EWCE 333

Wastewater Engineering and Sanitation

Course Content

Introduction to wastewater engineering, estimation and collection of wastewater, hydraulics of sewer, design, construction and maintenance of sanitary sewer and storm drainage system, sewer appurtenances, plumbing system for building. Microbiology of sewage and waste water, wastewater characteristics, wastewater treatment methods and disposal, treatment and disposal of industrial effluents, sludge treatment and disposal. Water supply, sanitation and health, sanitation for low-income communities, design and construction of septic tanks, soak wells and subsurface drain fields, sustainability of water and sanitation services.

References Books

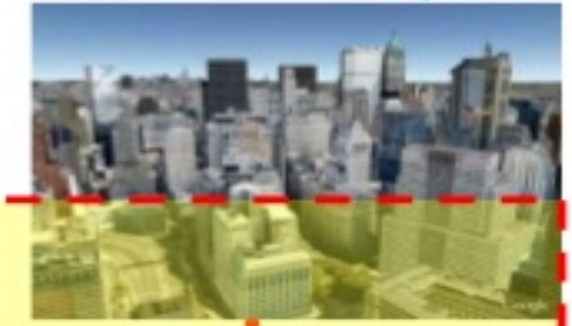
1. Water Supply and Sanitation- Feroz Ahmed and Mujibur Rahman.
2. Environmental Engineering – Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, McGraw Hill International Edition.
3. Environmental Sanitation, Wastewater Treatment and Disposal – Tanveer Ferdous Saeed, Abdullah Al-Muyeed, Tanvir Ahmed.
4. Introduction to Environmental Engineering – Gilbert M. Masters and Wendell P. Ela, 3rd ed., Prentice-Hall Inc.
5. Wastewater Engineering- Metcalf and Eddy.
6. Water Supply and Sewerage- Terence J. McGhee.
7. Wastewater Engineering- Metcalf and Eddy.
8. Plumbing Practices – Syed Azizul Haq, Peng
9. Plumbing Installation and Design – L. V. Ripka, 4th ed.







TREATED WATER



RAW WATER

WATER TREATMENT PLANT

WASTEWATER TREATMENT PLANT



TEATED WASTEWATER

WASTEWATER

Introduction

- The liquid waste- wastewater is essentially the water supply of the **community** after it has been used in a variety of **applications** and removed from **institution**, **commercial** and **industrial** establishments.
- When this wastewater accumulates and is allowed to go **septic**, the decomposition of the **organic matter** it contains will lead to **nuisance** conditions.
- The immediate and nuisance free **removal** of wastewater from its sources of generation followed by **treatment**, **reuse** or **disposal** into the environment is necessary to protect **public health** and the **environment**.

Introduction

- Wastewater engineering is that branch of **environmental engineering** in which the basic principles of science and engineering are applied to solve the issues associated with the treatment and reuse of wastewater.

Wastewater and Sewage

- **Domestic or sanitary wastewater** refers to liquid discharged from residential, business buildings and institutions.
- **Industrial wastewater** is discharged from manufacturing plants.
- **Municipal wastewater** is the general term applied to the liquid collected in sanitary sewers and treated in municipal plants.
- **Domestic sewage** is composed of human body waste and sullage which is the wastewater resulting from personal washing, laundry, and cleaning of kitchen utensils.

Problems Associated With Wastewater

- ***Decomposition*** of ***organic matter*** produce ***malodorous gases***
- Wastewater usually contains ***pathogenic microorganisms*** that dwell in the human intestine
- Wastewater may contain ***nutrients*** which stimulate ***aquatic growth***
- Wastewater may contain ***toxic compounds***

So immediate nuisance free removal of wastewater from its source of generation followed by treatment and disposal is important.

Wastewater Engineering

Wastewater engineering is that branch of environmental engineering which deals with the problem of water pollution control.

- ***Ultimate goal*** of wastewater engineering is ***wastewater management***.
  - Wastewater management is required to ***protect*** the ***environment*** in a manner appropriate with public health, economic, social, and political concerns.

Role of Wastewater Engineer

To protect public health and environment, it is important to have ***knowledge*** of:

- **Constituent** of concern in wastewater
- **Impacts** of these constituents when wastewater is disposed of into the environment
- Transformation and **long term fate** of these constituents in the treatment process
- Methods for **beneficial use** or **disposal** of solids generated by the treatment system

Sources of Wastewater
(Major Components)

1. Domestic: food, soap and detergents, Toilets (fecal and urine), and paper.
2. Commercial: Toilets and food from restaurants and other markets and shops.
3. Industrial: highly variable types of waste , dependent on the type of the industry and the processes involved.
4. Agricultural field runoff: Organic waste, may contain fertilizers, pesticides, herbicides and insecticides.
5. Runoff from streets: sand, petroleum, tars and tire residues.

How much wastewater do we produce each day?

Source	Average Daily Flow
Domestic sewage	60-120 gal/capita
Shopping centers	60-120 gal/1000 ft^2 total floor area
Hospitals	240-480 gal/bed
Schools	18-36 gal/student
Travel trailer parks	
Without individual hookups	90 gal/site
With individual hookups	210 gal/site
Campgrounds	60-150 gal/campsite
Mobile home parks	265 gal/unit
Motels	40-53 gal/bed
Hotels	60 gal/bed
Industrial areas	
Light industrial area	3750 gal/acre
Heavy industrial	5350 gal/acre
Source: Droste, R.L., 1997. Theory and Practice of Water and Wastewater Treatment	

These values are rough estimates only and vary greatly by locale.

Other Contributions to Wastewater Flows

- Infiltration
  - Older sewer pipe did not have water-tight joints
  - Since sewers are not under pressure, groundwater can enter in through joints (as well as sewage leak out if ground water is lower than pipe)

Collection of Sewage

- Sewage is conveyed in pipes known as sewers from its place of production to its place of treatment and disposal.
- The sewers are usually in network of underground conduits. They are either of the separate or combined system
- Pattern of sewer network
  - Type of system
  - Street layout
  - Topography
  - Location and type of treatment works

Composition of Sewage

- Sewage consists of about 99.9% water and 0.1 % solids, the solids are either organic or inorganic. The organic solids consist of about 65% protein, 25% carbohydrate and 10% fats.
- Faeces and to a less extent urine contain millions of intestinal bacteria and small numbers of other organisms.
- The organic mater contributed per person per day in domestic wastewater is approximately 110g of suspended solids and 90g of BOD in communities where substantial portion of the household kitchen waste is discharged to the sewer system.

Wastewater Treatment

The major categories of treatment steps include:

- **Preliminary treatment**: this removes materials that could damage plant equipment or would occupy treatment capacity without being treated.
- **Primary treatment**: this removes settleable and floatable solids
- **Secondary treatment**: this removes BOD, dissolved and colloidal suspended organic matter by biological action.
- **Advanced wastewater treatment**: this uses physical, chemical and biological processes to remove additional BOD, Solids and nutrients.
- **Disinfection**: this removes microorganisms to eliminate or reduce the possibility of disease
- **Sludge treatment**: this stabilizes the solids removed from wastewater during treatment, inactivates pathogenic organisms and reduces the volume of the sludge.

Table 3.3: National Standards – Waste Discharge Quality Standards for Industrial Units and Projects: Quality at Discharge Point

Parameter	Unit	Location of Final Disposal		
		Inland Surface Water[1]	Public Sewer[1]	Irrigated Land[1]
Ammonia (free ammonia)	mg/L	5	5	15
Ammoniacal Nitrogen (as N)	mg/L	50	75	75
Arsenic (As)	mg/L	0.2	0.5	0.2
BOD_5 20°C	mg/L	50	250	100
Boron (B)	mg/L	2	2	2
Cadmium (Cd)	mg/L	0.05	0.5	0.5
Chloride (Cl^-)	mg/L	600	600	600
Chromium (hexavalent Cr)	mg/L	0.1	1.0	1.0
Chromium (total Cr)	mg/L	0.5	1.0	1.0
COD	mg/L	200	400	400
Copper (Cu)	mg/L	0.5	3.0	3.0
Cyanide (CN)	mg/L	0.1	2.0	0.2
Dissolved Oxygen (DO)	mg/L	4.5-8	4.5-8	4.5-8
Dissolved Phosphorus (P)	mg/L	8	8	10
Electrical Conductivity	µMho/cm	1200	1200	1200
Fluoride (F)	mg/L	7	15	10
Iron (Fe)	mg/L	2	2	2
Lead (Pb)	mg/L	0.1	0.1	0.1
Manganese (Mn)	mg/L	5	5	5
Mercury (Hg)	mg/L	0.01	0.01	0.01
Nickel (Ni)	mg/L	1.0	1.0	1.0
Nitrate (N molecule)	mg/L	10.0	Undetermined	10.0
Oil and Grease	mg/L	10	20	10
pH		6-9	6-9	6-9
Phenol Compounds (C_6H_5OH)	mg/L	1.0	5	1
Radioactive Materials	As determined by Bangladesh Atomic Energy Commission			
Selenium (Se)	mg/L	0.05	0.05	0.05
Sulfide (S)	mg/L	1	2	2
Temperature – Summer	°C	40	40	40
Temperature – Winter	°C	45	45	45
Total Dissolved Solids (TDS)	mg/L	2100	2100	2100
Total Kjeldahl Nitrogen (N)	mg/L	100	100	100
Total Suspended Solids (TSS)	mg/L	150	500	200
Zinc (Zn)	mg/L	5.0	10.0	10.0

Notes: (1) *Land Surface Water* refers to any pond, tank, water body, water hole, canal, river, spring or estuary
Public Sewer refers to any sewer connected with fully combined processing plant including primary and secondary treatment
Irrigated Land refers to an appropriately irrigated plantation area of specified crops based on quantity and quality of wastewater