CE 370

Introduction to Water and Wastewater Treatment Plants

Water Treatment

➢ Purpose of water treatment
  • To make it safe for human consumption, aesthetically acceptable, and suitable for use by industries and other uses.

➢ Treatment operations and processes
  • There are several unit operations and processes that are used in water treatment depending on the water source and degree of contamination.

➢ Unit operation
  • Is a physical treatment. Typical unit operations include:
    Sedimentation, filtration, flotation

➢ Unit Process
  • Is a chemical or biological treatment. Typical unit processes include:
    Coagulation, GAC adsorption, ion exchange, chlorination, activated sludge
Water Treatment Plants

- **Common Treatment Plants for Surface Water**
  - Rapid sand filtration plants
  - Lime-soda softening plants

- **Common Groundwater Treatment Plants**
  Groundwater have much better water quality than surface water. Following are common GW treatment plants:
  - Gas stripping and chlorination plants
  - Softening plants (lime-soda or ion exchange)

Degree of Treatment

From bacteriological standpoint, the degree to which a water must be treated to obtain drinking water depends on the coliform count of the raw water as shown in the following table:

<table>
<thead>
<tr>
<th>Group Number</th>
<th>Max Permissible Average MPN Total Coliform Bacteria Per Month</th>
<th>Treatment Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MPN not more than 1.0</td>
<td>None for protected ground water, but, at the maximum, chlorination for surface water</td>
</tr>
<tr>
<td>2</td>
<td>MPN not more than 50</td>
<td>Simple chlorination or equivalent</td>
</tr>
<tr>
<td>3</td>
<td>MPN not more than 5000, and this MPN exceeded in not more than 20% of samples</td>
<td>Rapid sand filtration (including coagulation) or its equivalent plus continuous chlorination</td>
</tr>
<tr>
<td>4</td>
<td>MPN greater than 5000 in more than 20% of samples and not exceeding 20,000 in more than 5% of the samples</td>
<td>Auxiliary treatment such as pre-sedimentation or pre-chlorination or its equivalent (either separately or combined) or pre-sedimentation for 30 days or more plus rapid sand filtration and chlorination</td>
</tr>
<tr>
<td>5</td>
<td>MPN exceeds Group 4</td>
<td>Prolonged storage or equivalent to bring within Groups 1 to 4</td>
</tr>
</tbody>
</table>
Other Parameters that Affect the Selection of the Degree of Treatment

- Physical Characteristics
- Inorganic Chemicals
- Organic Chemicals
- Radionuclides
- Economy of the treatment

Design Parameters

- The plant is designed based on the average flow on the day of maximum demand

- The clear well, which provides storage, is designed so that the plant may operate at a constant rate on the day of maximum demand
Water Demand

Clear Well
Rapid Sand Filtration Plant

Lime-Soda Softening Plant
Groundwater Treatment Plant

Municipal Wastewater Treatment Plants

Common municipal wastewater treatment plants are:

- **Primary treatment**
  - Removes large amounts of suspended solids
  - Usually not a sufficient treatment and followed by secondary treatment

- **Secondary treatment**
  - Removes dissolved and suspended organics by bio-oxidation

- **Tertiary Treatment**
  - Provides further treatment to secondary effluent to increase its quality

- **Physical-chemical Treatment**
  - Uses several unit operations and processes
  - Not as common as biological treatment
Industrial Wastewater Treatment Plants

The organic quality of Industrial wastewater vary considerably depending on the industry. Therefore, a wide variety of treatment options exists. Common industrial wastewater treatment plants are:

- **Completely Mixed Activated Sludge**
  - Used for low to moderate suspended solids contents

- **Dispersed Plug-Flow Activated Sludge**
  - Used where the organic contents vary considerably during the day

- **Aerated Lagoon System**
  - Used when appreciable land area is available
**Completely-Mixed AS Process**

**Dispersed Plug-Flow AS Process**
Aerated Lagoon System

*Figure 18. Aerated Lagoon System for an Industrial Wastewater*