into water courses such as streams rivers or water bodies etc.
* The sewage to be disposed off may be raw or partially treated
* While discharging sewage in water body it should be ascertained that water is not polluted to such an extent that it becomes unfit for any other uses.
* The sewage in due course of time, gets purified automatically by the self purification capacity of water
* The quantity of pure natural water required for the process of self purification should be about 6-14 times the volume of the sewage disposed
* Diluting water must be rich in oxygen content for dilution
* Diluting waters are not become a source of water supply for at least some distance from the point of disposal

③ Land treatment : (3)

* Raw sewage or partly treated sewage is evenly spread on the surface of land
* Water treatmen' in the sewage percolates in the ground and suspended solids remains at the surface on the ground.

Advantage :

* Adds manure to the ground
* Increases fertility of land
* Water pollution is reduced

Disadvantage :

* Additional land is required
* If land is made up of heavy sticky and fine grained soil, its voids get chocked and may create nuisance.
* Sanitary reasons may not permit growing of crops on sewage farms

Disposal can be done with 3 Methods

* Collection Works
* Treatment Works
* Disposal Works

Collection Works:

Consists of collecting all types of waste products of town Refuse is collected separately

* Method of collection depends on the Funds available
* House to house collection is by far the best method
* People are expected to dump the refuse in the nearest public bin.
* ~~Actually~~ Collection methods normally practised in this country need drastic revision & improvement in the interest of better hygiene
* Municipalities & other local bodies should arrange for collection of refuse
* Open refuse cart should be abandoned and replaced by enclosed vans.
* Mechanical transport should be used wherever possible as it is more practical & economical than the 19th century methods
* There is a wide variety of refuse collection vehicles of all shapes & sizes

(4) Treatment Works :

Sewage treatment is the process of removing contaminants from waste water and house hold sewage. both effluents and domestic. It includes physical, chemical, & biological processes to remove physical chemical and biological contaminants.

* Treatment is required to treat the sewage before disposal so that it may not pollute the atmosphere & the water body in which it will be disposed of.
* Type of treatment processes depend on the nature of the waste water characteristics. & hygiene, aesthetics & economical aspects.
* Treated water is disposed of in various ways by irrigating fields or discharging in to natural water courses.

Different Methods of Domestic Waste Water disposal

1) old conservancy system
2) Modern water carriage system.

Old conservancy system:

* It is called dry system * out of date system but is
  Prevailing in small towns & villages
* Various types of refuse & storm water are collected conveyed
  & disposed of separately
* Garbage is collected in dustbins placed along the roads from
  where it is conveyed by trucks once or twice a day to the
  point of disposal.
* All the non combustible portion of garbage such as sand dust
  clay etc are used for filling the low level areas to reclaim
  land for the future development of the town.
* The combustible portion of the garbage is burnt.
* The decaying matters are dried & disposed of by burning or
  the manufacture of manure.
* Human excreta are collected separately in conservancy latrins.
* The liquid & semi liquid wastes are collected separately after
  removal of night soil it is taken outside the town in
  trucks & buried in trenches.
* After 2-3 years the buried night soil is converted into excellent
  manure
* In conservancy system Sullage and storm water are carried
  separately in closed drains to the point of disposal where
  they are allowed to mix the river water without treatment

⑤ Modern Water Carriage System

* With development and advancement of the cities urgent
need was felt to replace Conservancy system with some
more improved type of system in which human agency
should not be used for the collection & conveyance of
sewage
* After large number of experiments it was found that the
water is the only cheapest substance which can be easily
used for the collection & conveyance of sewage,
* As in this system water is the main substance therefore
it is called as Modern water carriage system.
* In this system the excremental matter is mixed up in
large quantity of water their are taken out from the city
through properly designed sewerage system, where they
are disposed of after necessary treatment in a satisfactory
manner
* The sewages so formed in water carriage system consists of
99.9% of water & 0.1% solids. All these solids remain
in suspension & do not changes the specific gravity of
water therefore all the hydraulic formulae can be directly
used in the design of sewerage system & treatment plants

CONSERVENCY SYSTEM	WATER CARRIAGE SYSTEM
* Very cheap in initial cost	* It involves high initial cost.
* Due to foul smells from the latrines, they are to be constructed away from living room so building cannot be constructed as compact units	* As there is no foul smell latrines remain clean & neat & hence are constructed with rooms, therefore buildings may be compact
* The aesthetic appearance of the city can't be improved	* Good aesthetic appearance of city can be obtained

* For burial of excremental matter large area is required	Less Area is required as compared to conservancy system
* Excreta are not removed immediately hence its decomposition starts before removal, causing nuisance smell.	* Excreta are removed immediately with water, no problem of foul smell or hygienic trouble
* This system is fully depended on human agency in case of	* As no human agency is involved in this system, there is no such problems as in case of conservacy system.

Types of Sewerage System

1. Separate system of sewage
2. Combined system of sewage
3. Partially combined or Partially separate system.

1. Separate System of Sewerage:

In this system 2 sets of sewers are laid the sanitary sewage is carried through sanitary sewers while the storm sewage is carried through storm sewers the sewage is carried to the treatment plant & storm water is disposed of to the river.

Advantages:

* Size of the sewers are small
* Sewage load on treatment unit is less
* Rivers are not polluted
* Storm water can be discharged to rivers without treatment.

⑥ Disadvantage;

* Sewerage being small, difficulty in cleaning them.
* Frequent choking problem will be their
* System proves costly as it involves two sets of sewers
* The use of storm sewer is only partial because in dry season the will be converted in to dumping places & may get clogged.

Combined System of Sewage;

When only one set of sewers are used to carry both sanitary sewage & surface water. this system is called combined system.

Sewage and storm water both are carried to the treatment plant through combined sewers.

Advantages: * Size of the sewers being large, chocking problems are less and easy to clean
* It proves economical as one set of sewers are laid
* Because of dilution of sanitary sewage with storm water nuisance potential is reduced

Disadvantages;

* Size of the sewers being large, difficulty in handling & transportation
* Load on treatment plant is unnecessarily increased
* It is uneconomical if pumping is needed because of large amount of combined flow
* unnessarily storm water is polluted

Partially Combined or Partially Separate System:

A Portion of Storm water during rain is allowed to enter sanitary sewer to treatment plants while the remaining storm water is carried through open drains to the point of disposal

Advantages:

* The sizes of sewers are not very large as some portion of storm water is carried through open drains.
* combines the advantages of both the previous system
* Silting problem is completely eliminated

Disadvantages: * During dry weather, the velocity of flow may be low

* The storm water is unnecessary put load on to the treatment plants to extend
* Pumping of storm water is unneccessary over-load on the pumps.

Suitable conditions for separate sewerage systems:-

* Where rainfall is uneven
* Where sanitary sewage is to be pumped
* The drainage area is steep, allowing to runoff quickly
* Sewers are to be constructed in rocky strata. The large combined sewers would be more expensive.

(7) Suitable Conditions for Combined System:

* Rainfall in even throughout the year
* Both the Sanitary Sewage and the Storm water have to be pumped
* The area to be sewered is heavily build up & space for laying 2 sets of pipes is not enough
* Effective or quicker flows have to be provided.

After Studying the advantages & disadvantages of both the systems, present day construction of sewers is largely confined to the separate systems except in those cities where combined system already exists. In places where rainfall is confined to one season of the year, like India and even in temperature regions, Separate systems are most suitable

Separate System	Combined System
* The quantity of Sewage to be treated is less because no treatment of storm water is done	* As the treatments of both are done the treatment is costly
* In the cities of more rainfall this system is more suitable	* In the cities of less rainfall this system is suitable
* As two sets of Sewer lines are to laid, this system is	* Overall construction cost is higher than separate system
* In narrow streets, it is difficult to use this system	* It is more suitable in narrow streets
* less degree of sanitation is achieved in this system, as storm water is disposed without treatment	* High degree of sanitation is achieved in this system

Dry Weather Flow (DWF);

Domestic sewage and industrial sewage collectively called as DWF. It does not contain storm water. It indicates the normal flow during dry season of the year

Wet Weather Flow (WWF):

Domestic sewage, an industrial sewage and storm water collectively called as WWF. It indicates the maximum flow of sewage during wet season

Factors Affecting DDF;

The DWF or the quantity of sanitary sewage depends upon the following factors:

* Rate of Water Supply
* Population growth
* Type of area served
* Infiltration of ground water

Rate of Water Supply;

The rate of water supply to a city or town is expressed so many litres/capita/day The quantity of waste water entering the sewer would be less than the total quantity of water supplied this is because of the fact that water is lost in domestic consumption, evaporation, lawn sprinkling, fire fighting, industrial consumption. However private source of water supply & infiltration of subsoil water in the sewers increase the waste water flow rate

⑧ This extra water that enters the sewers can be assumed to ⑧
approximately equal to the water lost in consumption etc. Due to
this reason, the waste water flow rate may be assumed equal to
the rate of water supply by the Muncipal authorities. the sewers
should be designed for a minimum of 150 litres per capita/day

Population growth; The quantity of sanitary sewage directly depends on the population. as the population increases the quantity of sanitary sewage also increases. the quantity of water supply is equal to the rate of supply multiplied of population. The sewage quantity which will be produced in the town due to future developments of the town and population should be taken into account & as far as possible accurate results should be obtained.

Type of area served;
The quantity of sanitary sewage also depends on the type of area to be served whether it is residential, industrial or commercial. the quantity of sewage produced in residential areas directly depends on the quantity of water supply to the area the quantity is obtained by multiplying the population with this factor. The quantity of sewage produced by various industries depends on their various industrial processes. and it is different for each industry this quantity can be determined by doing a survey of that area & collecting the data.

Infiltration of ground water; ground water or sub-soil water may infiltrate into the sewers through the leaky joints. ex-filtration is the reverse process which indicated the flow of waste water from the sewer into the ground while due to infiltration the quantity of flow through sewer increases, ex-filtration results in decrease in the flow & consequent increase in the pollution of ground water. both infiltration as well as ex-filtration are undesirable and take place due to imperfect joints. Infiltration unnecessarily increases the load on the treatment works

Quantity of Storm Water Flow;

When rain falls over the ground surface, a part of it percolates into the ground, a part is evaporated in the atmosphere and the remaining part overflows as storm water. this quantity of storm water is verly large as compared with sanitary sewage.

Factors affecting Storm Water:-

Factors affecting the quantity of storm water;

* Rainfall intensity and duration
* Area of the catchment
* Slope & shape of the catchment area
* Nature of the soil & the degree of porosity
* Initial state of the catchment.

If rainfall intensity & duration is more, large will be quantity of storm water available will be less.

Harder surface yield more runoff than soft, rough surfaces. Greater the catchment area greater will be the amount of storm water. Fan shaped & steep areas contribute more quantity of storm water. ~~Fan shaped & steep area~~ In addition to the above it also depends on the temp. humidity, wind etc.

Estimate ~~the~~ quantity of Storm Water;

* Rational Method
* Empirical formulae Method.

In both the above methods, the quantity of storm water is a function of the area, the intensity of rainfall & co-efficient of runoff

Rational Method: Runoff from an area can be determined by the Rational Method. the method gives a reasonable estimate upto a maximum area of 50ha (0.5 Km^2).

As every locality consists of different types of surface area, therefore for calculating the overall runoff coefficient the following formula is used

$$C = \frac{A_1C_1 + A_2C_2 + \ldots + A_nC_n}{A_1 + A_2 + \ldots + A_n}$$

C = Runoff coefficient
A_1 A_2 A_3 = Areas
C_1, C_2, C_3 = runoff coefficient

Emphirical formulas for rainfall intensities
given by British ministry of health is given by;

$$i = \frac{760}{t+10} \quad \text{(For storm duration of 5 to 20 min)}$$

$$i = \frac{1020}{t+10} \quad \text{(For storm duration of 20 to 100 min)}$$

i = Intensity of rainfall, mm/h & t = duration of storm, min

Time of concentration of flow;

The time taken for the maximum runoff rate of develop, is known as the time of concentration, & is equal to the time required for a drop of water to run from the farthest point of time required for a drop of water to run from the farthest point of the watershed to the point for which the runoff is to be calculated.

The time of concentration, t_c, of a watershed is often defined to be the time required for a parcel of runoff to travel from the most hydraulically distant part of a watershed to the outlet. It is not possible to point to a particular point on a watershed & say. the time of concentration is measured from this point. Neither is it possible to measure the time of concentration. Intead, the concept of t_c is useful for describing the time response of a watershed to a driving impulse, namely that of watershed runoff.

In the context of the rational method then, t_c represents the time at which all areas of the watershed that will contribute runoff are just contributing runoff to the outlet. That is, at t_c the watershed is fully contributing. We choose to use this time to select the rainfall intensity for application of the rational method. If the chosen storm duration

⑧ Assumptions and limitations;

* precipitation is uniform over the entire basin
* Precipitation does not vary with time or space.
* Storm duration is equal to the time of concentration
* A design storm of a specified frequency produces a design flood of the same frequency
* The basin area increases roughly in proportion to increases in length
* The time of concentration is relatively short and independent of storm intensity. the runoff coefficient does not vary with storm intensity or antecedent soil moisture
* Runoff is dominated by overland flow
* Basin storage effects are negligible
* The minimum duration to be used for computation of rainfall
intensity is 10 minutes if the time of concentration computed for
the drainage area is less than 10 minutes, then 10 minutes should
be adopted for rainfall intensity computations.

This method is mostly used in determining the quantity of
storm water. the storm water quantity is determined by the
rational formula:

$$Q = \frac{CiA}{360}$$

Where, Q = quantity of storm water in m³/sec
C = Coefficient of runoff
i = intensity of rainfall
A = area of drainage in hectare

Runoff co-efficient :

In rational method, the value of runoff co-efficient, C is
required. the whole quantity of rain water that fall over the ground
does not reach the sewer line. A portion of it percolates in the
ground, a portion evaporates, a portion is stored in ponds &
ditches and only remaining portion of rainwater reaches the
sewer line. the runoff coefficient depends mainly on characteristics
of ground surface as porosity, wetness, ground cover etc., which
varies from 0.01 for forest or wooded area to 0.95 for
a water tight roof surfaces

Time of Concentration is made up of inlet time (over land flow) & channel flow time.

Time of entry (inlet time or overland flow):
is the time required for water to reach a defined channel such
as a street gutter, plus the gutter flow in time to the inlet

Channel flow time: is the time of flow through the sewers to the
point at which rate of flow is being assessed The channel flow
time can be estimated is then determined as the flow length
divided by the average velocity.

The inlet time is affected by numerous factors, such as
rainfall intensity, surface slope, surface roughness, flow distance
infiltration capacity, & depression storage Because of this, accurate
values are difficult to obtain design inlet flow times of from
5 to 30 min are used in practice.

Estimating time of Concentration:
There are many methods for estimating t_c, In fact
just abt every hydrologist or engineer has a favourite method. All
methods for estimating t_c are empirical, that is, each is based on
the analysis of one or more datasets. The methods are not, in general
based on theoretical fluid mechanics for application of the
rational method, TXDOT recommends that t_c be less than 300 min (5hr)
& greater than 10min other agencies require that t_c be greater than
5 minutes the concept is that estimates of i become unacceptably
large for duration less than 5 or 10 minutes for long durations
the assumption of a relatively steady rainfall rate is less valid

Morgali & Linsley Method

For small urban areas with drainage areas less than ten or twenty acres, & for which the drainage is basically planar, the method developed by morgali & linsley (1965) is useful it is expressed as

$$t_c = \frac{0.94\,(nL)^{0.6}}{(i)^{0.4}\,S^{0.3}}$$

t_c = time of concentration (min)
i = design rainfall intensity (in/hr)
n = Manning surface roughness (dimensionless)

Kirpich Method ;

For small drainage basins that are dominated by channel flow,

$$t_c = 0.0078\,(L^3/h)^{0.385}$$

t_c = time of concentration (min)
L = length of main channel (ft)
h = relief along main channel (ft)

limited to watershed with a drainage area of about 200 acres

Kerby Hatheway Method ;

For small watersheds where overland flow is an important component, but the assumptions inherent in the Morgali & Linsley approach are not appropriate then the Kerby (1959)

$$t_c = (0.67\,NL/\sqrt{S})^{0.467}$$

Where : t_c = time of concentration (min)
N = Kerby roughness parameter (dimensionless)
S = overland flow slope (dimensionless)

Materials of Sewers; Type of Material of Sewers.

1) Asbestos cement
2) Bricks
3) Cast iron
4) Cement concrete plain or reinforced
5) Corrugated iron sewers
6) Stoneware sewers
7) Steel sewers
8) Plastic sewers
9) Wooden sewers.

(1) Asbestos Cement Sewers:

* These are manufactured from a mixture of asbestos, fibres, silica & cement asbestos fibers are thoroughly mixed with cement to act as reinforcement.
* These pipes are available in size 10 to 100cm internal diameter and length up to 4.0m
* These pipes can be easily assembled without skilled labour with the help of special coupling, called Ring Tie coupling or simplex joint
* The pipe and joints are resistant to corrosion & the joints are flexible to permit 12° deflection for curved laying
* These pipes are used for vertical transport of water for example transport of rain water from roofs in multi storeyed buildings, for transport of sewage to grounds & for transport of less foul sullage i.e, waste water from kitchen & bathroom.

Advantages

* Pipes are light in weight & hence, easy to carry & transport
* Easy to cut & assemble without skilled labour
* Interior is smooth (Manning n = 0.011) can make excellent hydraulically efficient sewer

Disadvantages

* These pipes are structurally not very strong
* These are susceptible to corrosion by sulphuric acid, when bacteria produce H_2S, in presence of water, H_2SO_4 can be formed

Bricks Sewers;

Bricks sewers are made it site. they are used for construction of large size. sewers. now a day's bricks sewers are replaced by concrete sewers because lot of labour is involved in the construction of brick sewers. this material is used for construction of large size combined sewer or particularly for storm water drains. The pipes are plastered from outside to avoid entry of tree roots and ground water through brick joints. these are lined from inside with stone ware or ceramic block to make them smooth & hydraulically efficient. lining also make the pipe resistant to corrosion.

Cast Iron sewers :

These pipes are stronger & capable to withstand greater tensile, compressive, as well as bending stresses. however these are costly cast iron pipes are used for outfall sewers, rising main of of pumping stations, & inverted siphons, where pipes are running under pressure. these are also suitable for sewers under heavy traffic load, such as sewers below railways & highways. They are used for carried over piers in case of low lying areas. They form 100% leak proof sewer line to avoid ground water contamination they are less resistant to corrosion hence generally lined from inside the cement concrete, coal tar paint, epoxy etc. these are joined together by bell & spigot joint.

Plain Cement Concrete or Reinforced Cement concrete: Plain cement concrete (1:1.5:3) pipes are available up to 0.45m diameter & reinforcement cement pipes are available upto 1.8m diameter. These pipes can be cast in situ or precast pipes. Precast pipes are better in quality than the cast in situ pipes. The reinforcement in these pipes can be different such as single cage reinforced pipes used for internal pressure less than 0.8m double cage reinforced pipes used for both internal & external pressure greater than 0.8m

(13) double cage reinforced pipes used for both internal & external pressure greater than 0.8m ; elliptical cage reinforced pipes used for larger diameter sewers subjected to external pressure : & hume pipes with steel shells coated with concrete from inside & outside. Nominal longitudinal reinforcement of 0.25% is provided in these pipes.

Advantages of concrete Pipes ;

* Strong in tension as well as compression.
* Resistant to erosion & abrasion
* They can be made of any desired strength
* Easily moulded, and can be in situ or precast pipes.
* Economical for medium and large sizes
* These pipes are available in wide range of side & the trench can be opened & backfilled rapidly during maintenance of sewers

Disadvantages ;

* These pipes can get corroded and pitted by the action of H_2SO_4
* The carrying capacity of the pipe reduces with time because of corrosion.
* These pipes are susceptible to erosion by sewage containing silt and grit.

The concrete sewers can be protected by internally by vitrified clay linings. with protection lining they are used for almost all the branch and main sewers. only high alumina cement concrete should be used when pipes are exposed to corrosive liquid like sewage.

Corrugated Iron Sewers: corrugated iron sewers are used for storm sewers. The sewers should be protected from the effects of corrosion by galvanization or by bituminous coatings. They are made in varying metal thickness and in diameters upto 450cm

Plastic Sewers: [PVC pipes]; Plastic is recent material used for sewer pipes. These are used for internal drainge works in house. These are available in sizes 75 to 315 mm external diameter & used in drainage works. they offer smooth internal surface. The additional advantages they offer are resistant to corrosion, light weight of pipe, economical in laying, jointing & maintenance, the pipe is tough & rigid, and ease in fabrication & transport of these pipes.

High Density Polyethylene (HDPE) pipes: use of these pipes for sewers is recent development they are not brittle like AC pipes & other pipes and hence hard fall during loading, unloading & handling do not cause any damage to the pipes. They can be joined by welding or can be jointed with detachable joints upto 630mm diameter (IS: 4984 - 1987) these are commonly used for conveyance of industrial wastewater. They offer all the advantages offered by PVC pipes

Steel Sewers; These sewers are used where lightness, imperviousness & resistance to high pressure are the prime requirements. these sewers are flexible & can absorb vibrations & shocks efficiently. These are mainly used for trunk or outfall sewers. Riveting should, as far as possible be avoided. These are used under the situations such as pressure main sewers, under water crossing, bridge crossing, necessary connections for pumping stations, laying

Pipes over self supporting spans railway crossings etc. They can withstand internal pressure, impact load and vibrations much better than CI pipes. They are more ductile and can withstand water hammer pressure better. These pipes cannot withstand high external load & these pipes may collapse when negative pressure is developed in pipes. They are susceptible to corrosion & are not generally used for partially flowing sewers. They are protected internally & externally against the action of corrosion.

Vitrified Clay or Stoneware Sewers:

These pipes are used for house connections as well as lateral sewers. The size of the pipe available is 5cm to 30cm internal diameter with length 0.9 to 1.2m. These pipes are rarely manufactured for diameter greater than 90cm. These are joined by bell & spigot flexible compression joints.

Advantages:

* Resistant to corrosion, hence fit for carrying polluted water such as sewage.
* Interior surface is smooth & is hydraulically efficient.
* The pipes are highly impervious
* Strong in compression.
* These pipes are durable & economical for small diameters
* The pipe material does not absorb water more than 5% of their own weight when immersed in water for 24 hour

Disadvantages:

* Heavy, bulky & brittle & hence, difficult to transport
* These pipes cannot be used as pressure pipes, because they are weak in tension.
* These require large number of joints as the individual pipe length is small

According to the Shape:

- ☆ Box or rectangular Sewers
- ☆ Egg shaped or avoid sewers
- ☆ Basket-handle Sections
- ☆ Horse shoe sewers
- ☆ Parabolic sewers
- ☆ Semi-circular sewers
- ☆ Semi-elliptical sewers
- ☆ U-Shaped sewers

Elliptical cage reinforced pipes used for larger diameter sewers subjected to external pressure; and hume pipes with steel shells coated with concrete from inside & outside. Nominal longitudinal reinforcement of 0.25% is provided in these pipes.

Advantages of Concrete Pipes:

* Strong in tensions as well as compression
* Resistant to erosion & abrasion
* They can be made of any desired strength
* Easily moulded, and can be in situ or precast pipes.
* Economical for medium & large sizes.
* These pipes are available in wide range of size & the trench can be opened & backfilled rapidly during maintanance of sewers.

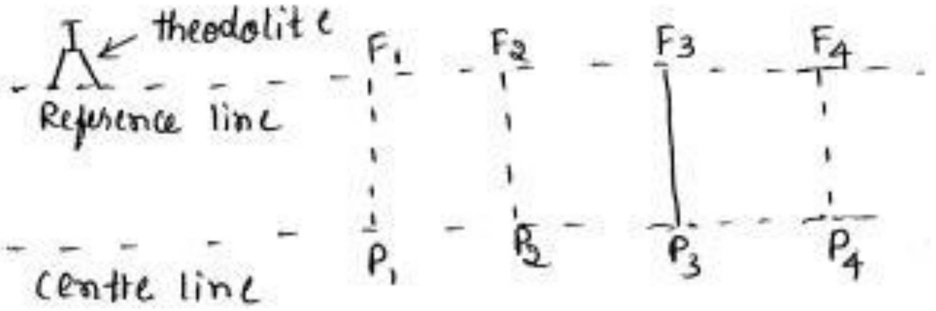
Disadvantages:

* These pipes can get corroded & pitted by the action of H_2SO_4
* The carrying capacity of the pipe reduces with time because of corrosion
* The pipes are susceptible to erosion by sewage containing silt & grit

Laying of Sewer pipes;

1. Marking of the Alignment

The center line of the sewer is marked along the road with a theodolite & invert tap. It may be marked either by reference line or With the help of straight rail the position of the manhole is also marked.



2. Excavation of Trench

After marking the centre line of the sewer, the excavation of trench is started. The excavation may be carried out either by Manual labour or by Machines like Power shovels, tracts excavators etc. The width of the trench at the bottom is generally kept 15cm more than the dia of sewer pipe. At the point of sewer joint, the width of the trench is made 60 cm for a length of 60cm the invert level is fixed by boning rod.

3. Timbering of the trench.

When, in ordinary soil, the depth of excavation is more than 2m, timber bracing or sheet piling is provided on both sides of the trench so that it may not collapse. the extent of timbering required depends upon the type of soil & the depth of excavation

4. Dewatering of trench;

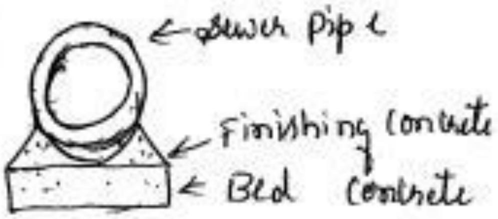
If water is met with during excavation, it is removed by pumping or any other suitable method.

Preparation of Sub-grade:

For soft soil, the bed of the sewer is prepared by plain concrete (1:3:6) the thickness of concrete varies from 15 to 20cm the bedding layer is not required in case of rocky of hard soil

Laying & joining of pipes:

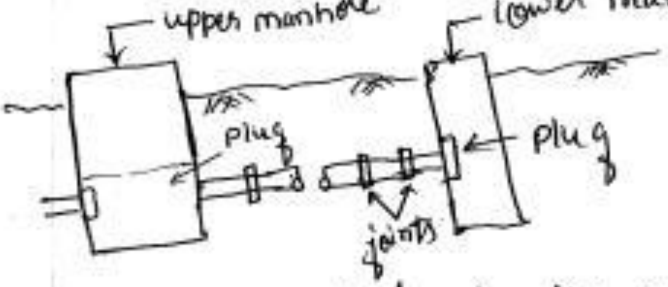
The sewers are laid along the trench very carefully then the joining of the sewer is done as per requirements. after joining both sides of the pipe are finished with concrete.



Testing of Leakage:

The leakage in the pipe joints or any other points is tested by water test or air test

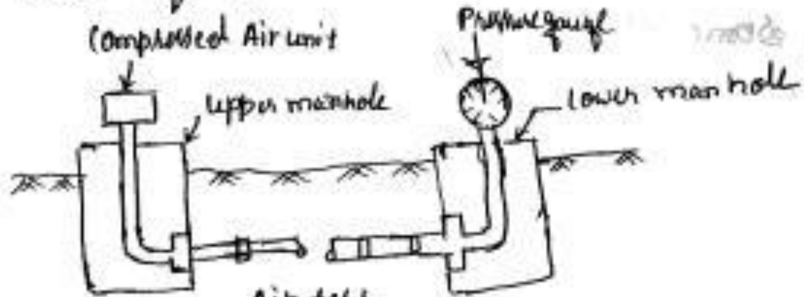
Water test: this test is carried out between 2 manholes. The lower end of the sewer line is provided with a plug and the upper is kept open. In the manhole at the upper end, water is filled in & it is allowed to flow through the sewer line



The depth of water in the upper manhole is maintained at about 150cm. the water is allowed to stay in the sewer for a weeks. Then the sewer line is inspected to detect the leakage by observing any sweating. if the leakage is detected it is rectified immediately.

Air Test :

This test is carried out for large diameter pipe. In this method, the pipe ends of both the manholes are plugged. An air compressor is connected to the plug of upper manhole & pressure gauge is attached with the plug of the lower manhole. The pressure is given in the pipeline by an air compressor & the amount of pressure is recorded in the pressure gauge



Air test

It is left for a few hours, If the pressure drops below the permissible limit then it is an indication of leakage. The exact point of leakage is found out by applying soap solution which will show bubbles at the point of leakage. If the leakage is detected it is rectified immediately.

Testing of Straightness of alignment & obstruction.

The straightness of the sewer pipe and the presence of any obstruction are tested by placing a mirror at one end of the sewer & a lamp at the other end. If the pipe line is straight, the full circle of light will be observed.

The presence of an obstruction in the pipe can also be tested by inserting a smooth ball at the upper end of the sewer. the dia of the ball is 13mm less than the internal diameter of the sewer. If there is no obstruction inside the sewer the ball shall roll down & reach the lower end of the sewer

Back filling

lastly the trenches are filled up with the excavated earth in layers of about 15cm thick. Each layer is properly watered & rammed.

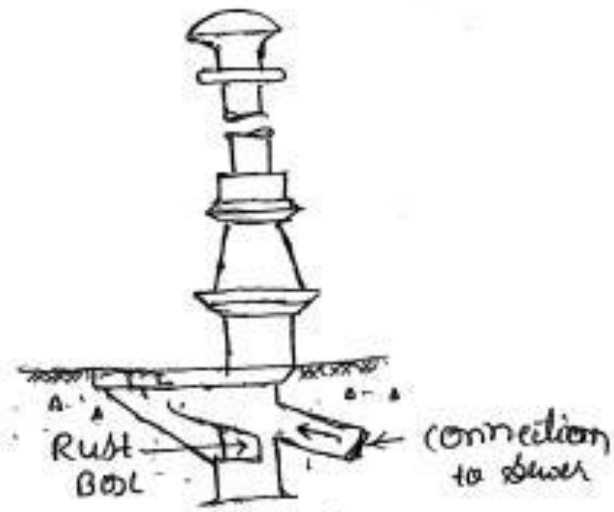
Ventilation of Sewer:

Sewage flowing in Sewers has got lot of organic & inorganic matters present in it. Some of the matters decompose & produce gases. these gases are foul smelling, corrosive & explosive in nature. If these gases are not disposed of properly they may create a number of difficulties. They may cause air locks in sewers & affect the flow of sewage. they may prove to be dangerous for the maintenance squard working in sewers. They may also cause explosion & put the sewer line out of commission. for the disposal of these gases, ventilation of sewer line is a must.

Methods of ventilation

Some of means or fittings which help in the ventilation of sewers,

1. Laying sewer line at proper gradient
2. Running the sewer at half full or 2/3 depth
3. Providing manhole with gratings.
4. Proper house drainage
5. Providing the ventilating columns or shafts



Ventilation column

TO determine dry weather Flow (DWF)

Total quantity of water supplied = q = ~~200×5000~~

= Water supplied/day × Population

$$= \frac{200 \times 50{,}000}{24 \times 60 \times 60} = 115.74 \text{ lit/sec}$$

$$q = \frac{115.74}{1000} = 0.116 \text{ m}^3/\text{sec}$$

But 75% of total water supplied will reach sewer as wastewater (DWF);

∴ Dry Weather Flow (DWF) = 0.116 × 0.75 = 0.087 m³/sec

) TO Determine Wet weather Flow (WWF);

WWF can be computed from Rational Formula

$$Q = \frac{AIR}{360}$$

A = 40 ha

I = 0.3

R = ?

R (Rainfall intensity) can be computed by general Formula:

$$R = \frac{25.4 \times a}{t + b}$$

Here, a = 30, b = 10, for t = 5 to 20 min

a = 40, b = 20, for t = 20 to 100 min

$$\therefore R = \frac{25.4 \times 40}{50 + 20} = 14.5 \text{ mm/hr}$$

Now, Wet weather Flow, $WWF = \frac{AIR}{360} = \frac{40 \times 0.3 \times 14.5}{360}$

WWF = 0.484 m³/sec

Finally;

Total Sewage Quantity Q = WWF + (2 × DWF)

= 0.484 + (2 × 0.087)

Q = 0.658 m³/sec

20/11/2020

is larger than t_c, then the rainfall intensity will be less than that at t_c therefore the peak discharge estimated using the rational method will be less than that at ~~t_c, therefore the peak at~~ the optimal value. If the chosen storm duration is less than t_c, then the watershed is not fully contributing runoff to the outlet for that storm length & the optimal value will ~~be~~ not be realized. therefore we choose the storm length to be equal to t_c for use in estimating peak discharges using the rational Method.

The time of concentration refers to the time at which the whole area just contributes runoff to a point

$$t_C = t_e + t_f$$

Where, t_c = time of concentration

t_e = time of entry to the inlet (usually taken as 5-10 min)

t_f = time of flow in the sewer [After problem]

Dry Weather Flow;

1) A certain part of a city has a projected population of 50,000 residing over an area of 40 hectares. find the design discharge for the sewer line for the following data:

* Rate of water supply 200 lpcd
* Average impermeability coefficient for entire area = 0.3
* Time of concentration = 50 min

The sewer lines is to be designed for a flow equivalent flow of wet weather Flow + twice the dry weather Flow. Assume that 75% of water supply to reach the sewer as wastewater

Given; Population = 50,000

Area = 40 ha

I = 0.3

t_c = 50 min

Rate of water supply = 200 lpcd

Q = ?

(11)

2) Calculate the quantity of sewage for separate & partially separate systems for a town given the following data:

i) Area of the town = 250 hectares
ii) Intensity of Rainfall = 50 mm/hr
iii) Population Density = 300 persons/hectares
iv) Rate of water supply = 250 lpcd
Peak factor = 2.0

Type of Surface	% Area	Impermeability coefficient
Roofs	50 %	0.9
Paved surface	20 %	0.85
Non-Paved Surface	30 %	0.30

Assume 80 % of the total water supplied reaches the sewer

Given; Population Density = 300 persons/ha
Area = 250 ha
R = 50 mm/hr
Rate of water supply = 250 lpcd
Peak factor = 2.0
C = ? Q = ?

i) To Determine DWF

Population = Population Density x Total area

Population = 300 x 250 = 75,000

Total quantity of water supplied $= q = \frac{250 \times 75,000}{24 \times 60 \times 60}$

$= 217.01$ lit/sec

Therefore, $q = \frac{217.01}{1000} = 0.217$ m³/sec

But 80% of total water supplied will reach sewer as waste water (DWF) :

(80%)

$$q = 0.217 \times 0.80 = 0.174 \ m^3/sec$$

Considering peak discharge factor = 2.0

Dry Weather Flow (DWF) = $2 \times 0.174 = 0.348 \ m^3/sec$

ii) To determine wet weather flow (WWF) ;

WWF can be computed from Rational formula,

$$Q = \frac{AIR}{360}$$

here, A = 250 ha
R = 50 mm/hr
I = ?

When total catchment Area is having different surfaces then Average impermeability factor 'I' can be calculated as :

$$\text{Average Impermeability factor } I = \frac{A_1I_1 + A_2I_2 + A_3I_3 \cdots + A_nI_n}{A_1 + A_2 + A_3 \cdots + A_n}$$

$$= \frac{\Sigma AI}{\Sigma A}$$

A_1 = 50% of 250 = 125 ha
A_2 = 20% of 250 = 50 ha
A_3 = 30% of 250 = 75 ha

$$\therefore I = \frac{(125 \times 0.9) + (50 \times 0.85) + (75 \times 0.3)}{125 + 50 + 75} = \frac{177.5}{250} = 0.71$$

$$WWF = \frac{AIR}{360} = \frac{250 \times 0.71 \times 50}{360} = 24.65 \ m^3/sec$$

Total sewage quantity,

$$Q = WWF + DWF = 24.65 + 0.348 = 24.998 \ m^3/sec$$

$$Q = 25.0 \ m^3/sec$$

Unit - 2

Design of sewers, hydraulic formula for velocity, effects of variation on velocity, regime velocity, design of hydraulic elements for circular sewers for full flow and partial flow conditions, disposal of effluents by dilution, self purification phenomenon, oxygen sag curve, Zones of purification, sewage farming, sewage sickness, numericals on disposal of effluents, streeter - phelps equation.

Introduction ;

The sewarage scheme is designed to remove entire sewage effectively and efficiently from the houses to the point of treatment & disposal

Following aspects should be considered while designing the system ;

* The sewer provided should be adequate in size to avoid overflow and possible health hazards
* For evaluating proper diameter of the sewer, correct estimation of sewage discharge is necessary
* The flow velocity inside the sewer should neither be so large as to require heavy excavation & high lift pumping nor should be ~~laid at least 2 to 3m deep to carry~~ so small causing deposition of the solid in the sewers
* The sewers should be laid at least 2 to 3m deep to carry sewage from basement.
* The sewage in sewer should flow under gravity with 0.5 to 0.8 full at designed discharge i.e at the maximum estimated discharge.
* The sewage is conveyed to the point usually located in low - lying area. where the treatment plant is located
* Treatment of plant should be designed taking into consideration the quality of raw sewage expected & to meet the discharge standards.

Water Supply Pipes	Sewer Pipes
* It carries pure water	* It carries contaminated water containing organic or inorganic solids which may settle in the pipe it can cause Cossosion of the pipe material
* Velocity higher than self-cleansing is not essential, because of solids are not present in suspension	* To avoid deposition of solids in the pipes self-cleansing velocity is necessary at all possible discharge.
* It carries water under pressure. Hence the pipe can be laid up & down the hills & the valleys within certain limits	* It carries sewage under gravity therefore it is required to be laid at a continuous falling gradient in the downward direction towards outfall point
* These pipes are flowing full under pressure	* Sewers are design to run partial full at maximum discharge this extra space ensures non-pressure gravity flow. this will minimize the leakage from sewer. from the faulty joints or chacks, if any

Net quantity of Sewage = Accounted quantity of water supplied from the water works + Addition due to unaccounted private water supplies + Addition due to infiltration − Subtraction due to water losses − Subtraction due to Non entering the Sewerage System

Design Period :

The Future period for which the provision is made in designing the capacities of the various components of the sewagage scheme is known as the design period. The design period depends upon the following :

* Ease and difficulty in expansion
* Amount and availability of investment
* Anticipated rate of population growth, including shifts in communities, industries and commercial investments.
* Hydraulic constraints of the systems designed, and
- Life of the material & equipment

Following design period can be considered for different components of sewerage scheme.

1. Laterals less than 15cm diameter : Full development
2. Trunk or main sewers : 40 to 50 years
3. Treatment units : 15 to 20 years
4. Pumping Plant : 5 to 10 years

Variations in Sewage Flow:

The sewage flow, like the water supply flow is not constant in practice but varies. The fluctuation may, in a similar way, be seasonal or monthly, daily and hourly

Variation occurs in the flow of sewage over annual average daily flow. Fluctuation in flow occurs from hour to hour and from season to season. The typical hourly variation in the sewage flow is shown in the figure. If the flow is gauged near its origin the peak flow will be quite pronounced the peak will deper if the sewage has to travel long distance this is because of the time required in travelling as sewage flow in sewer lines more and more sewage is mixed in it due to continuous increase in the area being served by the sewer line.

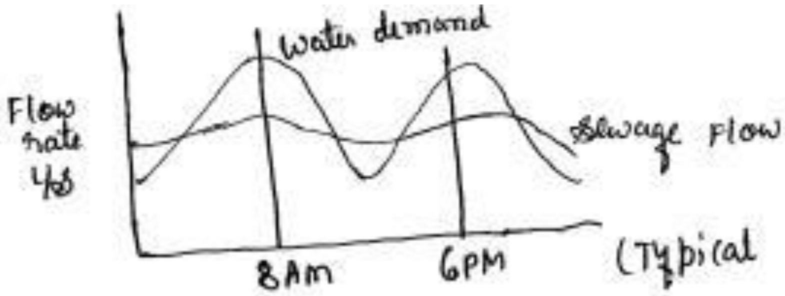
this leads to reduction in the fluctuations in the sewage Flow & the lag period goes on increasing The magnitude of variation in the sewage quantity varies from place to place and it is very difficult to predict for smaller township this variation will be more pronounced due to lower length and travel time before sewage reach to the main sewer & for large cities this variation will be less.

The seasonal variations are due to climatic effect. more water being used in summer than in winter. The daily fluctuations are the outcome of certain local conditions, involving habits and customs of people. Thus in U.S.A & other european countries Monday is the washing day as such amount of sewage flow would be much greater than on any other day. In India, however sundays or other holidays involve like activities which permit greater use of water hourly variations are because of varying rates of water consumption in different hours of the day.

The first peak flow generally occurs in the late morning it is usually about 200 percent of the average flow while the second peak flow generally occurs in the early evening between 6 & 9 p.m & the minimum flow occurring during the night after twelve or early hours of the morning is generally about half of the average Flow.

Importance : The maximum & minimum rates of sewage flow are controlling factors in the design of sewers. the sewer must have ample capacity to carry the maximum flow & also to ensure sufficient velocity to produce the self cleaning which would be available in case of minimum flow.

③



(Typical hourly variation in sewage flow)

Effects of Flow variation on velocity in a Sewer:

Due to variation in discharge the depth of flow varies, & hence the hydraulic mean depth (r) varies due to the change in the hydraulic mean depth, the flow velocity (which depends directly on $r^{2/3}$) gets affected from time to time it is necessary to check the sewer for maintaining a minimum velocity of about 0.45 m/s at the time of minimum flow (assumed to be 1/3rd of average flow) The designer should also ensure that a velocity of 0.9 m/s is developed at least at the time of maximum flow and preferably during the average flow periods also. moreover, care should be taken to see that the time of maximum flow. the velocity general does not exceed the scouring value.

Estimate of Sanitary Sewage:

Sanitary sewage is mostly the spent water of the community draining into the sewer system with some ground water & a fraction into the sewer with some ground water & a fraction of the storm runoff from the area, draining into it, The sewers should be capable of receiving the expected discharged at the end of design period. The provision however should not be much in excess of the actual discharge in the early years of its use to avoid depositions in sewers. The estimate of flow therefore requires a very carefully consideration & is based upon the contributory population & the per-capita flow of sewage, both the factors being guided by the design period.

Design Period :

Since it is both difficult & uneconomical to augment the capacity of the system at a later date, sewers are usually designed for the maximum expected discharge to meet the requirements of the ultimate development of the area

A design period of 30 years for all types of sewers is recommended.

The future period for which the provision is made in designing the capacities of the various components of the sewerage scheme is known as the design period. The design period depends upon the following.

* Ease & difficulty in expansion
* Amount & availability of investment
* Anticipated rate of population growth, including shifts in communities industries & commercial investments.
* Hydraulic constraints of the system designed &
* Life of the material & equipment.

Following design period can be considered for different components of sewarage scheme.

1. Laterals less than 15cm diameter : Full development
2.

Shield =

$$v = \sqrt{\left(\frac{8k}{f}\right)\left(\frac{s_s - s}{s}\right) g d}$$

1) Chezy's formula

$$v = C\sqrt{RS}$$

$$C = \frac{\left[23 + \left[\frac{0.00155}{S}\right] + \left(\frac{1}{n}\right)\right]}{\left[1 + \left(23 + \left(\frac{0.00155}{S}\right)\right)\left(\frac{n}{\sqrt{R}}\right)\right]}$$

2) Manning's Formula

$$v = \left(\frac{1}{n}\right) R^{2/3} S^{1/2}$$

3) Gimp's & Burge's formula

$$v = 83.33\, R^{2/3} S^{1/2}$$

4) Bazin's Formula :

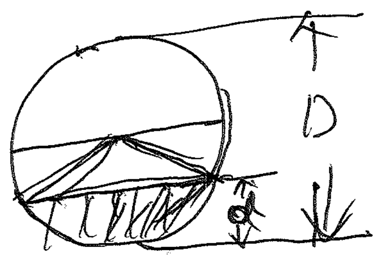
$$v = \frac{157.6\sqrt{RS}}{1.81 + \left(\frac{K}{\sqrt{R}}\right)}$$

Hazen - Williams formula

$$V = 0.85\, C R^{0.06}\, S^{0.54}$$

$$HMD = R = \frac{A}{P} = \frac{\text{Area}}{\text{Perimeter}}$$

$$R = D/4$$



Depth of Partial flow

$$d = \left[\frac{D}{2} - \frac{D}{2}\cos\left(\frac{\alpha}{2}\right)\right]$$

$$d = D\left[\frac{1}{2} - \frac{1}{2}\cos\left(\frac{\alpha}{2}\right)\right]$$

$$\frac{d}{D} = \frac{1}{2}\left[1 - \cos\left(\frac{\alpha}{2}\right)\right]$$

Area

$$\frac{a}{A} = \left[\frac{\alpha}{360} - \frac{\sin\alpha}{2\pi}\right]$$

$$\frac{p}{P} = \frac{\alpha}{360}$$

④

Self Cleansing Velocity:

It is necessary to Maintain a minimum velocity in a Sewer line to ensure that suspended settliable solids do not deposit to cause choking problems such a minimum velocity is called self cleansing velocity

It is determined by considering particle size & specific weight of suspended solids in sewage

Shield formula:

$$V_s = \sqrt{\frac{8K}{f}\left[\frac{S_s - S}{S}\right] g d} \longrightarrow (1)$$

f = Darcy's Coefficient of friction = 0.03

K = Characteristics of the solids

K = 0.04 for inorganic solids

K = 0.06 for organic solids

S_s = Specific gravity of Particles [2.65 generally]

S = Specific gravity of Sewage [1.0 generally]

g = Acceleration due to gravity = m/sec²

d = diameter of the particle in 'm'

$$V_s = \frac{1}{n} R^{1/6} \sqrt{Kd\left[\frac{S_s - S}{S}\right]}$$

n = Coefficient of Roughness

R = hydraulic Mean depth

K, S, S_s, d = Same as above.

Problems:

1) The main sewer was designed for an an area of 50 km² the Density of population of the town is 200 persons/hectare the Avg. flow is 250 lpcd the peak discharge is 1½ times more than the Avg. flow Rainfall equivalent of 8 mm in 24 hours All of which are runoff

a) What should be the capacity of the sewer in m³/sec

b) Find the minimum velocity & gradient required to transport sewage containing causes of from through a sewer of 35 cm diameter

Specific gravity of P is 0

and the value of K = 0.06 & F = 0.03

Density of Population = 200 person/hectre

Area = 50 km²
= 50 × 100 hectares
Area = 5000 hectares

∵ 1 hectre = 10^4 m
1 km² = 10^6 m
1 km² = 100 hectars

∴ total population of area = 200 person/hec × 5000 hec
= 1×10^6 persons

Sewage Flow Calculations:-

Average flow of sewage = $250 \times 10^6 = 25 \times 10^7$ lit/day

$$= \frac{25 \times 10^7}{1000 \times 24 \times 60 \times 60}$$

= 2.893 m³/sec

Maximum sewage flow or Peak flow = 1.5 × Average Flow of sewage
= 1.5 × 2.893
= 4.34 m³/sec

DWF = Q = 4.34 m³/sec

Storm Water Flow calculations

$$Q = \frac{CiA}{360}$$

$= \sout{50\times10^3\times10^3} A$ (R, I)

$= 50\times10^3 / \frac{5000\times(8/34)\times1}{360}$

$= 4.629\ m^3/sec$

∴ Storm water Flow $= Q = 4.629\ m^3/sec$

∴ capacity of Sewer = Peak Flow + Storm water Flow

$= 4.34 + 4.629$

$= 8.469\ m^3/sec$

Minimum velocity or Self cleansing velocity is given by SHIELD Formula

$$V_s = \sqrt{\frac{8K}{f}\left(\frac{S_s - S}{S}\right) g d_s}$$

$K = 0.06$
$f = 0.03$
$S_s = 2.65$
$S = 1.0$
$g = 9.8\ m/sec$
$d_s = 1mm = \frac{1}{1000} = 0.001\ m$

$$V_s = \sqrt{\frac{8(0.06)}{0.03}\left[\frac{2.65-1}{1}\right]\times 9.8\times 0.001}$$

$= 0.508\ m/sec$

$V_s \approx 0.51\ m/sec$

Calculation of gradient:

Manning's formula

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

Hydraulic Mean depth = HMD $= \frac{d}{4} = \frac{0.35}{4}$

$R = 0.0875\ m$

Assuming Manning's 'n' = 0.012

$$0.51 = \frac{1}{0.012}(0.0875)^{2/3} S^{1/2}$$

$S = 9.6418\times10^{-4}$

$S = 1$ in 1037.15

4) A 300mm dia sewer having an inward slope of 1 in 150 is flowing full. What would be the velocity of flow & discharge. Assume n = 0.013 is the velocity self cleansing?

By Manning's formula

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

$$R = \frac{d}{4} \left[\text{For circular sewer flowing full} \right]$$

$$V = \frac{1}{0.013} \left(\frac{0.30}{4} \right)^{2/3} \left(\frac{1}{150} \right)^{1/2}$$

$$V = 1.1169 \text{ m/sec}$$

Since the velocity is more than 1 m/sec as per Badmin's Recommendations, it is self cleansing

Discharge, $Q = AV$

$$= \frac{\pi d^2}{4} \times 1.1169$$

$$= \frac{\pi (0.3)^2}{4} \times 1.1169$$

$$Q = 0.0789 \text{ m}^3/\text{sec}$$

5) Design a circular sewer to serve a residential suburb of a city with the following data.

* Area of the suburb = 50 hectares
* Population = 6000 persons
* Avg. rate of water supply = 200 lpcd

Maximum flow = 3 times Avg Flow

Subtraction allowance = 20 %.

Critical design rainfall intensity = 40 mm/hr

Avg. ground slope = 1 in 1000

Co efficient of runoff = 0.45

Manning's (n) = 0.012

Since Avg. ground slope is given in the problem

BURKLI - ZIEGLAR Formula

$$Q_1 = \frac{CiA}{141.58} \sqrt[4]{\frac{S}{A}}$$

i = intensity of rainfall in cm/hr

A = Area in hectares

S = Slope of area = $\frac{1}{1000}$ m

$$Q_1 = \frac{0.45 \times 4 \times 50}{141.58} \sqrt[4]{\frac{1}{50}}$$

$$Q_1 = 0.239 \text{ m}^3/\text{sec}$$

Calculation of quantity of sewage

$$Q_2 = \frac{6000 \times 200 \times 3 (1 - 0.20)}{1000 \times 24 \times 60 \times 60}$$

$$Q_2 = 0.0333 \text{ m}^3/\text{sec}$$

Combined Flow, $Q = Q_1 + Q_2$

$= 0.239 + 0.333$

$Q = 0.2723 \text{ m}^3/\text{sec}$

$Q = AV$

Manning's Formula, $V = \frac{1}{n} R^{2/3} S^{1/2}$

$$V = \frac{1}{0.012} \left(\frac{d}{4}\right)^{2/3} \left(\frac{1}{1000}\right)^{1/2}$$

$$V = 1.046\, d^{2/3}$$

$$Q = \frac{\pi d^2}{4} \times 1.046\, d^{2/3}$$

$$0.2723 = \frac{\pi d^2}{4} \times 1.046\, d^{2/3}$$

$$\frac{0.272 \times 4}{\pi} = d^{8/4}$$

$$d = (0.3467)^{3/8}$$

$d = 0.672\,m$ [when the sewer is flowing full]

Provide sewer of 1m diameter

Disposal of Effluents :

Objects of Sewage Disposal :

* To eliminate or reduce danger to the public health by possible contamination of water supplies.
* To render the sewer inoffensive without causing odour or nuisance
* To prevent the life of fish or other aquatic life by allowing raw sewage into bodies of water as such
* The destruction of fish & other Aquatic life can be prevented by the sewage disposal methods.
* With proper sewage disposal the environment or the areas does not become polluted
* Sanitary conditions are maintained in the area

There are 2 principal Methods of sewage disposal by utilizing natural agencies i.e

1. Dilution i.e disposal of sewage of water
2. Land disposal or irrigation.

Dilution :

Dilution is the disposal of sewage by discharging it into large bodies of water like sea, stream, rivers etc. this method is possible only when the natural water is available in large quantity near the town. Proper care should be taken while discharging sewage in water so that sewage may not pollute natural water & make it unfit for any other purposes like. bathing, drinking, irrigation etc.

Conditions Favourable for Dilution

1. Where sewage is fresh
2. Where favourable currents exits in a stream
3. Where sewage is almost free from floating / settleable solids
4. Where thorough mixing is possible
5. Where diluting water has high quantities of dissolved oxygen.
6. When the city is situated near river or sea

Self purification Phenomenon;

Self Purification of Natural streams;

The automatic purification of natural water is known as self purification. The self purification of natural water system is a complex process that often involves physical, chemical, & 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 remove oxygen. In summer, rising temperature reduces solubility of oxygen, while lower flows reduce the rate at which oxygen enters the water from atmosphere.

Oxygen Sag Curve

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 & actual DO content at that time. The amount of resultant oxygen deflect can be obtained by algebraically adding the de-oxygenation & re-oxygenation curves. The resultant curve so obtained is called oxygen sag curve.

$$\text{Oxygen deficit, } D = \text{Saturation DO} - \text{Actual DO}$$

The saturation DO value for fresh water depends upon the temperature and total dissolved salts present in it; & its value varies from 14.62 mg/L at 0°c to 7.63 mg/L at 30°C & lower DO at higher temperatures.

The DO in the stream may not be at saturation level & there may be initial oxygen deficit 'D_o'. At this stage when the effluent with initial BOD load L_o, 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 i.e stream, & 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 (D_c) occurs at the inflexion points of the oxygen sag curve as shown in fig

Factors Affecting Self purification.

1. Dilution : When sufficient dilution water is available in the receiving water body, where the waste water 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 waste water

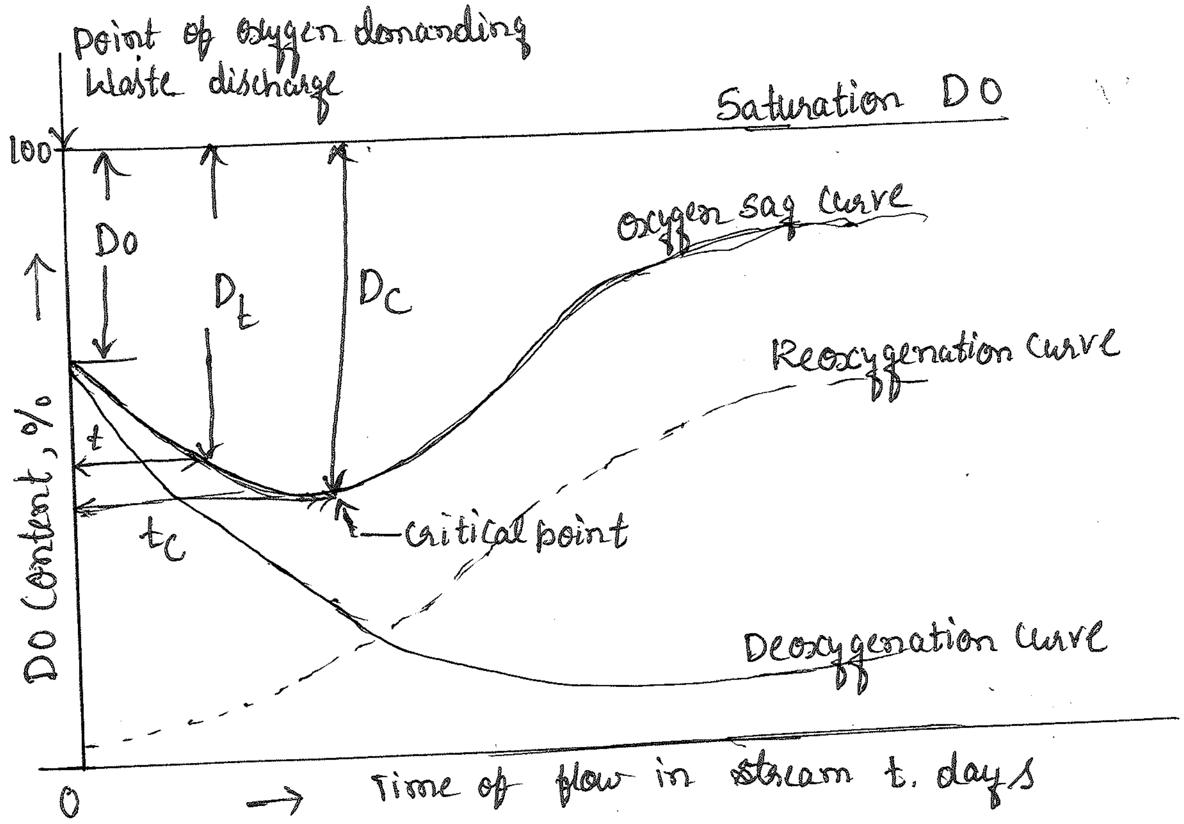
2. Current : When strong water current is available, the discharged wastewater will be thoroughly mixed with stream water preventing deposition of solids. In small current, the solid matter from the wastewater will get deposited at the bed following decomposition & reduction in DO

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 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 & low at lower temperature. The rate of oxidation of organic matter depends on the chemical composition of organic matter

8)



Deoxygenation, Reoxygenation & oxygen sag curve

⑨ Deoxygenation & Reoxygenation Curves:

De-oxygenation curve:

The curve which represents (or) showing & depletion of D.O with time at the given temperature

Re-oxygenation curve:

In order to counter balance the consumption of D.O due to the de-oxygenation, atmosphere supplies oxygen to the water & the process is called the reoxygenation

When wastewater is discharged in to 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 (L_t), 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 ordinates below the deoxygenation curve indicate the oxygen remaining in the natural stream after satisfying the bio-chemical demand of oxygen. 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 & existing concentration of DO
iv) Temperature of water solubility is lower at higher temperature & also saturation concentration is less at higher temperature

Zones of purification;

When sewage is discharged into water, a succession of changes in water quality takes place, If the sewage is emptied into a lake in which currents about the outfall are sluggish & shift their direction with the wind, the changes occur in close proximity to each other and as a result, the pattern of changes is not crisply distinguished. If on the other hand the water moves steadily away from the outfall, as in a stream, the successive changes occur in different river reaches & establish a profile of pollution which is well defined. However in most streams, this pattern is by no means static. It shifts longitudinally along the stream & is modified in intensity with changes in season & hydrography

When a single large charge of sewage is poured into a clean stream, the water becomes turbid, sunlight is shut out of the depths, & green plants, which by photosynthesis remove carbon dioxide from the water & release oxygen to it, die off. Depending on the stream velocity the water soon turns nearly black. Odorous sulfur compounds are formed & solids settle to the bottom, forming a sludge. The settled solids soon decompose, forming gases such as ammonia carbon dioxide, & methane or marsh gas. Scavenging organisms increase in number until they match the food supply The oxygen resources are drawn upon heavily & when overloaded become exhausted. Life in such water is confined to anaerobic bacteria (which exist when no oxygen is available) larvae of certain insects such as mosquitos, & a few worms there are no fish: turtles are generally the only forms of higher life present this condition is known as the zone of degradation.

(11) In a second zone, or zone of decomposition, more solids settle out, the water becomes somewhat clearer, & sunlight penetrates the surface. Oxygen is absorbed from the atmosphere at the air water interface permitting the establishment of aerobic (oxygen available) conditions. The aerobic bacteria bacteria continue the conversion of organic matter into nitrates, sulfates, & carbonates these, together with the carbon dioxide produced by decomposition as well as by bacteria & plant life, are food sources. With sunlight now penetrating the water, & with abundant food, algae, begin to flourish & form a green scum over the surface.

In the third zone, or zone of recovery: algae become more numerous & self-purification proceeds more rapidly. Green plants utilizing carbon dioxide & oxygen will liberate in the day time more oxygen than is consumed thus hastening the recovery of the stream. Simultaneously, the fish that require little oxygen such as catfish & carp, are also found. As the dissolved oxygen increases, more types of fish appear. After recovery, in the zone of cleaner water, fish find the stream highly favorable, as the algae support various aquatic insects & other organisms on which fish feed. The water is clear or turbid according to concentration of algae & may have odor for the same reason.

Throughout the stages of recovery of self purification, disease organisms are greatly reduced in number because they lack proper food & experience unfavourable temperatures & pH values of water. However the water is still dangerous since all disease organisms have not perished.

BOD of the resulting Mixture:

At the outfall, BOD of the river/waste water mixture (L_0) is given by:

$$L_0 = \frac{Q_r L_r + Q_w L_w}{Q_r + Q_w}$$

L_0 = Ultimate BOD at the point of waste discharge
Q_r = Flow in the river upstream of the discharge
L_r = Ultimate BOD of the river water r
Q_w = Flow of waste water from the discharge
L_w = Ultimate BOD in the discharged wastewater

Waste water Characteristics, sampling, significance & techniques, physical, chemical & biological characteristics flow diagram for muncipal waste water treatment. unit operations : screens : grit chambers, skimming tanks, equalization tanks suspended growth & fixed film bio process, design of trickling filters, activated sludge process, sequential batch reactors, moving bed bio reactors sludge digesters

Strength and characteristics of Waste Water :

The strength and characteristics of a sample of sewage depend upon : dilution of sewage locality of where it is produced time of collection of sample

Strength of sewage refers to its capacity to be hazard to public health. This mainly consists of offensive odour & organic matter which is to be oxidised. commonly referred to as bio-chemical oxygen demand (BOD) sewage with greater BOD is stronger than that with lower B.O.D Chemical oxygen demand is the amount of oxygen required for chemical oxidation of the decomposable solids present in sewage at a standard temperature under aerobic condition. Sewage from a separate system is naturally stronger than that from a combined system due to increased dilution from water storm water. This sewage greater BOD during day time & during the working day of industries.

Sewage from a combined system is weak because of storm water & inflow of domestic sewage.

Sampling of Sewage:

The first step to examine the sewage is to collect the sample of sewage for testing.

Quality of sewage is never the same throughout the day. It has been noted that the composition of the sewage that reaches the disposal works in the mornings is not the same as that of the sewage reaching in the afternoon or at night. Moreover in the same tank, quality of sewage varies at different depth. At the top sewage may contain floating matter whereas at the bottom there may be more sludge.

The Following points should be kept in mind while Sampling sewage:

* Samples of sewage are collected over a period of 24 hours at regular intervals say after an hour. The sampling bottles should be of capacity 100 c.c to 150 c.c The bottle should be closed tightly by stopper as soon as it is filled up & should be kept in a cool place.
* Samples must be taken little below the top surface where due to turbulence sewage is mixed with impurities
* The samples should be well mixed & tested within two hours of mixing
* A label indicating the date & time of collection of the sewage, & the name of the preservative should be pasted on the bottle. Commonly used preservatives are: chloroform, formalin & sulphuric acid.
* ~~The~~ In the treatment works, number of sampling points at different stages of treatment are provided to study the performance of the unit

* The test for D.O must be conducted immediately after the collection of sewage, other bacteriological tests must be conducted as early as possible.

2 types of sample can be taken, grab samples or composite samples:

Grab samples: A sample collected at a particular time & place
can represent only the composition of the source at that time &
place. This involves manual sampling & minimal equipment
buy may be unduly coastly & time-consuming for routine or
large-scale sampling programs. As the name implies 'Grab samples'
are simple scoops of the wastewater being sampled & are
appropriate where conditions are constant or well mixed and
slow to change This type of sample can be used for instance
for Balance Tank sampling or measuring sludge. solids in the
aeration basin (MLSS) Care should always be taken that a grab
sample is representative of the whole, & should be taken from
well mixed areas on all occassions.

Composite samples: composite samples are either amalgamated
or made up of smaller sub samples, & can be prepared in 2
ways Automatic samples can eliminate human errors in manual
sampling, reduce labour costs, provide the means for more
frequent sampling & are used increasingly.

The simplest form is time-related composites, which are
made up of sub samples of equal volume taken at specific
time intervals e.g sub samples very hours composited to make a
single daily sample. A composite sample representing a 24 hours
period is considered standard for most determinations. under other
circumstances, however, a composite representing a longer time period

or a shorter time period may be preferable The other form is flow proportional sampling, which requires a purpose-designed sampler. These units take samples of wastewater proportional to the flow & are usually linked to an automatic Flow meter this latter form of sampling is extremely accurated & can be used to establish the total wastewater load. Because of its accurate flow propotional composite sampling is preferable.

Characteristics of Waste water:

Sewage mainly consists of water (up to 99.9%.) The rest consists of unstable substances present as solution & suspension. These substances always go on changing & producing foul smell & creating nuisance to the general health of the public it is therefore necessary to study the various characteristics the process of treatment should be determined according to the characteristics and the treatment should be such that the effluent can be disposed of to the natural water sources safely.

The three important characteristics of sewage are:

1 Physical characteristics
2. chemical characteristics
3. Biological characteristics

Waste water characteristics	parameters
Physical characteristics	suspended solids : organic in nature, colour, odour, temperature, turbidity, sp. gravity
chemical characteristics	organic contents: BOD, COD, fats, Phenols, surfactants, oil & grease, etc
	inorganic contents : alkalinity, chlorides, nitrogen, sulphur, phosphorous, heavy metals, pH, carbohydrates etc
	Gases : oxygen, methane, hydrogen sulpide.

Biological Characteristics — Animals, Plants, Photista, (3) (3) Pathogenic organisms : viruses.

Analysis of Sewage

Objects :

* To determine the various substances present in sewage.
* To determine characteristics of the sewage so that the method & degree of treatment required.
* To regulate the treatment plant according to variation in the nature of sewage
* To adopt optimum treatment to sewage to obtain the effluent of high quality
* To prevent the pollution of natural bodies of water & land.

Method of Sewage analysis:

Analysis of sewage are classified into the following three main categories

1. Physical Analysis. 2. chemical Analysis. 3. Biological or bacteriological analysis.

Physical Analysis :

i) Suspended Solids ; Sanitary sewage usually contains large quantities of suspended solids that are mostly organic in nature. Suspended solids are aesthetically displeasing & provide adsorption sites for chemical & biological agents. Suspended organic solids degrade biologically resulting in objectionable by products of foul odours

ii) colour;

The colour of fresh sewage is earthy or grey. In 3 to 4 hours decomposition starts & it becomes stale with all the oxygen present in the sewage exhausted. When there is no oxygen, the sewage becomes septic & the colour become dark. The colour of the industrial sewage depends on chemical ~~to~~ process used in the industries.

Industrial wastes from textile & dying operations, pulp & paper waste waters, food processing waste liquids, mining refining & slaughterhouse operations add to colour of receiving streams.

Colour is a visible pollutant. Coloured water is not aesthetically acceptable for domestic as well as industrial use. Highly coloured water may not be accepted for laundering, dyeing, papermaking, beverage manufacturing, dairy production, food processing, ~~waste liquids, mining,~~ ~~refining~~ & ~~slaughterhouse. operations add to colour of receiving streams~~ textile & plastic production.

Methods involving measurements of intensity of colouration is based on comparision with standardized coloured materials. Results are expressed in true colour units (TCU'S) one true colour unit is equivalent to the colour produced by 1mg of platinum in the form of chloroplatinate ions along with 0.5mg of cobalt chloride being dissolved in one litre of distilled water.

ii) PH-Value

At the beginning the fresh sewage is alkaline in nature. but it is converted to acidic nature after few hours. The bacteria can't survive in acidic sewage. The test for pH gives an idea about the condition of sewage. Properly oxidized effluent should have a pH value of about 7.3 or so. The pH of fresh sewage varies from 7.3 to 7.5 (slightly Alkaline) As it becomes stale it turns acidic after complete oxidation & stabilization it becomes alkaline again.

Control of pH value is very important in the treatment of sewage or sludge. Sewage containing industrial wastes will be highly acidic or alkaline

The pH-value of sewage is determined by electrometric method or colourimetric method.

iii) Dissolved oxygen (D.O)

Dissolved oxygen (D.O) refers to the amount of oxygen dissolved in the sewage. this indicates the condition of sewage.

This is very important for the precipitating & dissolution of inorganic matter in water. The solubility of oxygen in sewage depends upon its temperature.

Fresh sewage has more D.O than stale sewage. The treated sewage (effluent) which is discharged into a river or stream should not reduce the D.O in the river to a level that will harm or destroy aquatic life which survives only when there is minimum dissolved oxygen in the water.

It may be determined in the laboratory by using the reagents manganese sulphate, concentrated sulphuric acid, starch indicator, sodium thiosulphate etc.

The D.O concentration maintained in the water after receiving sewage should never be less than 4-8 mg per litre.

) Bio-chemical oxygen Demand (BOD)

The organic matter present in wastewater has been classified on the basis of laboratory methods used for its determination. As the two most widely used parameters for expression of the organic content of wastewater are biochemical oxygen demand (BOD) & chemical oxygen demand (COD)

The Biochemical oxygen demand (BOD) may be defined as the oxygen required for micro organisms to carry out biological decomposition of dissolved solids or organic matter in the waste water under aerobic conditions at standard temperature.

It indicates the amount of decomposible organic matter in the sewage. The more the organic matter, greater is the BOD & more is the strength of sewage

The BOD test is necessary to know the amount of oxygen, required by the bacteria for oxidising the organic matter under aerobic condition for 5days or 10 days at standard temperature of 20°C this test helps to know the strength of sewage & to know the amount of clear water necessary for the disposal of sewage by dilution.

Normally, BOD considered in the design of biological treatment is a measure of carbonaceous biodegrable organic fraction for 5 day at 20°C & Ultimate BOD or total carbonaceous BOD is known as first stage BOD.

Therefore, in general the BOD of water, polluted water or wastewaters is the quantity of dissolved oxygen in mg/l, required by the microorganisms for oxidation of the carbonaceous biodegradable organic matter present in the liquid. The organic content of wastewater serve as food for micro-organisms (mainly bacteria) & energy for their metabolism is derived by its oxidation

Odour ;

Fresh sewage has no odour, but the stale sewage has offensive odour of hydrogen sulphide & other sulphur compounds

Substances which comes into prolonged contact with water may impart perceptible taste & odour. Minerals, metals & salts from the soil. end products from biological reaction & constituents of wastewater attribute taste & odour

Odour is mainly caused because of gases of decomposition of organic matter, fresh sanitary sewage has mild, earthy, inoffensive odour or it may be even odourless. Because of anaerobic decomposition of proteins & other organic matter rich in nitrogen sulphur & phosphorous foul smelling & highly ~~odourless~~ odourous gases as ammonia, hydrogen sulphide, mercaptans & skatol are produced

Odour causes more a psychological stress than any direct harm. offensive odours reduce appetite for food, lower water consumption, impair respiration, nausea, result in vomiting & mental perturbation & in extreme cases lead to deterioration of personal & community pride, interfere in human relations discouraging capital investments, lowering socio-economic status & deterring growth and decline in value & sales.

* Threshold odour Number (TON) is an index of odour

Varying amounts of odourous water are poured into containers & diluted with enough odour free distilled water to make a 200ml mixture

$$TON = \frac{A+B}{A}$$

Where A is the volume of odourous water (ml) & B is the volume of odour free distilled water required to produce a 200ml mixture

iv) Temperature ;

The temperature of sewage is more than that of water that is supplied. When sewage flows in closed conduits its temperature further rises. which increases the viscosity & bacterial activity.

Rise in temperature enhances toxicity of poisons and intensity of odour besides changing the taste. Also increase in temperature causes growth of undesirable water plants & waste water fungus. It influences the biological species present & their rates of biological activity. Temperature has an effect on most chemical reactions that occur in natural water systems. Aerobic digestion ceases at a temperature greater than 50°C. At less than 15°C anaerobic digestion is affected methane bacteria become inactive.

Temperature affects the reactions rates & solubility levels of chemicals. Most chemical reactions involving dissolution of solids are accelerated by increased temperatures. The solubility of gases on the other hand, decreases at elevated temperatures. Also the higher the temperature the lower is the viscosity which increases the efficiency of treatment units. If temperature below normal indicates infiltration of ground water & above normal indicates presence of hot industrial waste.

This is an important parameter & is measured by using thermometers. Temperature is recorded upto an accuracy of 0.1°C

v) Turbidity ;

The turbidity of sewage depends directly on the quantity of solid matter present in it in suspension state. Sewage is normally turbid because it contains floating & suspended matter. Turbidity is greater in storage sewage.

Collodial material of clay, silt, rock fragments & metal oxides from the soil, vegetables fibres & microorganisms cause turbidity. Also soaps. detergents & emulsifying agents produce stable colloids that results in turbidity. Although turbidity measurements are not commonly run on waste water discharges of wastewater may increase the turbidity of natural bodies of water

The colloidal material associated with turbidity Provides adsorption adsorption site for chemicals that may be harmful or cause undesirable tastes & odours & shield Pathogenic biological organisms from disinfection

Jackson turbidity unit (JTU) was based on light absorption being equal to the turbidity produced by 1 mg SiO_2 in 1 litre of distilled water. Nephelometric turbidity unit (NTU) is based on light scattering principle.

vi) Specific gravity:

The specific gravity of sewage is slightly more than that of water

c. Chemical Analysis:

* The sewage contains 0.1% of solid matters & 99.9% of water. The solids may be suspended, dissolved, colloidal or settleable. Solids present in the sewage may be of both organic & inorganic matter
* organic matter is present to the extent of 45% by weight of total solids. It consists of Animal wastes, & proteins, carbohydrates from vegetables & animal matter: Starch, cellulose: fats and urea.
* Inorganic matter comprises 55% of total solids by weight. It consists of: Minerals: salts: gravel: sand: debris: dissolved salts: chlorides: & sulphates, etc.
* In addition to solids & liquids, sewage contains dissolved gases such as H_2S (hydrogen sulphide), CO_2 (carbon dioxide) & CH_4 (methane) The main odour producing gas is H_2S
* colloidal matters include silt, clay, etc.
* The fresh sewage is alkaline in nature, & the ~~spe~~ septic sewage is acidic in nature.

i) Total Dissolved Solids (TDS) ;

Total solids are made up of suspended solids, settleble solids, and dissolved solids, Tests for these must be done so as to determine the load on treatment units. They indicate the strength of sewage.

Dissolved solids result mainly because of prolonged contact of water with the salts of different catchments. They may be of organic or inorganic origin. Inorganic substances are minerals & metals. Decay products of vegetable & animal origin give rise to organic matter. Dissolved salts may produce colour, taste & odour of which some are objectionable.

Imhoff cone

Sanitary sewage usually contains large quantities of suspended solids that are mostly organic in nature. Suspended solids are aesthetically displeasing & provide adsorption sites for chemical & biological agents suspended organic solids degrade biologically resulting in objectionable by-products of foul odours

Total solids present in the sewage are determined by evaporating a ~~measured volume of solid settled at the bottom is directly measured~~ evaporating a measured volume of sewage at 100°c and weighing the residue.

Volatile solids can be determined by nothing the loss in the weight of the total solids on ignition in an electric muffle furnace.

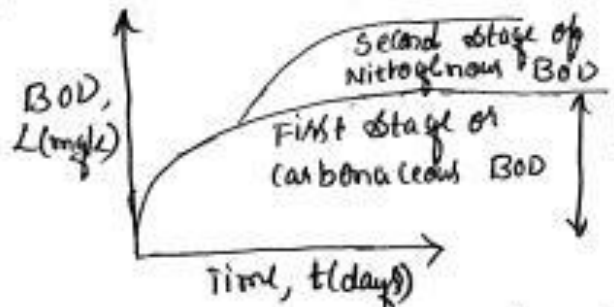
Settleable solids are suspended solids which will settle within one hour to the bottom of the cylinder of specific height it is determined by using an imhoff cone as in figure

Imhoff cone is conical glass of one litre volume & is graduated in mililitres at the bottom. The cone is filled with the sewage and is allowed to settle for one hour. After one hour the volume of solid settle at the bottom is directly measured this gives the volume of settleable solids

Now to know the exact amount of settleable solids the moisture from the sediment is removed and weighed.

The oxidation Process of organic matter proceeds in two stages The first stage lasts 10 days or more when the carbonaceous matter gets oxidized, the quantity of oxygen taken up is rapid at first but then proceeds slowly, the rate depending upon the temperature and characteristics of sewage

In the second stage, oxidation of the nitrogenous matter takes place. This is called nitrification & proceeds for a much longer period before the process gets stabilized. The determination of complete oxygen demand may therefore, appear to be impracticable however, by determining the oxygen used by a sample after a definite number of days of incubation at a given temperature it is pratically possible to arrive at a value very near to the total oxygen demand of the sample



Test for BOD are usually made at a temperature of 20°C & a period of 5 days 20°C is more or less a median value as far as natural bodies of water are concerned

Theoretically infinite time is required for complete biological oxidation of organic matter of domestic sewage but for all practical purposes. the reaction may be considered to be completed in about (90-95%) 20 days. In case of domestic wastewaters it has been found that the 5day BOD value is about 70 to 80% of ultimate (I stage - carbonaceous) BOD.

This is fairly a higher percentage and hence 5day (at 20°c) values are used for many consideration and unless otherwise mentioned BOD means only 5 day 20°C value only. Nitrifying bacteria is the bacteria which oxidize proteinous matter for energy the nitrifying bacteria are usually present in relatively small numbers in untreated domestic wastewater their reproductive rate at 20°C is such that their populations do not become sufficiently large to exert an appreciable demand for oxygen until about 8 to 10 days.

Once the organisms become established, they oxidize nitrogen in the form of ammonia to nitrates & nitric acid in amounts that induce serious error in BOD estimation.

Estimation of BOD.

→ Most widely used parameter of organic pollution applied to both wastewater and surface water is the 5 day BOD $(BOD)_5$ at 20°C values are used for many considerations and under,)

→ BOD determination involves the measurements of the dissolved oxygen used by micro-organisms in the biochemical oxidation of organic matter

⇒ The reason is that BOD test results are now used

i) To determine the approximate quantity of oxygen that will be required to biologically stabilize the organic matter present

ii) To determine the extent of waste treatment facilities.

iii) To measure the efficiency of the biological treatment process

For water + wastewater, BOD is normally determined in a laboratory by measuring the initial DO concentration normally in the diluted sample + final DO concentration in the same diluted sample after 5 days incubation at a standard temperature of 20°C the difference between two readings is assumed to be the DO consumed by micro-organisms in 5 days & therefore, will measure the BOD_5 at 20°C.

$$BOD_5 \text{ at } 20°C = \frac{D_I - DO_f}{P}$$

Where, DO_i = initial DO in diluted sample, mg/l

DO_f = final DO in sample after 5 days incubation period at 20°C mg/l

P = Percent dilution of sample in decimal.

During the BOD test the organic matter (8) will be converted into stable end product such as CO_2 sulphates (SO_4) orthophosphate (PO_4) & nitrate (NO_3)

The simple representation of carbonaceous BOD can be explained as below:

$$\text{organic matter} + O_2 \xrightarrow{\text{Microorganisms}} CO_2 + H_2O + \text{New cells} + \text{Stable Products}$$

This reaction continued till sufficient DO is available in the water. When DO is not a available condition becomes anaerobic decomposition (fermentative reduction) The reaction under anaerobic conditions is as under

$$\text{organic matter} \xrightarrow{\text{Microorganisms}} CO_2 + CH_4 + \text{New cells} + \text{other products } (NH_3, H_2S)$$

Limitation of the BOD test:

→ The 5-day BOD period is an orbitrary period which does not correspond to the point where all of the waste is consumed there is thus not much control nor there is anything definite where the 5-day BOD value will fall on the BOD curve.

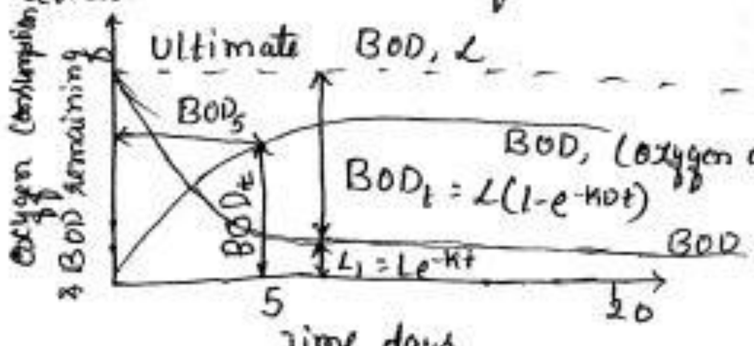
→ There is not much relationship of the test conditions with those which prevail in the biological treatment plant. The BOD test uses a small culture of microorganisms to stabilize organic matter under constant temperature condition & with a limited DO supply Actually biological treatment plant high concentration of organism have to be constantly agitated so as to keep them in contact with the concentrated substrated & excess of DO supply.

→ Results do not give true indication of the rates of oxygen used up unless BOD values are determined at daily intervals over a period instead of the standard 5-day period

Relation b/n strength of sewage & B.O.D

5-day B.O.D in p.p.m or mg/l	strength of sewage
i) 5 to 10	very good filter effluent
ii) 20	Standard Filter effluent
iii) 200	weak sewage
iv) 300	Average sewage
v) 400 to 500	strong sewage

Mathematical Formulations of the BOD;



Variation in DO Profile during BOD test with duration of incubation

It is generally assumed that the rate at which the oxygen is consumed is directly proportional to the concentration of degrable organic matter remaining at any time. The kinetics of BOD reaction can be formulated in accordance with first order reaction kinetics as:

$$dL_t/dt = -K_D L_t$$

L_t = Amount of first order BOD remaining in waste water at time t

K_D = BOD reaction rate constant, $time^{-1}$

Integrating $\int_0^t dL_t = -K_D L_t dt$

i.e $[\log L_t]_0^t = -K_D \cdot t$

$$\frac{L_t}{L} = e^{-K_D \cdot t} \text{ or } 10^{-K_D t}$$

where L or BOD_u at time t=0, i.e ultimate first stage BOD initially present in the sample. the relation between

K (base e) & K_2 (base 10) is

K (base 10) = K (base e) / 2.303

The amount of BOD remaining at time 't' equals

$$L_t = L e^{-K_D \cdot t}$$

The amount of BOD that has been exerted (amount of oxygen consumed) at any time t is given by

$$BOD_t = L - L_t = L e^{-K_D \cdot t}$$

And the five day BOD is equal to

$$BOD_5 = L - L_5 = L\left(1 - e^{-5K_D}\right)$$

For polluted water & wastewater, a typical value of K_D (base e, 20°C) is 0.23 per day & K_D (base 10, 20°C) is 0.10 per day. these values vary widely for the wastewater in the range from 0.05 to 0.3 per day for base 10 & 0.23 to 0.7 for base e.

The ultimate BOD (LO) is defined as the maximum BOD exerted by the wastewater. it is difficult to assign exact time to achieve ultimate BOD, the theoritically it takes infinite time. From the practical point of view, it can be said that when the BOD curve is approximately horizontal the ultimate BOD has been achieved the time required to achieve the ultimate BOD depends upon the characteristics of waste water i.e chemical composition of the organic matter present in the wastewater & its biodegradable properties & temperature of incubation at higher temperature for same concentration & nature of organic matter ultimate BOD will be achieved in shorter time as compared to lower temperatures where it will require more time. The ultimate BOD test expresses the concentration of degradable organic matter based on the total oxygen required to oxidize it

The BOD reaction rate constant is dependent on

a) The Nature of the waste
b) The ability of the organisms in the system to utilize the waste
c) The temperature

Chemical oxygen demand (COD)

The demand of oxygen for the chemical oxidation of organic matters in sewage by using strong chemical oxidant is known as chemical oxygen demand [COD]

This test is used to measure the content of organic matter of sewage The COD test is useful to measure the organic matter on some of the industrial wastes which do not respond to BOD test COD test can be conducted within the 3 hours The only disadvantages of this test is that it cann't differentiate between biologically oxidizable & biologically inert matter.

The COD test is carried out by :

1) A known amount of sample of sewage is taken.
2) A known amount of potassium dichromate ($K_2Cr_2O_7$) & Sulphuric acid (H_2SO_4) are added to the sample
3) The mixture is kept for about three hours.
4) During this period, a chemical reaction takes place to produce CO_2 & H_2O
5) After the reaction, the remaining amount of potassium dichromate is determined by titration with ferrous ammonia sulphate $Fe(NH_4)^2 (SO_4)^3$ solution.
6) The consumption of dichromate indicates the amount of oxygen required for the oxidation of organic matter

Module - 4

INDUSTRIAL WASTEWATER ENGINEERING:

Difference b/n domestic and industrial wastewater:

Sl No. Domestic waste water	Industrial Waste water
1. Fresh domestic wastewater is grey in color, while septic domestic wastewater is black in colour	color of industrial wastewater depends on the chemical process in industries
2. Domestic sewage has soapy or oily dour but septic sewage has H_2S odour	odour of industrial wastewater depends on the chemical processes in industries.
3. Temperature of domestic sewage is slightly higher than the water supplied	Generally temperature is higher than domestic wastewater
4. Fresh sewage is alkaline in nature then turns acidic when it becomes stale	Industrial wastewater may be acidic or alkaline depending upon the processes
5. Sewage contain large amount of bacteria more quantity of bacteria are harmless helping in sewage treatment. Bacteria from hospital's are harmful	Bacteria are discharged from slaughter houses and tanneries etc.,
6. Sewage contains no toxic elements	Industrial wastewater contains traces of toxic elements like chromium cadmium, lead arsenic, copper iron etc.
7. Radioactivity is absent in case of domestic wastewater	Radio activity may be present in the industrial wastewater
8. Requires less treatment than industrial wastewater	Requires exhaustive treatment.

Effect of effluent discharge on streams;

Following materials cause pollution;

Inorganic salts; It is present in the most of the industrial effluent and also as natural deposits. It induces hardness in water & makes stream unsuitable for industrial municipal & agricultural usage.

Acids and Alkalies: Sources are, chemicals industries Acids make water unsuitable for recreational purposes. It kills fish and other aquatic life. High concentrations of acids cause corrosiveness of metals Acids also cause deterioration of fish nets PH of stream water must not be less than 4.5 for fish to survive

Alkalies cause imbrittlement in pipes Treatment plant function is affected by alkalies and also in high concentration become fatal to fish life.

organic matters; organic matters exhaust the oxygen resources of the stream & creates unpleasant taste and odour & also general settling conditions. critical range for the survival of fish is 3ppm to 4ppm of DO

suspended Matters; The suspended particles settle down at the bottom or wash up on the bank & decompose. causing odours & depleting oxygen in the river & thus affecting aquatic life visible sludge creates unslightly conditions & destroys the stretch of river for recreational purposes the suspended particles also increase the turbidity

Heated Water: Warm water contains less DO warm water causes stratification of water layers it affects municipal treatment plant operations this also influences the processes carried out in the industries.

(5) <u>Floating</u> <u>Solids</u>; These include oils, grease and other materials which floats on the surface Floating solids not only makes river unsightly but also obstruct the passage of light into the river retarding the growth of plants. The oil causes the following effects:

i) It interferences with the natural re-aeration process.
ii) It is toxic to certain types of fishes
iii) It creates fire hazards iv) It destroys vegetation
v) It interferes in the functioning of the treatment plant units
vi) It imparts taste and odours to the water.

Colour; Sources are textile mills, paper mills, tanneries, etc. Colours interferes with the transmission of light into the surface water bodies. Thus decreasing the photosynthesis activity. It may also interfere with the oxygen absorption from the atmosphere. It is difficult to remove colour in the water treatment plant.

Toxic chemicals: The toxic materials may be lead, arsenic, copper, chromium, fluoride, chloride etc. The toxic materials may be both organic & inorganic & even in low concentrations may be poisonous to aquatic plants & animals. They have cumulative effects on human digestive system.
Chlorides are toxic to fish at around 400 PPm copper concentrations as low as 0.1 to 0.5 PPm may become poisonous to bacteria & other micro organisms.

Micro organisms; Sources are slaughter houses, tanneries, etc. Non pathogenic bacteria aid in the stabilization of organic matter. Pathogenic bacteria causes diseases.

Radio Active materials; Sources are nuclear power plants, research laboratories hospitals, etc. The effect of radioactivity may be immediate or delayed

Foam Producing Matter: Sources are textile mills, paper & pulp industries, chemical plants, etc. It leads to undesirable appearance of the receiving streams. It is an indication of contamination and is often more objectionable than lack of oxygen.

Treatment Methods-I

Volume Reduction ;

In general, the first step in minimizing the effects of industrial wastes on receiving streams & treatment plants is to reduce the volume of such wastes. This may be accomplished by ;

i) Classification of wastes
ii) Conservation of wastewater
iii) Change in the production to decrease wastes
iv) Reusing both the industrial & Municipal effluents as raw water supplies.

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 & separate the process waters themselves so that only the most polluted ones are treated & the relatively uncontaminated are discharged without treatment.

Three main classes of wastes are ;

a) Wastes from manufacturing process
b) Waters used as cooling agents in industrial process
c) Wastes from sanitary uses

Conservation of waste waters ;

Water conserved is water saved. Conservation begins when an industry changes from an open to closed system.
For example, a paper mill which recycles white water and thus reduces the volume of water it uses, is practicing water conservation.

Introduction of conservation practices requires a complete engineering survey of existing water views & an inventory of all plant operations using water & producing wastes. So as to develop an accurate balance for peak & average operating conditions.

Change in production to Decrease wastes :

This is an effective method of controlling the volume of wastes but at the same time it is very hard to pursue the industries to change their operations just to eliminate wastes as this may involve additional costs. However, the engineer can point out that reduction in the amount of sodium sulphite used in dyeing, sodium cyanide used in plating & other chemicals used directly in production has resulted in both reduction of wastes & saving of Money.

Reusing Both industrial & Muncipal effluents as raw water supplies :-

This is practiced mainly in areas where water is scares and expensive. However, many industries & Muncipalities hesitate to reuse effluents for raw water supply this is mainly due to lack of adequate information on the part of industries, certain technical problems such as hardness, colour etc., and an aesthetic reluctance to accept effluents as potential source of water of any purposes.

The greater usage of water in manufacturing process is for cooling purposes. these if any portion of a final industrial effluent can be reused. there will be less waste to treat & dispose off. Similarly reuse of sewage effluent will reduce the quantity of pollutants discharge by the Municipality.

Strength Reduction:

Waste strength reduction is the second major objective for an industrial plant concerned with waste treatment. The strength of the waste may be reduced by.

a) Process changes. b) Equipment Modifications c) Segregation of wastes d) Equalization of wastes e) By-product recovery f) Proportioning wastes g) Monitoring waste streams.

a) Process Changes: In reducing the strength of waste through process changes, the engineer is concerned with wastes that are most troublesome from a pollutional stand point. Many industries have solved their waste problems through process changes.

b) Equipment Modifications: Changes in equipment can effect a reduction in the strength of the waste, usually by reducing the amount of contaminants in the waste stream. Often slight changes can be made in the present equipments to reduce waste generation. For instance, in cucumber pickle factories, screens placed over drain lines in cucumber tanks prevent the escape of seeds & pieces of cucumber which add to the strength and density of the wastes.

c) Segregation of wastes: Segregation of wastes reduces the strength & or the difficulty of treating the final waste from an industrial plant. It usually results in 2 wastes: one strong & small in volume & the other weaker with almost the same volume as that of original un-segregated waste. The small volume strong waste can then be handled with methods specific to the problem it presents. In terms of volume reduction alone, segregation of cooling waters & strong waters from process water will mean saving in the size of the final treatment plants.

d) Equalization of Wastes: Plants which have many Products from a diversity of Process, preferred to equalize their wastes. This requires holding wastes for a certain period of time. For an instance, If a manufactured Product requires a series of operations that take 8 hours, the plant needs an equalization basin designed to hold its wastes to that 8 hr period. Here Stabilization of pH & BOD & settling of Solids and heavy metals are among the objectives of equalization. Stable effluents are treated are treatment more easily & efficiently then unstable once. Sometimes equalization may produce an effluent which requires no further treatment.

e) By-Product Recovery: Any use of waste Materials eliminates at least some quantity of waste that eventually must be disposed off & it provides a solution to decreasing the waste problems. All wastes contain by Products. i.e the exhausted materials used in the Process. Since some wastes are very difficult to treat at low cost, recovery Plants which produce a marketable by Product & the same time solves the cost of waste treatment should be encourage

f) Proportioning of Wastes: By Proportioning its discharge of concentrate wastes in to the main sewer a plant can often reduce the strength of its total waste to the point where it will need a minimum of final treatment or will pose the least damage to the stream or treatment plant

g) Monitoring of waste streams:
Sopistication in plant control should include that of waste water control by remove sensing devices that enables the operations to stop. Reduce or Redirect the flow from any Process when its concentration of contaminants exceeds certain limits are an excellent method of reducing waste strengths.

Neutralization: Excessively acid or alkaline wastes should not be discharged without treatment into a receiving stream, since they are adversely affected by low or high pH values. This adverse condition is even more critical when sudden slugs of acids or alkalies are discharged into streams.

Methods of Neutralizing excess acidity or excess alkalinity of waste waters such as:

1. Mixing wastes so that the net effect is a near neutral pH
2. Passing Acid through beds of lime stone
3. Mixing Acid wastes with lime slurries or dolomite lime slurries
4. Adding concentrated solution of caustic soda (NaOH) or soda Ash (Na_2CO_3) to acid wastes.
5. Blowing waste boiler-flue gas through alkaline wastes
6. Adding compressed CO_2 in Alkaline wastes.
7. Producing CO_2 in alkaline wastes
8. Adding sulphuric acid to alkaline wastes.

1. Mixing wastes: Mixing of wastes can be accomplished within a single plant operation or between neighbouring industrial plants. Acids & alkali wastes may be produced individually with one plant at appropriate times can accomplish proper mixing of these wastes neutralization

2. Lime Stone ($CaCO_3$) Treatment of Acid Waste:
Passing acid wastes through beds of lime stone was one of the original methods of neutralizing them. The wastes can be pumped up or down through the bed, depending on the head available and the cost involved.

$$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2CO_3$$

Acid waste

3) Lime Slurry Treatment for Acid Waste: mixing acid wastes with lime slurries is an effective procedure for neutralization the reaction is similar to that obtained with lime stone beds. in this case, however, lime is used up continuously because it is converted to calcium sulphate & carried out in the waste

even though it is slow acting time possesses a high neutralizing Power & its action can be quickened by heating or by oxygenating the mixture it is relatively expensive but in large quantities the cost can be important point.

4) Caustic Soda Treatment for Acid wastes :

Adding concentrated solution of caustic soda or Sodium carbonate to acid waste in the Proper Propotions results in a faster but more costly neutralization. Smaller volume of the agent are required since these neutralizers are more powerful than lime or lime stone. Another advantages is that the reaction products are soluble and do not increase the hardness of receiving waters. This method is suitable for small volumes. but for neutralizing large volumes of acid waste water especially Proportioning equipment should be provided as well as a suitable sized storage tanks for the caustic soda.

When sodium hydroxide is used as a neutralizing agent for sulphuric acid wastes. the following reactions takes Place.

$$NaOH + H_2SO_4 \longrightarrow NaHSO_4 + H_2O$$

$$NaHSO_4 + NaOH \rightarrow Na_2SO_4 + H_2O$$

Neutralization takes place in 2 steps & the end products depend on the final pH desired

5) Using waste Boiler Flue gas : Blowing waste boiler flue gas through alkaline wastes is a relatively new & economical method for neutralizing them well burnt or completely burnt stalks gas contains approximately 14% of CO_2

CO_2 dissolved in waste water will form Carbonic acid with inturn reacts with caustic wastes or alkaline wastes to neutralize the excess alkalinity as follows :

$$\underset{\text{Stackgas}}{CO_2} + \underset{\text{Waste water}}{H_2O} \longrightarrow \underset{\text{Carbonic Acid}}{H_2CO_3}$$

$$H_2CO_3 + 2NaOH \rightarrow Na_2CO_3 + 2H_2O$$

Caustic soda in water — Soda ash

$$H_2CO_3 + Na_2CO_3 \rightarrow 2NaHCO + H_2O$$

Soda Ash in water — Sodium bicarbonate in water

The equipment Required usually consists of a blower placed in the stack, a gas pipe line to carry the gases to the waste treatment site, a filter to remove sulphur & unburnt carbon particles from the gases and a gas diffuser to disperse the stack gases in the wastewater

6. Carbondioxide Treatment for Akaline waste: Bottled CO_2 is applied to waste waters in much the same way as compressed air is applied to the activated sludge basin. It neutralizes alkaline wastes on the same principle as boiler - flue gases which much less operating difficulty. The cost may be extremely high however, when the quality of alkaline waste is large

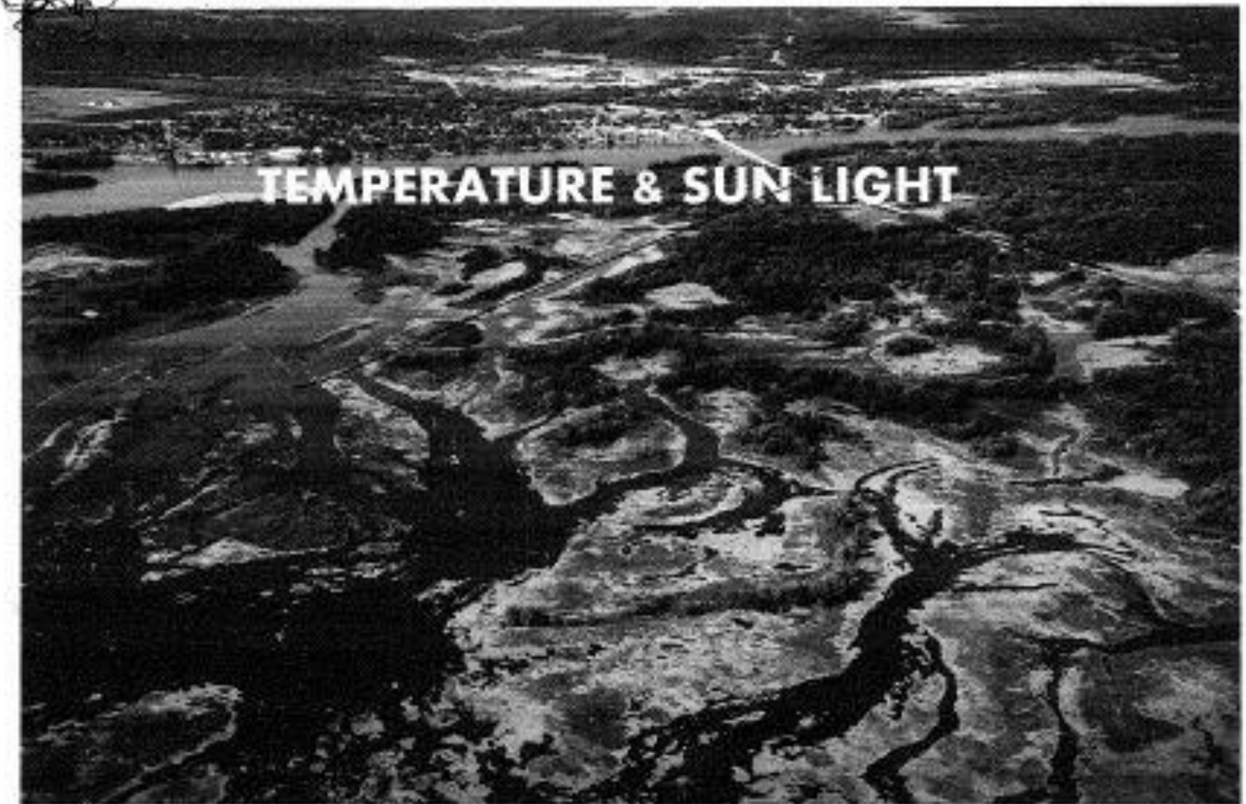
7. Producing carbondioxide in alkaline solution: Another way to produce CO_2 is to burn gas under water. This process is called submerged combustion & has been used in the disposal of nylon waste to neutralize the waste prior to biological treatment.

8. Sulphuric acid treatment for alkaline wastes: The addition of sulphuric acid to alkaline waste is a fairly common but rather expensive mean of neutralization storage & feeding equipment requirements are low as a result of its great activity but it is difficult to handle because of its corrosiveness the neutralization reaction which occurs when it is added to waste water is as follows:

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

Sulphuric acid as Neutralizer — Resulting Neutralized salt

SELF PURIFICATION PROCESS



⑥

Propotioning : propotioning Means the discharge of industrial waste water in proportion to the flow of Municipal sewage in the sewers or to the stream flow in the receiving river. In most cases it is possible to combine equalization and proportioning in the same basin. The effluent from the equalization basin is metered into the sewer or stream according to a predetermined schedule. The objective of proportioning in sewers is to keep constant the percentage of industrial waste water to domestic sewage flow entering the Municipal sewage plant:

This procedure has several purposes:

* To protect Municipal sewage plant from being impaired by sudden overdose of chemicals contained in the industrial waste
* To protect biological treatment devices from shock loads of industrial wastewater this may inactivate the bacteria.
* To Minimize the fluctuations of sanitary standards in the treated effluents.

The rate of flow of industrial waste water varies from instant to instant, as does the flow of domestic wastewater and both enter into the same sewage system. therefore the industrial waste water must be equalised & retained then proportioned to the sewer or stream according to the volume of domestic sewage or stream flow. to pacilitate proportioning, an industy should construct a holding tank with a variable speed pump to control the effluent discharge

There are 2 general methods of discharging industrial waste water in proportion to the flow of domestic sewage at the Muncipal plant i.e 1) Manual control & 2) Automatic control

(7) Treatment Method - 2

Removal of suspended solids:

1. Sedimentation: Sedimentation tanks are primarily used for removing settleable suspended matter this method of treatment is utilized & in almost all domestic sewage treatment plants but can also be considered for industrial waste treatment only when the industrial waste is combined with domestic sewage & is contain a high perlentage of setteable suspended solids such as that found in cannery, paper coal washery & certain other wastes. The efficiency of sedimentation tanks depends upon the detention period, waste water characteristics, tank depth floor surface area, temperature. particle size, velocity of particles density of Particles etc.

2) Floatation: Flotation is the process of converting or removal of the suspended substances and some colloidal, emulsified. & dissolved substances from the waste water to floating matter. The small and difficult to settle particles in suspension can be flocculated & buoyed to the liquid surface by the lifting power of the many minute air bubbles which attach themselves to the suspended particles. The floated agglomerated sludges can then be readily & continuosly removed from the surface of the liquid by skimming these skimmings are usually collected as concentrated sludge and normally drains quite readily. A convenient practice practice is to detain the sludge float for a few hours & remove the clarified liquid from the bottom of the floatation unit. Since the flotation process brings the chemical compounds in the wastewater in contact with oxygen the floation can be achieved in 2 ways.

Screening :

Screening of industrial wastes is generally practiced on waste containing larger suspended solids : Example : from canneries, pulp & paper mills & poultry processing plants. It is an economical & effective means of rapid separation of these larger suspended solids to allow enough concentration to be acceptable for discharge in to a muncipal sewer or a nearby stream. often considerable BOD is also removed by screening process & the percentage removed varies almost directly with the size of the screen & the amount of BOD associated with the screenable solids. screens are available in sizes ranging from coarse (10 to 20 mesh) to fine (120 to 320 mesh)

Removal of organic solids :

1) Lagooning gin oxidation ponds
2) Trickling Filter
3) Activated Sludge treatment
4) Modification of the Activated Sludge Process
5) Anaerobic digestion
6) High - Rate aerobic treatment
7) Wet combustion
8) Spray irrigation

Removal of Inorganic dissolved Solids

i) Evaporation
ii) Electro-dialysis
iii) Ion Exchange
iv) Algae
v) Reverse Osmosis
vi) Miscellaneous.

★ Removal of colloidal solids

A colloids particle is extremely small size these particles do not settle out on standing & cannot be removed by conventional physical treatment processes. colloids are often responsible for a relatively high percentage of the color, turbidity & BOD of certain industrial wastes. thus it is important to remove colloids from wastewater before they can reach into streams.

chemical coagulation:

this is a process of destabilizing colloids, aggregating them & binding them together for sedimentation. It involves the formation of chemical flocs that absorb, entrap or otherwise bring together, suspended matter that is so finally divided as to be colloidal. The chemicals most commonly used are; alum, copperas, ferric sulfate, ferric chloride. Ferric chloride & chlorinated copper as a mixture of ferric sulfate & chloride

Merits of combined treatment Methods;

Demerits of combined treatment Methods;

Disposal by Dilution without Treatment

This method is favoured

1. When the floating and SS are removed
2. The water body has large volume wrt the WW
3. The water body has high DO (for both BOD & aquatic organisms)
4. When the water body undergoes through mixing (currents)
5. No toxic substance in WW
6. The water body is not the drinking waste source (immediately D/S)

Feasibility of Study for combined treatment

* Type of Municipal Sewage treatment
* Characteristics of industrial waste
* Receiving stream water quality
* volume ratio of industrial to Municipal waste
* Economics of alternatives.
* Discharge of raw, partially treated & completely treated wastes to streams.

Module – 5

Structure

5.0 Introduction

The fibers used in the textile industry may be groups such as cotton, wool, synthetic etc. The characteristics of the waste from the mill depends on the type of fiber used, as different types of fibers go through different sequences of operations before the woven cloth is sent out of the mill. The pollutants in the waste water include the natural impurities in the fibers used and the processing chemicals.

5.1 Objectives

1. Understand and design different unit operations involved in conventional and biological treatment process.
2. Apply the principles of Industrial effluent treatment process for different industrial wastes.

5.2 Cotton and Textile Industry

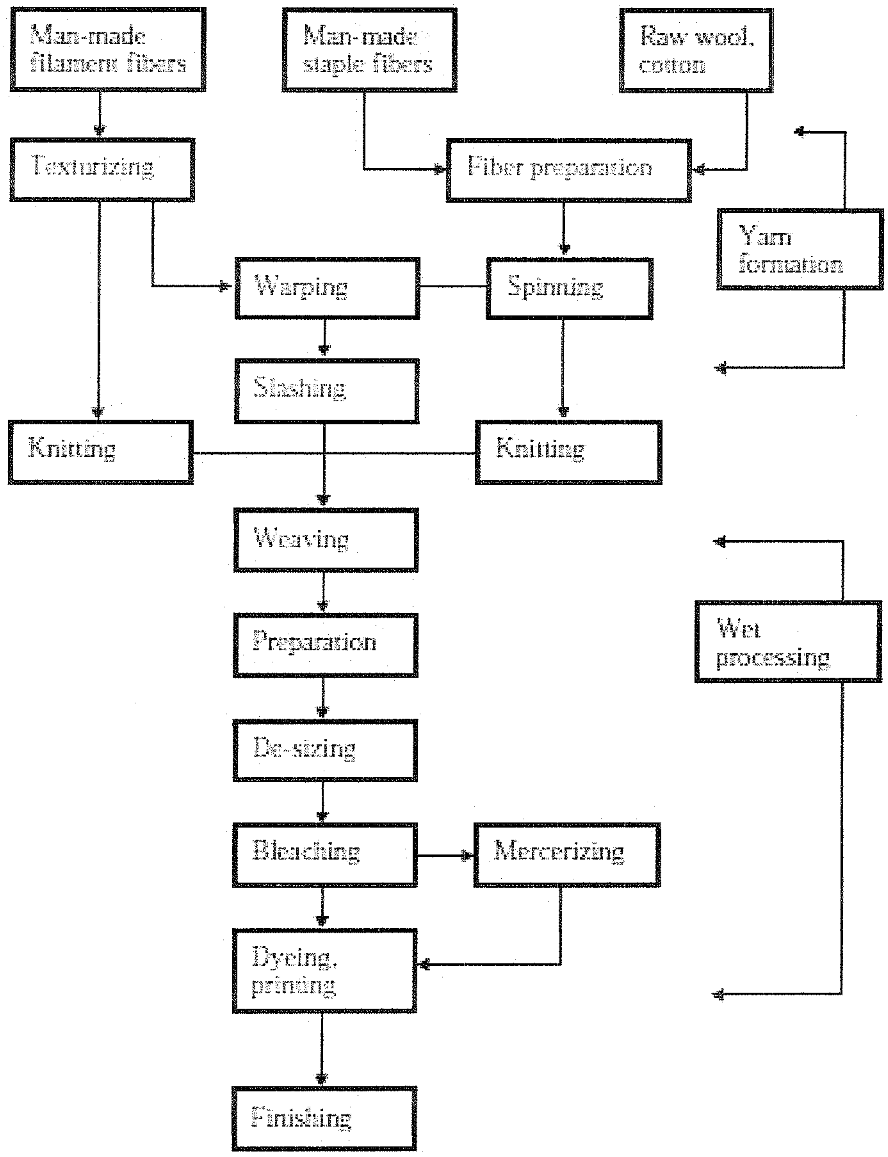
Manufacturing process

An integrated cotton textile mill produces its own yarn from the raw cotton. Production of yarn from raw cotton includes steps like opening & cleaning picking, carding, and drawing spinning, winding & 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 (sizing), scouring, desizing, bleaching, mercerzing, dyeing & finishing.

In slashing the yarn is strengthen by loading it with starch or other substances wastes originates from the sections due to spills & floor washings. The substitution of low BOD sizes (such as carboxy methyl cellulose) for the high BOD of the mill effluent by 40 to 90%.
After slashing, the yarn goes for weaving. The prepared cloth now requires scouring & 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 the is purpose. Caustic soda, soda ash, detergents etc. are also used in this section.

Bleaching operations use oxidizing chemicals like peroxides & hyper chloride to remove natural coloring material. The section contributes about 10% of the total pollution load.

Mercerzing consists of passing the sloth through 20% caustic soda solution. This process includes the strength elasticity luster & dye affinity. Waste from this section is recycled after sodium hydroxide recovery. Negligible waste which may come out of this section contributes little BOD but a high degree of alkalinity.



Dyeing may be done in various ways, using different types of dyes and chemical classes of dyes include Vat dyes, developing dyes etc. color from the dyes vary widely and although these are not usually toxic, they are treated separately . Thickened dyes are used for probing and subsequent fixation. After fixation of the prints, the fabric is given a thorough wash to remove the unfixed dyes. The finishing section of the mill imparts various types of chemicals are used for various objectives. These include starches, dextrines, natural & synthetic waxes, synthetics etc. Therefore a composite waste from an integrates cotton textile

5. INDUSTRIAL WASTEWATER TREATMENT

* Cotton textile Mills Waste :

Cotton From Field to Fabric

Process

Spinning & Weaving

Cotton Bales
↓
Opening & Cleaning
↓
Picking
↓
Carding
↓
Combing
↓
Drawing
↓
Spinning
↓
Slashing
↓
Weaving & Knitting
↓
Grey cloth
↓
To processing

Textile Processing

From Weaving Section
↓
Grey cloth
↓
Desizing
↓
Scouring
↓
Bleaching
↓
Mercerizing
↓
Dyeing
↓
Printing
↓
Finishing
↓
Packing
↓
Market

Disposal of Effluents

Methods of Disposal

- Natural methods:------- Dilution; Land treatment
- Artificial Methods:----- Primary; secondary; tertiary treatment
- Combined Methods:---- Primary treatment and disposal by natural methods

Picking :

Carding :

Drawing: Fibres are straightened

Combing : is optional but is used to remove the shortest Fibres , creating a

Slubbing : A loosely twisted roll of fibre prepared for spinning

Spinning : is an ancient textile art in which plant, animal or synthetic fibers are drawn out & twisted together to form yarn

Textile processing

Winding & Warping: yarn after spinning sent to weaving section where warping is done.

Slashing: It is a process that involves layering up fabric, stitching usually in parallel channels & then cutting through to the base of layers.

⑤ Singeing & Desizing :

The process by which the projecting or floating or hairy fibres stand out on the fabric surface are burnt off. is called singeing

a) To remove hairy fibres projecting on the surface of cloth & to smooth surface
b) optical levelness of the dyeing & clean out lines of a printing design
c) To increase luster in the finished fabric
d) To prepare the fabric for next process.

chemicals used: Enzymes, Acids, Caustic soda, soda ash, Detergents
this operation contributes about 50% of total pollution load of mill

Bleaching ; ★ Removal of colouring matter
★ Increases whiteness
★ Bleaching is a process to make fabric or yarn looks brighter & whiter
★ This is achieved by oxidizing or reducing the coloring matters in to colorless form. Mostly widely used textile bleaching method is hydrogen peroxide bleaching. This is carried out in an alkaline bath at about 80 to 85°C at a pH of 11

Mercerizing ;
Mercerising consists of passing the cloth through 20% caustic soda solution process improves strength, elasticity lustre & dye affinity
Waste is little BOD but a high degree of alkalinity.

Dyeing & Printing:

vat dyes, Developing dyes, Napthol dyes, Sulphur dyes, Basic dyes, Direct dyes, etc., in addition dyes require some chemicals to reduce them to soluble form such as caustic soda, sodium sulfide, sodium nitrite etc..,

Characteristics of cotton textile mill waste:

Composite waste may include: starch, carboxymethyl cellulose, sodium hydroxide, detergents, peroxides, Hypochlorites, Dyes, & pigments. Sodium gums, dextrins, waxes, sulphides, Soap etc.

* PH : 9.8-11.8
* Total Alkalinity : 17.35 mg/lt as $CaCO_3$
* BOD : 760 mg/lt
* COD : 1418 mg/lt
* Total solids : 6170 mg/lt
* Total chromium : 12.5 mg/lt

Effects of cotton textile Mill wastes on Receiving streams/sewers

* Rapid depletion of DO
* settlement & Decomposition of sediments

mill may include the following organic & inorganic substances starch, carboxyl methyl cellulose, sodium hydroxide, detergents, peroxides , hyperchloride dyes & pigments, sodium gums, dextrines, waxes, sulphides, soap etc. Depending on the process & predominant dye used, the characteristics of the mill waste varies widely.

The characteristic of a typical Indian cotton textile mill is given below.

Characteristics	Value
pH	9.8-11.8
Total alkalinity	17.35 mg/lt
BOD	760 mg/lt
COD	1418 mg/lt
Total solids	6170 mg/lt
Total Chromium	12.5 mg/lt

Effect of textile mill waste on receiving streams/sewers

If the mill waste water is discharged into streams, it causes depletion of DO of the stream. This is due to the settlement of the suspended substances and subsequent decomposition of the same in anaerobic condition. The alkalinity and toxic substances like sulphides & chromium affects the aquatic life and also interferes with the biological treatment processes. Some of the dyes are also found to be toxic. The color often renders the water unfit for use for side. The presence of sulphides makes the waste corrosive particularly to concrete structures. All treatment plants should be planned giving serious consideration for the reduction of waste volume & strength, through process of chemical substitution, chemical recovery & recycling of water. The pollution load from a textile, mill is dealt with operations like segregation, neutralization, equalization, chemical ppt, chemical oxidation & biological oxidation. Several chemicals are used to reduce the BOD by chemical coagulation such as alum, ferric sulphate, ferrous sulphate & ferric chloride, lime or H_2So_4 is used to adjust pH in this process. The dye waste may be economically treated by biological methods prior equalization, neutralization & chemical oxidation.

A Composite waste, when free from toxic substances may be treated as efficiently as domestic sewage, as most of the textile mill wastes contain sufficient nutrients like nitrogen & phosphorous. Trickling filters, activated sludge process & stabilization ponds have been effective in treating textile mill wastes. Extended aeration is found to be very effective in treating strong wastes even without equalization & pretreatment.

5.3 Tanning Industry

The tanning industry is one of the old industries in India. Usually the tannery wastes are characterized by strong color high BOD, high pH & high dissolved salts. The concentrated growth of this industry in certain localities has shown how the waste from this industry can issue severe damage to the water environment in the vicinity. In view of this peculiar pollution potential and the increasing demand for good quality water, it has become essential to treated it waste to a certain degree prior to its disposal.

Manufacturing process

Tanning process consists of 3 basic stages

1. Preparation of hides for tanning
2. Tanning proper
3. Finishing

Preparation of hides for tanning

In the first stage, the hides are used to remove dirt and preservative salts use earlier, and soaked in fresh water containing sodium chloride and preservative chemicals 1-5 days. The soaked hides are then washed again in sufficient water.

The washes hides are then lined with a paste of lime in sodium sulphide. Lined hides are then mechanically cleaned off hairs & flushing in wooden Vats with running fresh water. The subsequent operations are de liming and bating. Batting prepares the hides for tanning by reducing pH. Reducing the swelling and removing the degradation products in it. The deliming and batting is carried out in vertically ground in warm solution of ammonium salts and commercial prepared enzymes. An additional treatment knows a pickling is required for preparing the height for "chrome tanning". Which involve treatment of hides with sodium chloride and acids.

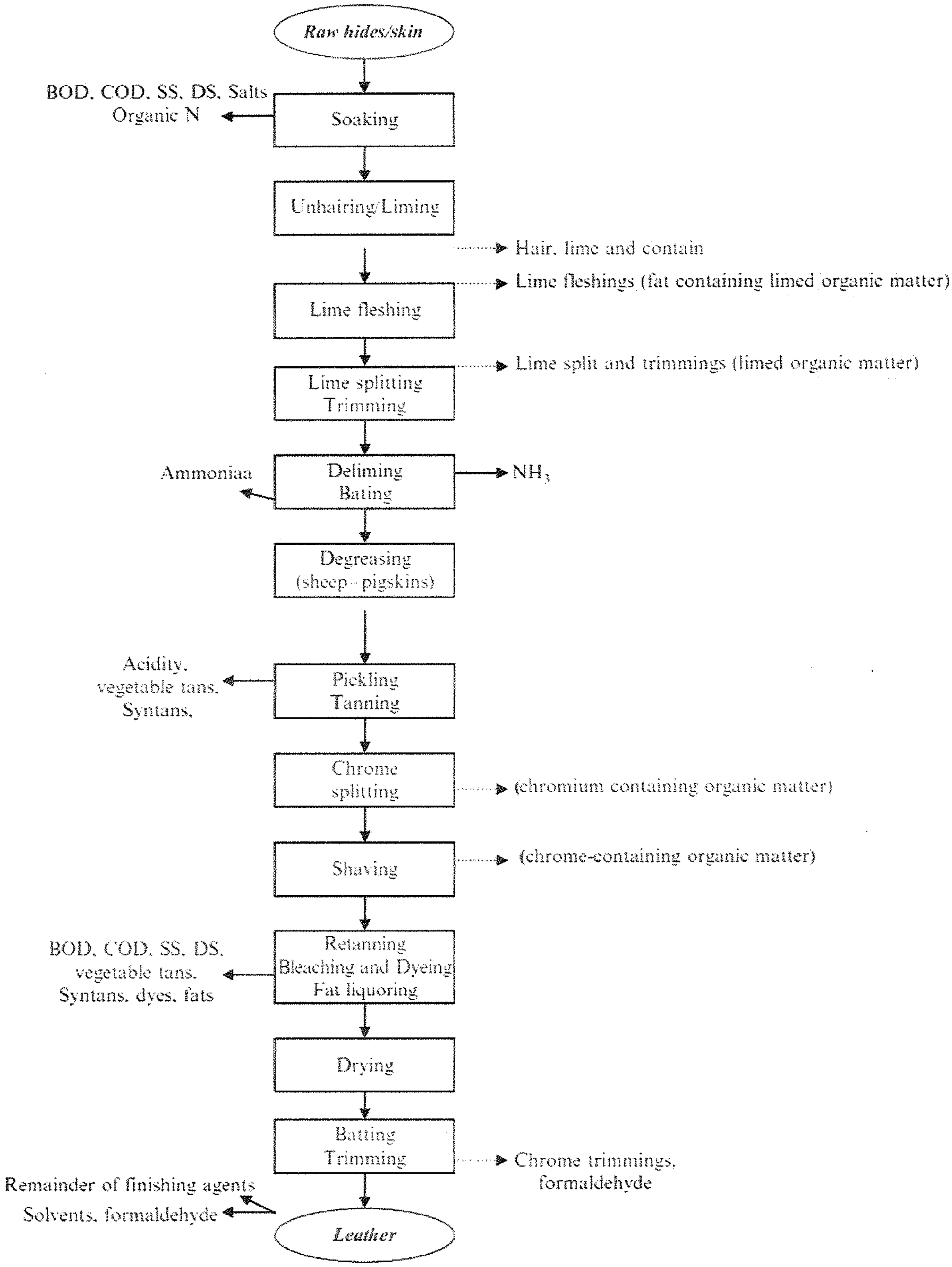
Tanning proper

The second stage of leather making, the tanning, involves the treatment of hides to make them non putrescible and soft even when dried. Depending on the type of product, either r vegetable substances containing naturals tanning's such as extract of barks, wood, nuts etc. or inorganic chroming salts are used as tanning agents. The use of synthetic tanning materials is expensive and is not adopted anywhere in India.

Vegetable tanning is used for leather, while chrome tanning is used for light leathers. In Chrome tanning process the tanning is done in the same vat after one day of pickling by adding the solution of chromium sulphate. After 4 hours of tanning, the leather is bleached with the dilute solution of sodium sulphate and sodium carbonate in the same vat. The chromes tanned leather is then pulled out and half of the spent liquor if thrown out and remaining is reused and along with a fresh volume of water. The vegetable tanned leathers are washed after the tanning proper.

Finishing

The third stage of finishing consists of stuffing and fat liquoring followed by dying. Dyeing can be done using synthetic stuffs.



Sources and characteristics of waste water

The waste water originates from the all operations in the tanning process. The waste may be classified as continues flow water, and intermittent flow waste. Continues flow waste consists of wash water after various processes and comprises of large portions of the total waste and are relatively and less polluted then the other one. Spent liquors belonging to soaking, liming and batting, pickling, tanning and finishing operation are discharged intermittently. Although small in volume, they are highly polluted and contain varieties of solute and organic and inorganic substances.

The spent and soaked liquor contains soluble proteins of the hides, dirt and large amount of common salt where salted hides are process. This spent liquor under goes putrefaction very rapidly as it offers a good amount nutrient and favorable environment of bacterial growth. 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 matters and also carrying a sludge composed of unreacted lime, Calcium sulphide and calcium carbonate. As such the spent lime liquor as a high alkalinity and moderate BOD and high ammonia nitrogen content.

The spent bate liquor contains high amount of organic and ammonium nitrogen due to the presence of soluble skin proteins and ammonia salts used in bating.

The vegetable ton exact containing tannins and also non tannins. Tannins are of high COD but relatively low BOD value. While non tannins including inorganic salts, organic acids and salts and sugar are of high BOD and COD. The spent vegetable tanning liquor is the strongest individual waste in the vegetable tannin having the highest BOD and very strong dirty brown color.

The spent pickling and chrome tanning waste comprises of as small volume, having a low BOD and contains traces of proteins impurities, sodium chloride and minerals acids and chromium salts. Chromium is known to be highly toxic to the living aquatic organisms.

Table shows the characteristic of Indian Tannery Industrial wastewater

Item	Spent soak liquor	Spent lime liquor	Spent delime liquor	Spent bating liquor	Spent vegetable tan liquor	Spent chrome tan liquor	Spent dyeing liquor
pH	8.4	12.8	9.3	9.9	5.4	3.2	6.2
Alkalinity as CaCO3, mg/L	600	1600	800	600	-	-	-
Acidity as CaCO3, mg/L	-	-	-	-	2560	5400	1000
Chloride, mg/L	16800	8900	400	240	3000	-	1000
Total solids, mg/L	35800	38240	27450	5000	34800	7480	4255
Suspended solids, mg/L	4500	3590	445	1060	2660	705	1255
COD, mg/L	3584	12000	2500	2374	30240	3584	6720
BOD, mg/L	708	7300	775	887	16000	-	-

Effects of waste on streams and sewage plant

Tannery waste characterized by high BOD, high suspended solids and strong colors. The waste when discharged into streams they deplete the DO very rapidly due to both chemical and biological oxidation of sulphide and organic compounds. A secondary pollution of streams may occur due to the deposition of solids near the discharge points and its subsequent putrefaction. The gas evolved during this process as got a typical foul odor.

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Seventh Semester B.E. Degree Examination, Dew4,,ver—T/Jan.2020

Municipal and Industrial Wastewater Engineering

Time: 3 hrs. Max. Marks: 80

Note: 1. *Answer any FIVE full questions, choosing ONE full question from each !nodule.*
2. *Assume any suitable missing data.*

Module-I

1 a. Explain briefly the different types of sewerage system. **(06 Marks)**
b. Explain the various factors affecting the dry weather flow. **(04 Marks)**
c. The drainage area of one sector of a town is 20 hectares. The classification of the surface of this area is as follows :

% Total surface area	Type of surface	Run — off coefficient
25	Hard pavements	0.85
25	Roof surface	0.80
15	Unpaved street	0.30
25	Gardens and Lawns	0.15
10	Wooded area	0.10

If the time of concentration for the area is 30 minutes. Find the maximum run off. Use the following formula for intensity of rainfall $R = 900/(t + 60)$. **(06 Marks)**

OR

2 a. Briefly explain the essential requirements of a good sewer material. **(04 Marks)**
b. Explain with a neat sketch, working of an "oxidation pond". **(06 Marks)**
c. Explain with a neat sketch, construction and working of a manhole. **(06 Marks)**

Module-2

3 a. Briefly explain self cleaning velocity and non scouring velocity. **(04 Marks)**
b. State the hydraulic formulas for velocity which are commonly adopted in the design of sewers. Explain any one in brief. **(06 Marks)**
c. A stone — ware sewer having 30cm in diameter is laid at a gradient of 1 in 100 use N = 0.013 in Manning's formula. Calculate the velocity, discharge and Chezy's co-efficient when the sewer is running full. **(06 Marks)**

OR

4 a. Explain the phenomenon of self— purification of natural streams subjected to pollution with the help of oxygen — sag curve indicating the salient features. **(10 Marks)**
b. The sewage of a town is to be discharged into a river. The quantity of sewage produced per day is 8 million liters and its BOD is 250 mg/C. If the discharge in the river is 200 f/s and if its BOD is 6mg/C, find the B.O.D of the diluted water. **(06 Marks)**

Module 3

5 a. Write the flow diagram employed to treat municipal waste water and indicate the importance of each treatment unit. **(08 Marks)**
b. With a neat sketch, explain the working of a grit chamber and skimming tank. **(08 Marks)**

OR

6 a. Explain with a neat sketch, the working principles of a trickling filer. **(08 Marks)**
b. Briefly explain the terms : i) Suspended growth ii) Activated sludge iii) Sludge digester iv) Sequential batch reactors. **(08 Marks)**

Module-4

7 a. Explain the effects of effluent discharge on the stream water quality. **(08 Marks)**
b. What is meant by strength reduction? Explain the various methods of strength reduction being adopted in the industries. **(08 Marks)**

OR

8 a. List and explain the methods of removal of colloidal solids from wastewater. **(08 Marks)**
b. Explain the principles of raw and partially treated wastes before discharged into streams. **(08 Marks)**

Module-5

9 a. With the help of a flow diagram, explain the treatment units suggested to treat wastewater from a tanning industry along with wastewater characteristics. **(08 Marks)**
b. State the sources and characteristics of the wastewater from dairy industry. **(08 Marks)**

OR

10 a. With the help of a line diagram, explain the process of paper and pulp industry highlighting the sources of wastewater generation. **(08 Marks)**
b. Discuss the characteristics and treatment of waste water from a pharmaceutical industry. **(08 Marks)**

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CBCS SCHEME

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15CV71

Seventh Semester B.E. Degree Examination, Aug./Sept.2020

Municipal and Industrial Waste Water Engineering

Time: 3 hrs. Max. Marks: 80

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Draw neat sketches wherever necessary.
3. Assume suitable data wherever necessary.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Discuss briefly types of Sewerage System. (05 Marks)

b. Explain the various types of materials used for sewer construction. (05 Marks)

c. Compute the population served, drainage area and diameter of storm water sewer (outfall) for the following data:

For Sanitary sewer:

"Flowing full" discharge = 0.02 m^3/s

"Design" discharge (per capita) = 1.5114 m^3/person/day

For Drainage area and Outfall sewer:

Population density = 75 persons per hectare

Coefficient of runoff = C = 0.278 (for area, A in km^2)

Intensity of rainfall = 107 mm/hour (Based on 10 year rainfall frequency curve and time of concentration = 20 minutes)

Velocity of flow in storm sewer = 3.0 m/s (Discharge measured in m^3/s). (06 Marks)

OR

2 a. Explain with a neat diagram Drop Manhole. (05 Marks)

b. Illustrate the working principle of oxidation pond as a Low Cost Treatment Method. (05 Marks)

c. A city has three streams carrying waste water with discharges of 350 MLD, 300 MLD and 250 MLD. $BOD_{5d,\ 20°C}$ of streams are 300 mg/L, 290 mg/L and 270 mg/L respectively. Compute the BOD loading (total) in tons per annum. If TSS/BOD Ratio = 1.3, determine total TSS loading. (06 Marks)

Module-2

3 a. A 3m diameter circular sewer discharges 3 m^3/s of sewage into a pump well. The waste water level in the pump well rises to full depth of 3 m above invert of incoming sewer.. Assuming Manning's value of 0.012 and gradient of 0.5/1000 determine the velocity of flow and ratio of discharge (q) to full discharge (Q_{full} = 10.856 m^3/s). (05 Marks)

b. Explain the self purification of streams with a Sag curve. (05 Marks)

c. Discuss the various flow-friction formulae used in design of sewers. (06 Marks)

OR

4 a. Find out where critical DO occurs in a fully saturated river (with DO) for the following data:

City discharge = 100 m^3/s

Minimum river discharge = 1250 m^3/s ; Minimum velocity in river = 0.15 m/s

$BOD_{5d,\ 20°C}$ = 260 mg/L ; Coefficient of purification of river = 4.0

Coefficient of DO = 0.11

Ultimate BOD = 125% of BOD of mixture of sewage and river water (05 Marks)

b. Explain the term "Zone of Purification" in a river. (05 Marks)

c. Derive the Streeter-Phelps Oxygen Sag equation in river analysis. (06 Marks)

Module-3

5 a. Explain the various waste water characteristics. (05 Marks)

b. Distinguish between Grab sampling and Composite sampling. (05 Marks)

c. Draw a neat flow diagram of a domestic sewage treatment plant showing various unit operations and unit processes and briefly explain. (06 Marks)

OR

6 a. Explain with a neat sketch working of a Trickling filter. (05 Marks)

b. Distinguish between suspended growth and fixed film biological processes. (05 Marks)

c. Design a set of two rectangular primary settling tanks for type-I settling of sewage for an average flow of 20000 m^3/d, design SOR of $40 m^3/m^2.d$. Draw a neat sketch of the same. Assume peak flow = 2.5 times average flow check whether the design ensures safety against re-suspension if max. scour velocity = 0.06 m/s. (06 Marks)

Module-4

7 a. Discuss the effect of effluent discharge on streams. (05 Marks)

b. Explain the terms volume reduction and strength reduction of industrial waste water. (05 Marks)

c. How is shock loading on treatment plants prevented using equalization and proportioning. (06 Marks)

OR

8 a. Explain the advantages and disadvantages of combined treatment of industrial waste with domestic waste water. (05 Marks)

b. Discuss the methods of removal of "inorganic solids" from industrial waste water. (05 Marks)

c. Explain the methods of maintaining quality in a stream using effluent and stream standards. (06 Marks)

Module-5

9 a. Explain the effect of dairy waste on receiving streams and give a treatment proposal. (05 Marks)

b. Explain the treatment of cane sugar effluent with the help of a flow chart. (05 Marks)

c. Explain the role of anaerobic stabilization ponds as energy efficient method of treating distillery waste. (06 Marks)

OR

10 a. Give the schematic flow diagrams of cotton textile industry showing the generation of wastewater. (05 Marks)

b. Give the typical characteristics of Indian tannery industrial waste water. (05 Marks)

c. Tuna fish canning industry is proposed near the coast. What are the expected operations leading to discharge of waste? Also give the treatment strategy. (06 Marks)

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Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Course/Subject Title	Municipal & Industrial Waste Water Engineering	**Course/Subject Code**	17CV71
Semester	VII – B	**Scheme**	CBCS – 17
Date	07.12.2020	**CIE No.**	1
Time	9 to 10 AM	**Max. Marks**	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note: Answer any one full question from each Part.

Q. No.	Question	Marks	RBT Level	CO
	Part A			
1	**Define** Sewer Appurtenances & **Explain** with neat sketch construction & working of Manhole, Gully traps	10	L1	1
2	**List** and **explain** different types of sewers with neat sketches	10	L1, L2	1
	Part B			
3	a. **Define** sanitation? **Explain** the need for good sanitation & also **list** the differences between Combined & Separate Sewerage System.	10	L2	1
	b. A town has a population of one lakh with a per capita average sewage flow as 300 lpcd. **Design** a sewer running 0.6 times full depth at peak discharge. The sewer is to be laid at a slope of 1 in 625. Take Manning's constant 'N' as 0.013 and peak factor as 3.0.	10	L3	2
	a. **Determine** the ratio of dry weather flow & wet weather flow of a City having the following Particulars. Area-35,000 ha ,Water Supply rate-180 lt/P/D,Population-17×10^5 rainfall intensity-14mm/hr, Average permeability factor-0.5, Assume that 60% of water supply reaches the sewer suggest the sewage carrying system.	10	L3	1
	b. **Define** sewage sickness? **Explain** the methods used for the prevention of Sewage Sickness.	10	L2	2

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi G.H 4/12/20
Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

3rd

1) 10 → 3

2) 10 → 3

3) a → 4

b → 3

4) a → 4

b → 3

3rd

1)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Course/Subject Title	Municipal & Industrial Waste Water Engineering	**Course/Subject Code**	17CV71
Semester	VII – B	**Scheme**	CBCS – 17
Date	30.12.2020	**CIE No.**	2
Time	11:30 to 12:30	**Max. Marks**	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note :Answer any one full question from each Part.

Q. No.	Question	Marks	RBT Level	CO
	Part A			
1	**Show** the flow diagram employed to treat municipal waste water and **list** the importance of each treatment unit.	10	L1	3
2	With a neat sketch, **Explain** the working of a grit chamber and skimming tank.	10	L2	3
	Part B			
3	a. **Define** strength reduction? **Explain** the various methods of strength reduction being adopted in the industries	10	L1,L2	4
	and			
	b. Briefly **explain** the characteristics of domestic waste water .	10	L2	3
4	a. **List** out the difference between domestic waste water and industrial waste water .briefly **Explain** about volume reduction methods for industrial waste water	10	L1,L2	4
	and			
	b. **Find** the size of a high rate trickling filter given the following data. Flow =4.5 MID recirculation ratio=1.4. BOD of raw sewage=250 mg/l, BOD removal in primary Clarifier =25%,final effluent BOD defined =50 mg/l.	10	L3	3

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi G.H
Course Coordinator
(Faculty in charge)

26/12/2020
Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®

Bapuji Institute of Engineering and Technology, Davangere–577 004

Department of Civil Engineering

USN

Assignment

Date	26	11	2020

Assignment No.		Maximum Marks	10
Course/Subject Title	Muncipal and industrial waste water Engineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Course Co-ordinator			

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Sketch and explain the different sewer appurtenances.	5	L1	1
2	Sewage from a town is discharged into a river having a discharge of 250 lt/sec if the quantity of sewage is [illegible] MLD and the BOD of sewage and river are 250ml/l & 6 mg/l respectively determine the BOD of the diluted water if it is required to reduce the BOD of the diluted water if to 20 mg/l **determine** should be the discharge in the river	2.5	L3	2
3	A city discharges 100 cumecs of sewage into river, which is fully saturated with oxygen & flowing at the rate of 1500 cumecs during its lean days with a velocity of 0.1 m/s. The 5 days BOD of sewage at 20 °C is 280 mg/l. Find when & where the critical DO deficit it will occur in the downstream portion of river also **find** the value of critical DO deficit assume self purification constant of river as 4.0 co efficient of de oxygenation as 0.1 per day at 20 °C & saturation D is 9.2 mg/l.	2.5	L3	2

Last date for submission	30	12	2020

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Course Coordinator (Faculty in charge) | Coordinator DQAC | Program Coordinator (HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

USN										

Course/Subject Title	Municipal & Industrial Waste Water Engineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Date	11.1.2021	CIE No.	3
Time	8 to 9 a m	Max. Marks	30

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note :Answerany one full question from each Part.

Q. No.	Question	Marks	RBT Level	CO
	Part A			
1	**Explain** the methods used in neutralization of acidic and alkaline wastes.	10	L1	4
2	**Explain** the methods for removal of Suspended Solids.	10	L2	4
	Part B			
3	a. With process flow diagram **Explain** the method of cotton textile mill origin and	10	L2	5
	b. **List** out the advantagages and disadvantages of combined treatment of waste water and also **List** the characteristics of industrial waste combined with domestic waste .	10	L2	4
4	a. With process flow diagram , **Explain** the units used for treatment of dairy waste on receiveing stream. and	10	L2	5
	b. **Explain** the methods of removal of inorganic solids, and **list** the methods for removal of organic soilds in industrial waste	10	L2	4

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi B.H 8/1/2021
Course Coordinator (Faculty in charge)

08/01/2021
Coordinator DQAC

08/1/2021
Program Coordinator (HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment -

Date	26	11	2020

Assignment No.	1	Maximum Marks	10
Course/Subject Title	Muncipal and industrial waste water Eengineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Course Co-ordinator	Jyothi S H		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Sketch and explain the different sewer appurtences.	5	L1	1
2	Sewage from a town is discharged into a river having a discharge of 250 lt/sec if the quantity of sewage is 9 MLD and the BOD of sewage and river are 250ml/l & 6 mg/l respectively determine the BOD of the diluted water if it is required to reduced the BOD of the diluted water if to 20 mg/l **determine** should be the discharge in the river	2.5	L3	2
3	A city discharges 100 cumecs of sewage into river, which is fully saturated with oxygen & flowing at the rate of 1500 cumes during its lean days with a velocity of 0.1 m/s. The 5 days BOD of sewage at 20 °C is 280 mg/l Find when & where the critical DO deficit it will occur in the downstream portion of river also **find** the value of critical DO deflicit assume self purification constant of river as 4.0 co efficient of de oxygenation as 0.1 per day at 20 °C & saturation D is 9.2 mg/l.	2.5	L3	2

Last date for submission	30	12	2020

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi S.H
Course Coordinator
(Faculty in charge)

20/10/2020
Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment

Date	26	11	2020

Assignment No.	2	Maximum Marks	10
Course/Subject Title	Muncipal and industrial waste water Eengineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Course Co-ordinator	Jyothi S H		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note :Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Sketch and explain the different sewer appurtences.	5	L1	1
2	Sewage from a town is discharged into a river having a discharge of 250 lt/sec if the quantity of sewage is 9 MLD and the BOD of sewage and river are 250ml/l & 6 mg/l respectively determine the BOD of the diluted water if it is required to reduced the BOD of the diluted water if to 20 mg/l **determine** should be the discharge in the river	2.5	L3	2
3	A city discharges 100 cumecs of sewage into river, which is fully saturated with oxygen & flowing at the rate of 1500 cumes during its lean days with a velocity of 0.1 m/s. The 5 days BOD of sewage at 20°C is 280 mg/l Find when & where the critical DO deficit it will occur in the downstream portion of river also **find** the value of critical DO deflicit assume self purification constant of river as 4.0 co efficient of de oxygenation as 0.1 per day at 20 °C& saturation D is 9.2 mg/l.	2.5	L3	2

Last date for submission	30	12	2020

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi S.H

Course Coordinator (Faculty in charge) | **Coordinator DQAC** | **Program Coordinator (HOD, Civil)**

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment

Date	26	12	2020

Assignment No.	2	Maximum Marks	10
Course/Subject Title	Mancipal and industrial waste water Eengineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Course Co-ordinator	Jyothi S H		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Sketch and explain the different sewer appurtences.	5	L1	1
2	Sewage from a town is discharged into a river having a discharge of 250 lt/sec if the quantity of sewage is 9 MLD and the BOD of sewage and river are 250ml/l & 6 mg/l respectively determine the BOD of the diluted water if it is required to reduced the BOD of the diluted water if to 20 mg/l **determine** should be the discharge in the river	2.5	L3	2
3	A city discharges 100 cumecs of sewage into river, which is fully saturated with oxygen & flowing at the rate of 1500 cumes during its lean days with a velocity of 0.1 m/s. The 5 days BOD of sewage at 20 °C is 280 mg/l Find when & where the critical DO deficit it will occur in the downstream portion of river also **find** the value of critical DO deflicit assume self purification constant of river as 4.0 co efficient of de oxygenation as 0.1 per day at 20 °C & saturation D is 9.2 mg/l.	2.5	L3	2

Last date for submission	30	12	2020

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi S.H
Course Coordinator
(Faculty in charge)

Coordinator 26/12/2020
DQAC

Program Coordinator
(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment

Date	26	11	2020

Assignment No.	2	Maximum Marks	10
Course/Subject Title	Muncipal and industrial waste water Eengineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Course Co-ordinator	Jyothi S H		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note :Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Sketch and explain the different sewer appurtences.	5	L1	1
2	Sewage from a town is discharged into a river having a discharge of 250 lt/sec if the quantity of sewage is 9 MLD and the BOD of sewage and river are 250ml/l & 6 mg/l respectively determine the BOD of the diluted water if it is required to reduced the BOD of the diluted water if to 20 mg/l **determine** should be the discharge in the river	2.5	L3	2
3	A city discharges 100 cumecs of sewage into river, which is fully saturated with oxygen & flowing at the rate of 1500 cumes during its lean days with a velocity of 0.1 m/s. The 5 days BOD of sewage at 20°C is 280 mg/l Find when & where the critical DO deficit it will occur in the downstream portion of river also **find** the value of critical DO deflicit assume self purification constant of river as 4.0 co efficient of de oxygenation as 0.1 per day at 20 °C& saturation D is 9.2 mg/l.	2.5	L3	2

Last date for submission	30	12	2020

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi S.H

Course Coordinator (Faculty in charge) | **Coordinator DQAC** | **Program Coordinator (HOD, Civil)**

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Assignment

Date	27	12	2020

Assignment No.	2	Maximum Marks	10
Course/Subject Title	Muncipal and industrial waste water engineering	Course/Subject Code	17CV71
Semester	VII – B	Scheme	CBCS – 17
Course Co-ordinator	Jyothi S H		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	***Design*** *industrial* waste water *treatment plant*

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	Sketch the layout of municipal waste water plant and explain briefly the individual units	5	L2	3
2	Define strength reduction explain the different methods used for strength reduction of industrial waste water	5	L2	4

Last date for submission	29	12	2020

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi S.H
6/1/21

Course Coordinator
(Faculty in charge)

Coordinator
DQAC

Program Coordinator
(HOD, Civil)

Assignment

Date	13	01	2021

Assignment No.	3	**Maximum Marks**	10
Course/Subject Title	Muncipal and industrial waste water Eengineering	**Course/Subject Code**	17CV71
Semester	VII – B	**Scheme**	CBCS – 17
Course Co-ordinator	Jyothi S H		

Course Outcome Statements : After the successful completion of the course, the students will be able to	
CO1	**Estimate** the factors affecting the design of sewers
CO2	**Design** the sewers and **describe** the effect of sewage disposal into the receiving streams
CO3	**Analyse** the characteristics of sewage and **propose** a suitable treatment plant
CO4	**Describe** the characteristics of sewage and industrial effluents
CO5	**Describe** the combined issues of sewage and industrial effluents
CO6	**Design** industrial waste water treatment plant

Note : Answer all the questions.

Q. No.	Question	Marks	RBT Level	CO
1	With the flow chart **explain** the treatment of waste from a large synthetic drug plant.	5	L2	6
2	With the flow chart **explain** the treatment of dairy wastes.	5	L2	6

Last date for submission	16	01	2021

RBT (Revised Bloom's Taxonomy) Levels : Cognitive Domain		
L1 : Remembering	L2 : Understanding	L3 : Applying
L4 : Analysing	L5 : Evaluating	L6 : Creating

Jyothi S.H 13/1/21

Course Coordinator (Faculty in charge) | **Coordinator DQAC** | **Program Coordinator (HOD, Civil)**

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Muncipal & Industrial waste water engg.	**Course/Subject Code**	17CV71
Semester	7th Sem, B Sec	**CIE No.**	1
Date	7/10/20	**Max. Marks**	30

A. 1)	Defination	2
	Sketch of Manhole	2
	Explanation of Manhole	2
	Sketch of gully traps	2
	Explanation on gully traps	2
2)	Listing of types of sewers	4
	Sketches	4
	Brief explanation	2
B. 3) a)	Defination	2
	Need of sanitation 5 ~~Points~~ Needs	4
	Differences b/n the sewagage systems - 4 difference	4
4) b)	Given Data	1
	Water supply calculation	2
	Dry weather Flow	3
	Wet weather Flow	3
	Ratio of DWF & WWF	1

Jyothi S.H 6/1/21
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Department of Civil Engineering

Scheme of Valuation

3) b)	Given	1M
	Determination of peak discharge	3M
	Manning's formula	1M
	Area & Perimeter calculations	2M
	θ Angle calculation	1M
	Finding Diameter D value	2M
4) b)	Defination & brief explanation	2M
	Mentioning & briefly explanation of individual Process	
	Mentioning Methods	2M
	Explanation of individual process	6x1 = 6M

Jyothi B.H 6/1/21
Course Coordinator (Faculty in charge)

Coordinator DQAC

Program Coordinator (HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Muncipal & industrial Waste Water Engineering	Course/Subject Code	17CV71
Semester	7th Sem	CIE No.	2
Date	30/12/20	Max. Marks	30

Q.	Solution	Marks
A. 1)	Full Sketch of treatment Plant	4
	Individual unit explanation	
	Priliminary	2
	Primary	2
	Secondary	2
	Tertiary	1
2)	For grit chamber	
	Sketch	2.5
	Explanation	2.5
	For Skimming tank	
	Sketch	2.5
	Explanation	2.5
B 3) a)	Strength Reduction Defination	3
	For Individual Method 1 Mark each	1x7
	7 Methods	

Jyothi S.H 6/1/21
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Department of Civil Engineering

Scheme of Valuation

Q.	Solution	Marks
3) b)	Three characteristics ~~Names~~	1
	~~Two~~ Physical	3
	Chemical	3
	Biological	3
4) a)	Individual Difference	1
	5 Difference	5
	~~Volu~~ Mentioning the volume reduction	4
	explanation of individual Methods	1X4
4) b)	Given Data	1M
	Efficiency of the Filter	2
	volume of the Filter	3
	Area of the Filter	1
	Diameter of the Filter	7

Jyothi B.H 6/1/21
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(HOD, Civil)

Bapuji Educational Association ®
Bapuji Institute of Engineering and Technology, Davangere-577 004
Department of Civil Engineering

Scheme of Valuation

Course/Subject Title	Municipal & Industrial Waste Water Engg.	Course/Subject Code	17CV71
Semester	7th 'B'	CIE No.	3
Date	15-1-21	Max. Marks	30

	Part-A	
1)	Explanation about Neutralization	2
	Mentioning the 8 Methods for Neutralization	3
	Brief explanation on individual Method	5
	Part-B	
3 b)	Advantages of Combined treatment	2.5
	Disadvantages of Combined treatment	2.5
	Characteristics of combined Waste W/r	5
	~~Part B~~	
3) a)	Flow diagram of cotton textile mill	5
	Brief explanation	5
4 a)	Flow diagram of treatment of dairy Waste	5
	Brief explanation	5

Jyothi S.H 21/1/21
Course Coordinator
(Faculty in charge)

22/01/2021
Coordinator
DQAC

22/1/2021
Program Coordinator
(HOD, Civil)

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Bapuji Institute of Engineering and Technology, Davangere–577 004
Department of Civil Engineering

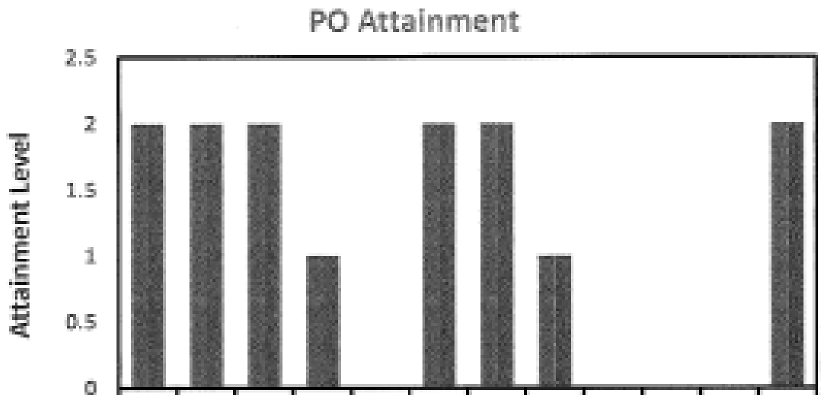
Scheme of Valuation

4) b)	Listing the 5 Methods of Removing the inorganic solids & Brief Explanation * Evaporation * Dialysis * Ion exchange * Algal & * Reverse osmosis	6
	Listing the Methods of Removal of organic solids 16 Methods [8-10 Methods]	4
	Part -A	
2)	Removal of suspended solids:	
	1) Sedimentation	4
	2) Flotation	3
	3) Screening	3

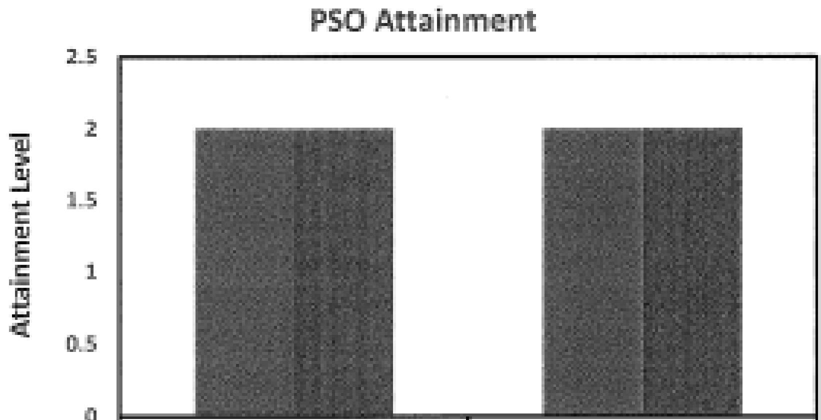
Jyothi S.H 21/1/21
Course Coordinator
(Faculty in charge)

Coordinator
DQAC

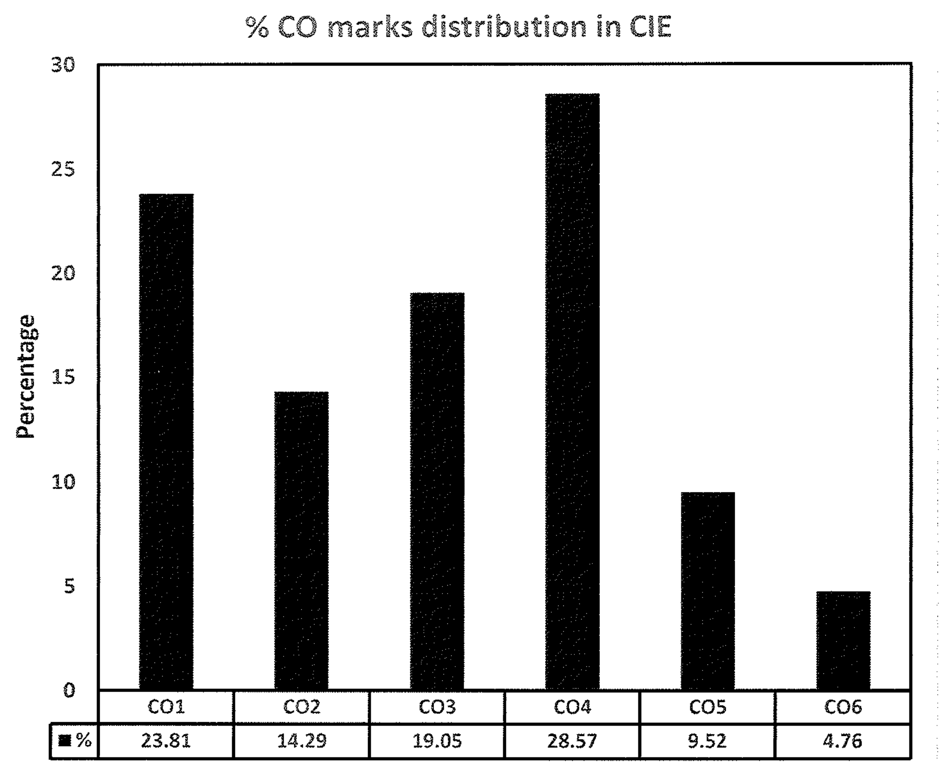
22/1/2022
Program Coordinator
(HOD, Civil)

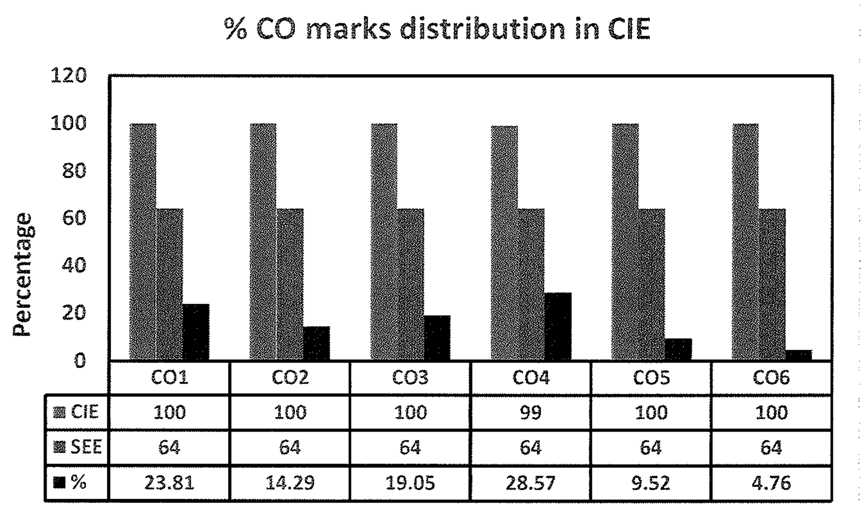


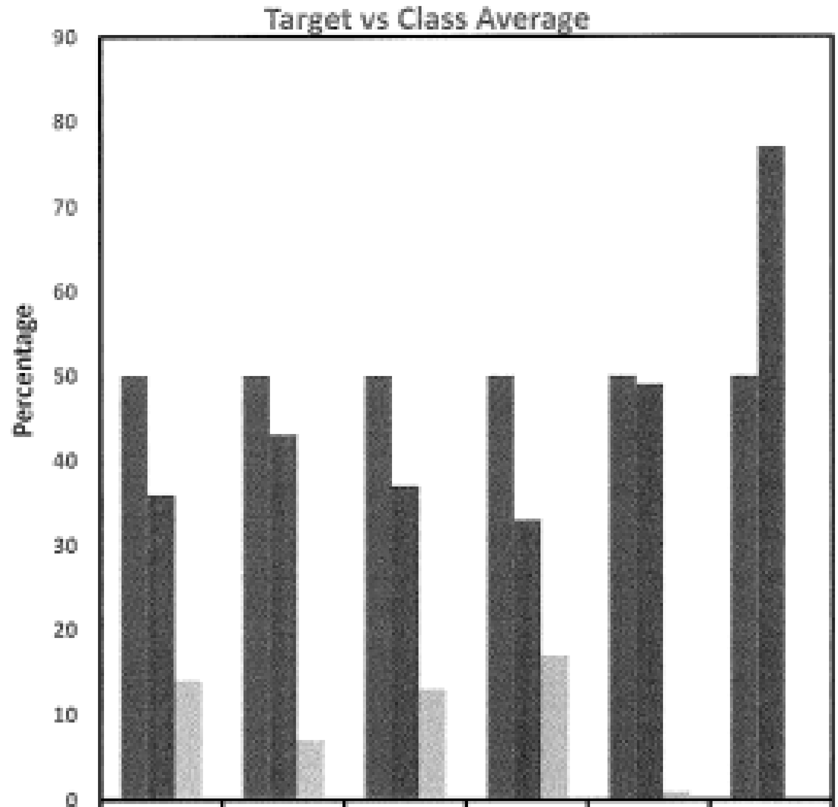
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
Expected	2	2	2	1	0	2	2	1	0	0	0	2
Actual	2	2	2	1	0	2	2	1	0	0	0	2



	PSO1	PSO2
Expected	2	2
Actual	2	2


% CO marks distribution in CIE
Percentage
30
25
20
15
10
5
0
CO1 CO2 CO3 CO4 CO5 CO6
% 23.81 14.29 19.05 28.57 9.52 4.76


% CO marks distribution in CIE
Percentage
120
100
80
60
40
20
0
CO1 CO2 CO3 CO4 CO5 CO6
CIE 100 100 100 99 100 100
SEE 64 64 64 64 64 64
% 23.81 14.29 19.05 28.57 9.52 4.76



	CO1	CO2	CO3	CO4	CO5	CO6
Target	50	50	50	50	50	50
Class Average	36	43	37	33	49	77
Gap	14	7	13	17	1	0