



# Industrial Waste Treatment



## Teaching Scheme and Examination Scheme

- Lecture – 4 Hrs / Week
- Practical/Tutorial - 2 Hrs / Week
- Term Work/oral – 25 +25 Marks
- Theory Paper – 80 Marks
- Internal Assessment - 20 Marks

# Course Objectives

1. To study different characteristics of liquid waste generated from different industries
2. To study the effect of disposal of liquid waste into natural water course, municipal sewer and on land
3. To study general treatment of industrial wastes like neutralization, equalization and segregation.

# Course Objectives

4. To study the conventional aerobic and anaerobic biological treatment methods

# Unit 1

- General: Liquid wastes from industries – their volumes and characteristics
- Effect of disposal into natural water courses, Municipal sewers and on land
- River standards and effluent standards.

# Unit 2

- Sampling and analysis of industrial wastes,
- Treatability study,
- good housekeeping,
- bioassay test,
- population equivalence.

## Unit 3

- Stream sanitation: Effects of industrial wastes on self-purification of streams and fish life,
- Statement and significance of the parameters of Streeter and Phelp's equation and BOD equations,
- Deoxygenating and reaeration , Oxygen sag and numericals based on this.

## Unit 4

- General treatment of industrial wastes: Neutralization, equalization, segregation.
- Modification of conventional aerobic and anaerobic biological treatment methods.
- Dewatering and disposal of sludges - floatation, vacuum filtration, centrifugation, filter press and membrane filters.

# Unit 5

- Detailed consideration of wastes produced from following industries:
- Manufacturing processes normally followed , Volume and effects of raw and treated effluent on streams, sewers,
- characteristics of effluents and land Treatment methods, reuse-recovery

# Unit 5

1. Textiles: cotton
2. Pulp and paper:- Sulphate process
3. Electroplating
4. Dairy
5. Sugar-sugarcane
6. Distilleries
7. Tanneries
8. Refineries

## **Unit 6**

- Provision of various acts pertaining to industrial wastes / effluents,
- Introduction to environmental impact assessment and environmental audit.

## **Unit 7**

- Common Effluent Treatment Plants (CETPs):  
Location, Need, Design, Operation and  
Maintenance Problems and Economical  
aspects.

# Reference Books

1. Waste Water Treatment: *Rao and Datta*, Oxford and IBH Publishing Co.
2. Environmental Pollution and Control in Chemical Process Industries: *Bhatia, S. C.*, Khanna Publication.
3. Industrial Water Pollution Control: *Eckenfelder Jr, W. W.*, Mc Graw Hill.
4. Industrial Water Pollution Management: Gurnham, E. F., John Wiley.
5. Biological Waste Treatment: Eckenfelder and Connor, Pergamon Press.
6. Theories and Practices of Industrial Waste Treatment: Addison Wesley.
7. Pollution Control in Process Industries: Mahajan, S. P., Tata McGraw Hill.
8. Industrial Waste: Rudolfs, W.(Ed), L E C Publishers Inc.



9. The Treatment of Industrial Wastes:  
Besselievre, E. D., Mcgraw Hill.

10. Industrial Waste Disposal: Ross, R. D.  
(Ed), Reinhold Book Corporation

11. Industrial Waste Treatment - Nelson  
Nemerow, Addison – Wesley

## Introduction

- Industrial wastewater treatment covers the **mechanisms and processes** used to treat wastewaters that have been contaminated in some way by **anthropogenic (man made) industrial** or commercial activities prior to its release into the environment or its re-use.



- Most industries produce **some wet waste**.
- Although recent trends/studies in the developed world have been to minimize such production or **recycle such waste** within the production process.
- However, many industries remain dependent on processes that **produce wastewaters**.

## Industrial Effluent

- One of the major reasons for the **diminishing water quality** is due to industrial effluents released to the water bodies which in turn cause significant effect to the **marine organisms and plants** as well as to the human health.



- Industrial processes generate natural and synthetic organic chemicals while sewage discharge contains **organic substances** such as **carbohydrates, lignin, fats, soap, synthetic detergents and proteins.**

- The presence of inorganic substances including a number of potentially toxic elements such as **arsenic, cadmium, chromium, copper, lead, mercury, zinc** and others resulting from domestic and industrial sources may also contribute to the unfavorable effect towards the quality of the water.
- Also the effluents generated from the industries contain high **COD, BOD and pH.**

- Therefore it is **necessary** for Effluent Treatment Plants to maintain their **COD, BOD** and other parameters of their effluent to meet specifications decided by **pollution control boards** (Effluent standards).
- The lists of major polluting industrial sector are shown in next slides

| <b>Sr. No.</b> | <b>Sector</b>                 | <b>Pollutants</b>   |
|----------------|-------------------------------|---|
| <b>1</b>       | <b>Fertilizers</b>            | <b><math>F^-</math>, <math>PO_4^{-3}</math>, <math>NH_4^{+}-N</math>, <math>NO_3^{-}-N</math></b> |
| <b>2</b>       | <b>Leather tanneries</b>      | <b>BOD, COD, colour, TDS, chromium</b>  |
| <b>3</b>       | <b>Dyes and intermediates</b> | <b>COD, colour</b>  |
| <b>4</b>       | <b>Pharmaceuticals</b>        | <b>BOD, COD</b>   |
| <b>5</b>       | <b>Petrochemicals</b>         | <b>COD, toxic organics</b>  |
| <b>6</b>       | <b>Pulp and paper</b>         | <b>BOD, COD, colour</b>   |

|    |                                    |  |
|----|------------------------------------|--|
| 7  | <b>Sugar and distilleries</b>      | <b>TDS, BOD, COD, colour</b>   |
| 8  | <b>Pesticides and insecticides</b> | <b>COD, toxicants</b>  |
| 9  | <b>Coke ovens</b>                  | <b>COD, phenols, CN<sup>-</sup>/CNS<sup>-</sup>, NH<sub>4</sub><sup>+</sup>-N, toxicants</b> |
| 10 | <b>Chemical industry</b>           | <b>BOD, COD, toxicants</b>   |
| 11 | <b>Caustic soda</b>                | <b>Incinerator performance, VOC</b>  |
| 12 | <b>Cement</b>                      | <b>BOD, COD</b>  |

|    |                             |   |
|----|-----------------------------|---|
| 13 | <b>Copper melting</b>       | <b>SO<sub>2</sub> emissions, sludge disposal</b>      |
| 14 | <b>Oil refinery</b>         | <b>SO<sub>2</sub> emissions, sludge disposal, VOC</b> |
| 15 | <b>Thermal power plants</b> | <b>BOD, COD, heavy metals</b>                         |
| 16 | <b>Zinc melting</b>         | <b>BOD, COD, SO<sub>2</sub> emissions</b>             |
| 17 | <b>fermentation</b>         | <b>BOD, COD, color, lagoon discharge.</b>             |

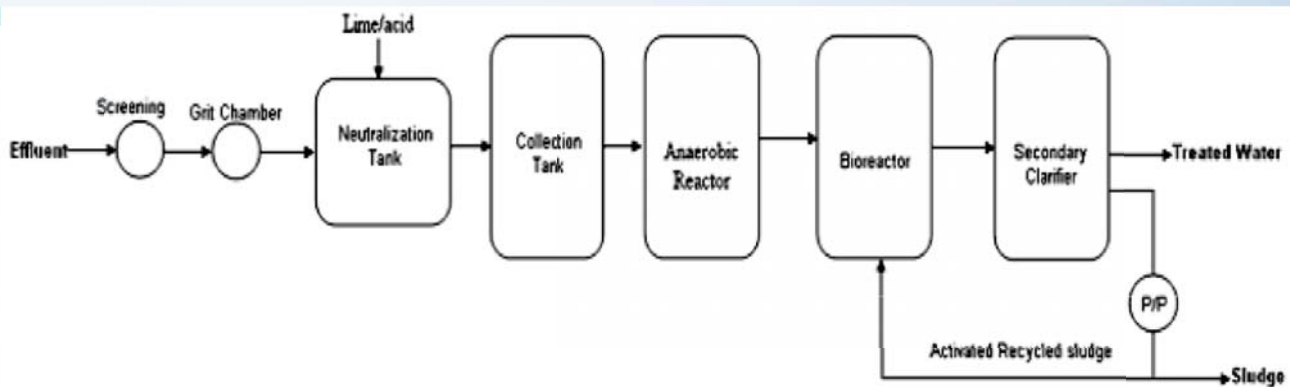


- There are numerous processes that can be used to treat effluent depending on the **type** and **extent of contamination**.
- This effluent can be treated by Effluent Treatment Plant which may include physical, chemical and biological treatment processes.
- The most important aerobic treatment system is the activated sludge process.

- **Anaerobic** processes are also widely used in the treatment of industrial wastewaters and biological sludge.
- Modern systems include **tertiary treatment** by micro filtration or synthetic membranes.
- After **membrane filtration**, the treated wastewater is indistinguishable from waters of natural origin of drinking quality.

- Disposal of wastewaters from an industrial plant is a difficult and **costly** problem.
- Most of the industries have **onsite** facilities to treat their wastewaters so that the pollutant concentrations in the treated effluent comply with the local and/or national **regulations** regarding disposal of wastewaters into community treatment plants or into rivers, lakes or oceans.

- Nowadays, due to the increasing presence of molecules, the **conventional biological methods** cannot be used for complete treatment of the effluent and hence, introduction of newer technologies to degrade these molecules into smaller molecules, which can be further oxidized by biological methods, has become imperative.



Typical Effluent Treatment Plant

## Treatment level of wastewater

| Treatment level         | Description  |
|-------------------------|--|
| <b>Preliminary</b>      | Removal of wastewater constituents such as <b>rags, sticks, floatable, grit, and grease</b> that may cause <b>maintenance or operational</b> problem with the treatment operations, processes, and ancillary system. |
| <b>Primary</b>          | Removal of portion of the <b>suspended solids</b> and <b>organic matter</b> from the wastewater  |
| <b>Advanced primary</b> | Enhanced removal of suspended solids and organic matter from the wastewater. Typically accomplished by chemical addition or filtration   |



|  |  |
|--|--|
| <b>Secondary</b>                       | Removal of <b>biodegradable organic matter</b> (in solution or suspension) and suspended solids  |
| <b>Secondary with nutrient removal</b> | Removal of <b>biodegradable organics, suspended solids, and nutrients</b> (nitrogen, phosphorous)  |
| <b>Tertiary</b>                        | Removal of <b>residual suspended solids</b> (after secondary treatment), usually by granular Tertiary medium filtration or micro screens. Nutrient removal and disinfection is also the part of tertiary treatment |
| <b>Advanced</b>                        | Removal of dissolved and suspended materials remaining after normal biological treatment when required for various water reuse applications  |

### Water use in India

| Industrial Sector    | Annual wastewater water discharge (million cubic meters) (%) | Annual consumption (million cubic meters) | Proportion of water consumed in industry |
|----------------------|--|---|--|
| Thermal power plants | 27000.9  | 35157.4                                   | 87.87                                    |
| Engineering          | 1551.3   | 2019.9                                    | 5.05                                     |
| Pulp and paper       | 695.7  | 905.8                                     | 2.26                                     |
| Textiles             | 637.3  | 829.8                                     | 2.07                                     |
| Steel                | 396.8  | 516.6                                     | 1.29                                     |
| Sugar                | 149.7  | 194.9                                     | 0.49                                     |
| Fertiliser           | 56.4   | 73.5                                      | 0.18                                     |
| Others               | 241.3  | 314.2                                     | 0.78                                     |
| <b>Total</b>         | <b>30729.2</b>   | <b>40012.0</b>                            | <b>100.0</b>                             |

Source: Estimated by CSE based on the wastewater discharged data published by CPCB in "Water quality in India (Status and trends) 1990 - 2001".

# Objective Questions

1. Industrial waste contains high \_\_\_\_\_ and \_\_\_\_\_ values.
2. After \_\_\_\_\_, the treated wastewater is indistinguishable from waters of natural origin of drinking quality.
3. In secondary treatment \_\_\_\_\_ is removed.

# Theory Questions

- Q1. Write a note on ' Overview of Industrial treatment'.
- Q2. Explain different treatment levels of wastewater.