

## **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:

Group Number	Max Permissible Average MPN Total Coliform Bacteria Per Month	Treatment Required
1	MPN not more than 1.0	None for protected ground water, but, at the maximum, chlorination for surface water
2	MPN not more than 50	Simple chlorination or equivalent
3	MPN not more than 5000, and this MPN exceeded in not more than 20% of samples	Rapid sand filtration (including coagulation) or its equivalent plus continuous chlorination
4	MPN greater than 5000 in more than 20% of samples and not exceeding 20,000 in more than 5% of the samples	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
5	MPN exceeds Group 4	Prolonged storage or equivalent to bring within Groups 1 to 4

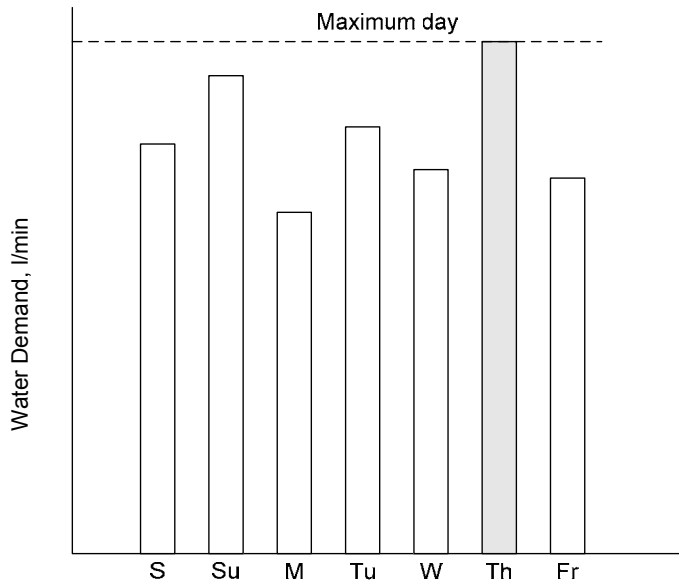
## **Other Parameters that Affect the Selection of the Degree of Treatment**

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

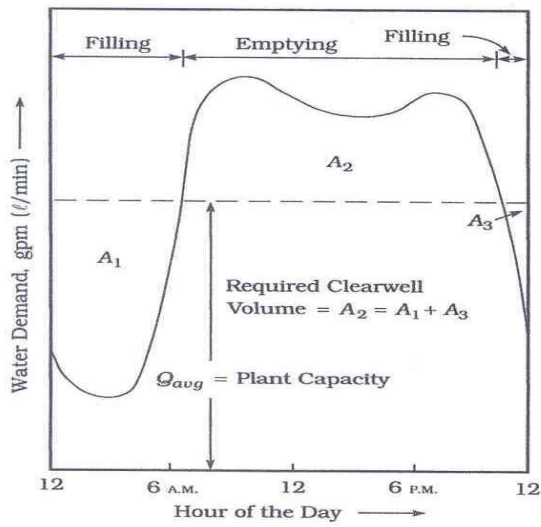
## **Design Parameters**

- 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

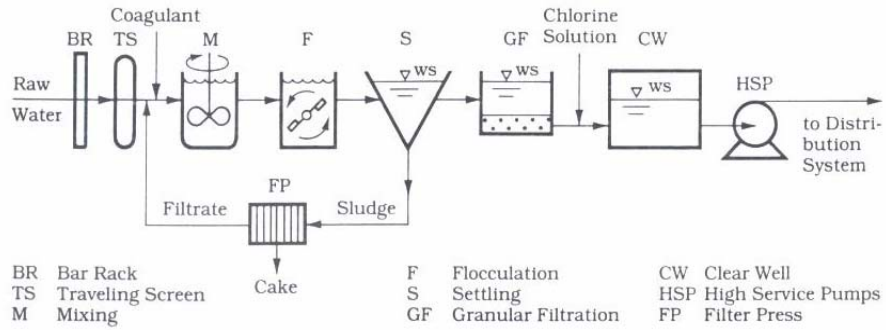
## Water Demand



## Clear Well

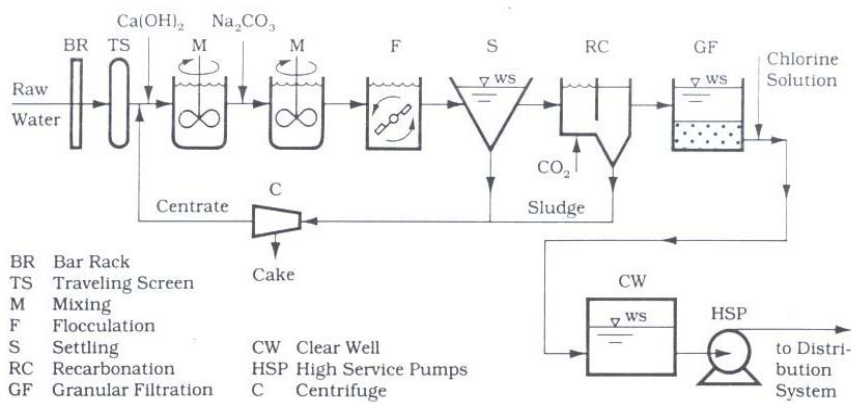


## Rapid Sand Filtration Plant



## Lime-Soda Softening Plant

Figure 1.2. Lime-Soda Softening Plant



## Groundwater Treatment Plant

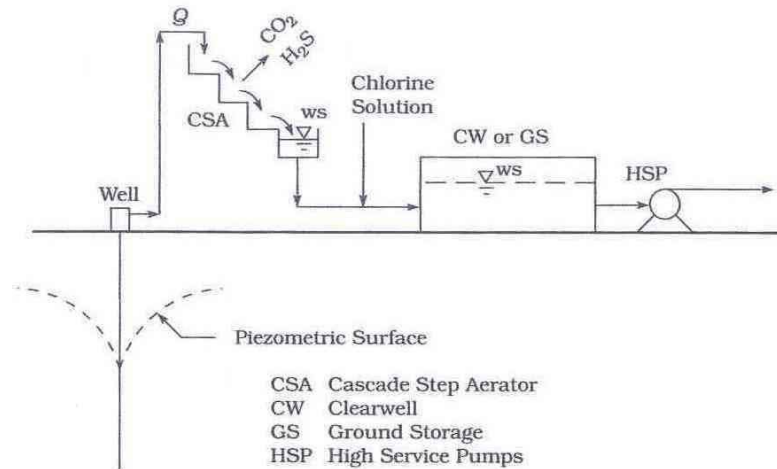


FIGURE 6.4 Typical Groundwater Treatment Plant

## 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

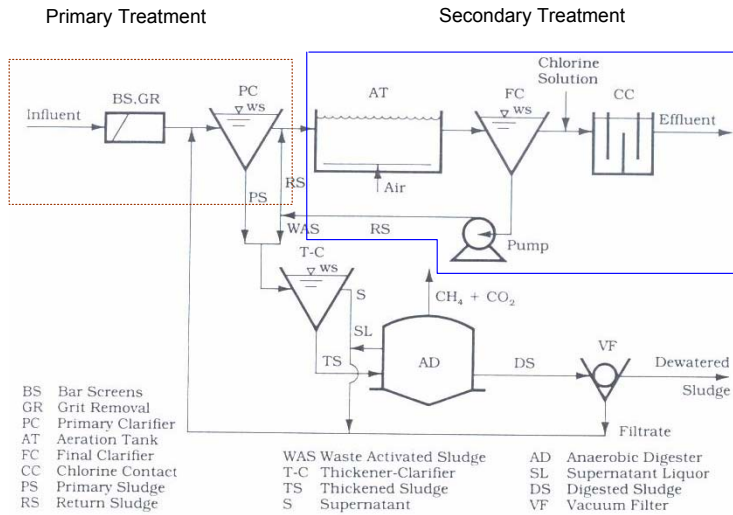
### ➤ Tertiary Treatment

- Provides further treatment to secondary effluent to increase its quality

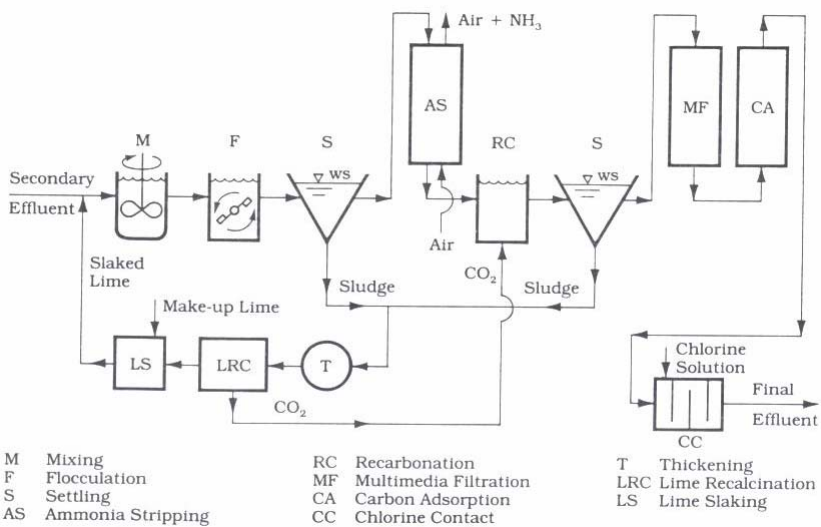
### ➤ Physical-chemical Treatment

- Uses several unit operations and processes
- Not as common as biological treatment

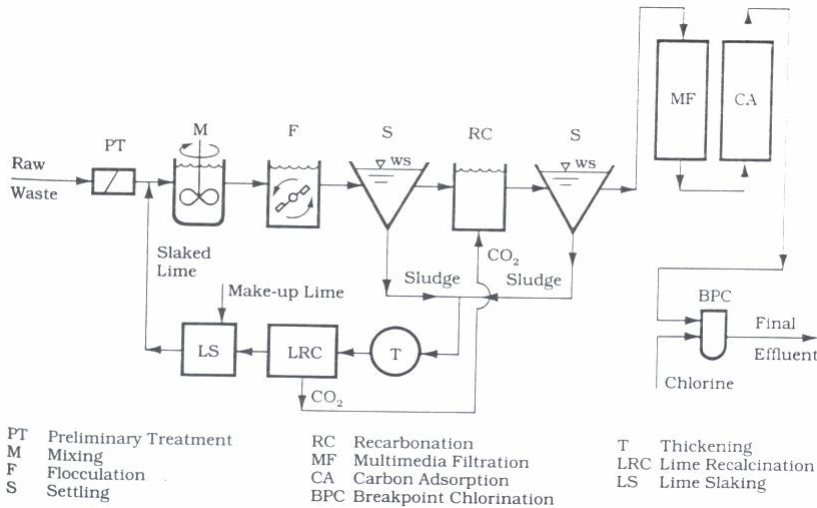
# Primary and Secondary (Activated Sludge) Plant



# Tertiary Treatment Plant



## Physical-Chemical Treatment Plant



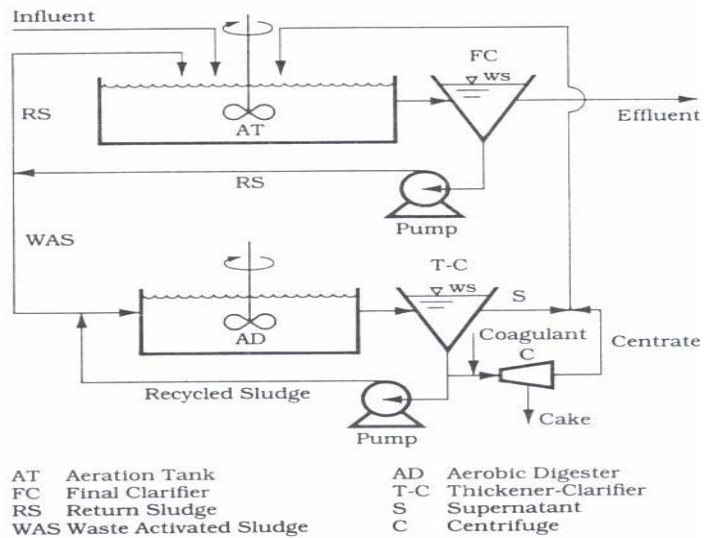
## Industrial Wastewater Treatment Plants

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:

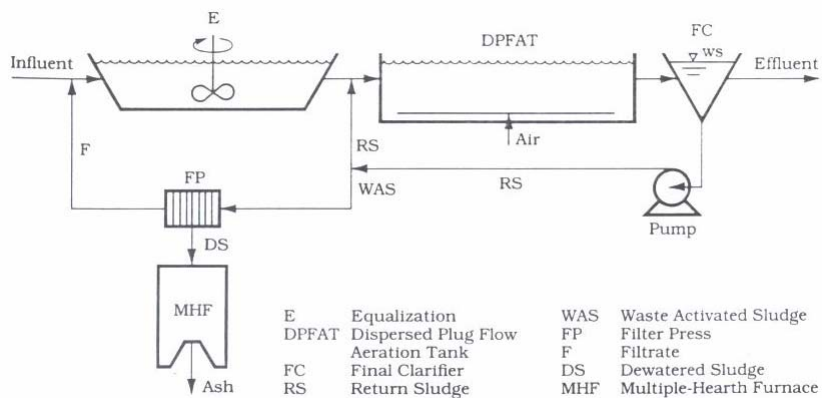
- Completely Mixed Activated Sludge
  - Used for low to moderate suspended solids contents
- Dispersed Plug-Flow Activated Sludge
  - Used where the organic contents vary considerably during the day
- Aerated Lagoon System
  - Used when appreciable land area is available



## Completely-Mixed AS Process



## Dispersed Plug-Flow AS Process



# Aerated Lagoon System

Figure 1.8. Aerated Lagoon System for an Industrial Wastewater

