water and liquid affluent management

Lecture 5

Sources of water pollution

- Until recently, water pollution was viewed primarily as a threat to human health because of the transmission of bacterial and waterborne diseases.

- Water pollutants comes mainly from industrial facilities and municipal wastewater treatment plants.

The most important types of water pollutants include

- Sediments and suspended solids, inorganic material washed into a stream as a result of construction and mining operations.
- Oxygen demanding substances, such as might be discharged from milk processing plants or paper mills.

- Nutrients, mainly nitrogen and phosphorus.
- Pollution from petroleum compounds “oil pollution”.
- Heat may be classified as s pollutant when it is caused by industry

The effect of pollution into aquatic environments

- The effect of pollution on streams **depends on the type of pollutant**. Some compounds are acutely toxic to aquatic life (e.g., heavy metals), and will cause dead zones downstream from the pollutant source. Some types of pollutants are health concerns to humans, but have little impact on stream communities.

- The effect of pollution on lakes differs in several respects from the effect on streams. Water movement in lakes is slower than in streams, so sediments tend to settle out of the water column rather than being transported downstream.

Measurement of water quality

- Quantitative measurements of pollutants are obviously necessary before water pollution can be controlled.

- Some tests require the measurement to be conducted at the site because the process of obtaining a sample may change the measurement.

- Most tests may be performed on a water sample taken from the stream.

- The process by which the sample is obtained, however, may greatly influence the result.

- The three basic types of samples are **grab samples**, **composite samples**, and **flow-weighted composite samples**.

Measurement of water quality

- The grab sample, as the name implies, measures water quality at only one sampling point. Grab samples accurately represent the water quality at the moment of sampling, but say nothing about the quality before or after the sampling.

- A composite sample is obtained by taking a series of grab samples and mixing them together.

- The flow-weighted composite is obtained by taking each sample so that the volume of the sample is proportional to the flow at that time.

Measurement of Water Quality

- Dissolved oxygen:

✓ Dissolved oxygen is inversely proportional to temperature.

- pH:

✓ he pH of a solution is a measure of hydrogen (H+) ion concentration, which is a measure of acidity.

- Alkalinity:
  - ✓ Water that has a high alkalinity can accept large doses of acids or bases without altering the pH significantly.
- Nitrogen and phosphorus.

Measurement of water quality

- Turbidity:

✓ Water that is not clear but is "dirty," in the sense that light transmission is inhibited, is known as turbid water.

- Color, taste and odor.

- Solids:

✓ Both dissolved and suspended materials are called solids.

- Heavy metals:

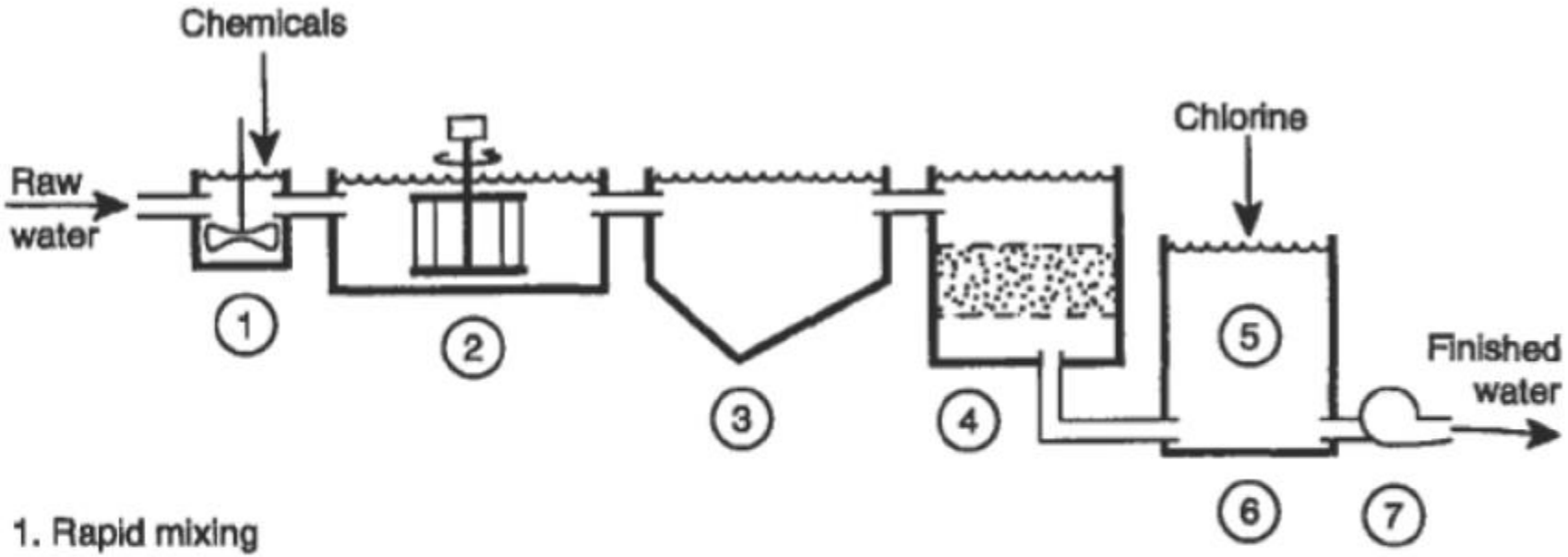
✓ Heavy metals such as arsenic, copper, and mercury.

Water treatment

- Generally, the characteristics of raw water determine the treatment method.
- Most public water systems are depended on for drinking water as well as for industrial consumption and fire fighting. Thus, we focus on treatment techniques that produce potable water.

- A typical water treatment plant is diagrammed in next figure. It is designed to remove odors, color, and turbidity as well as bacteria and other contaminants.

Water treatment



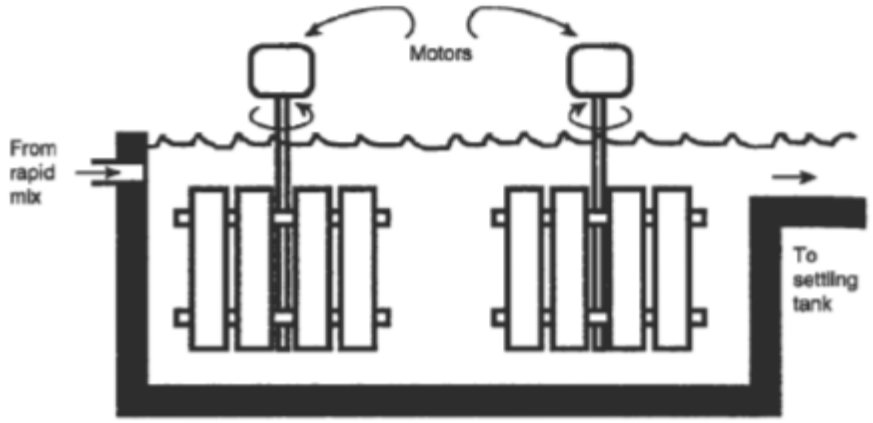
1. Rapid mixing
2. Flocculation
3. Settling
4. Filtration
5. Chlorination
6. Clear well storage
7. Pumping to distribution system

Water treatment

- Coagulation and flocculation:

➢ The removal of silt particles by settling requires first that their charges be neutralized and second that the particles be encouraged to collide with each other.

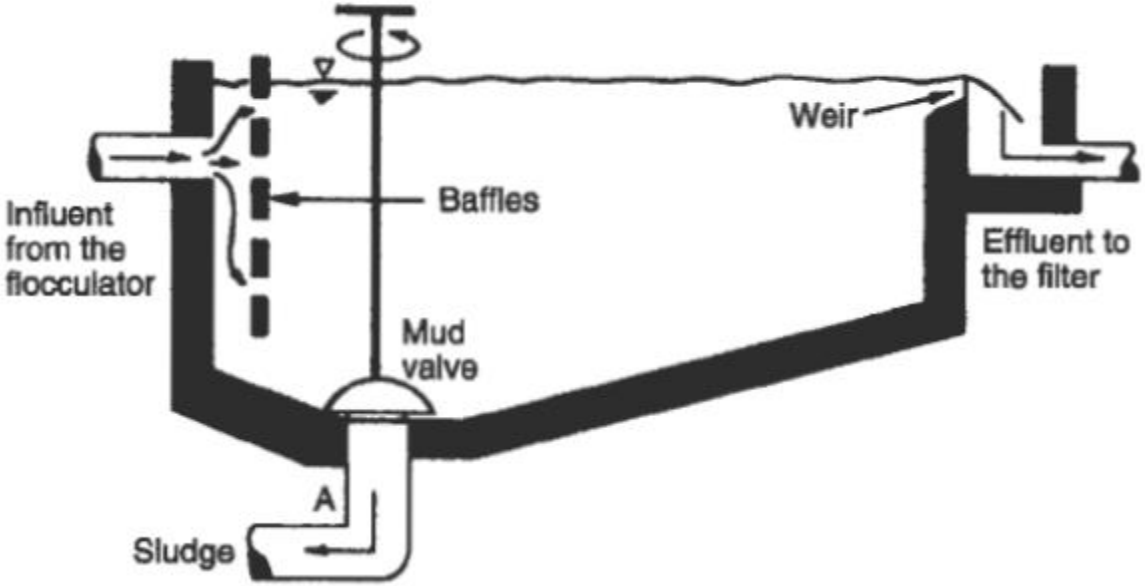
- The charge neutralization is called coagulation, and the building of larger flocks from smaller particles is called flocculation.



Water Treatment

- Settling:

➢ Settling tanks are designed to approximate uniform flow and to minimize turbulence.

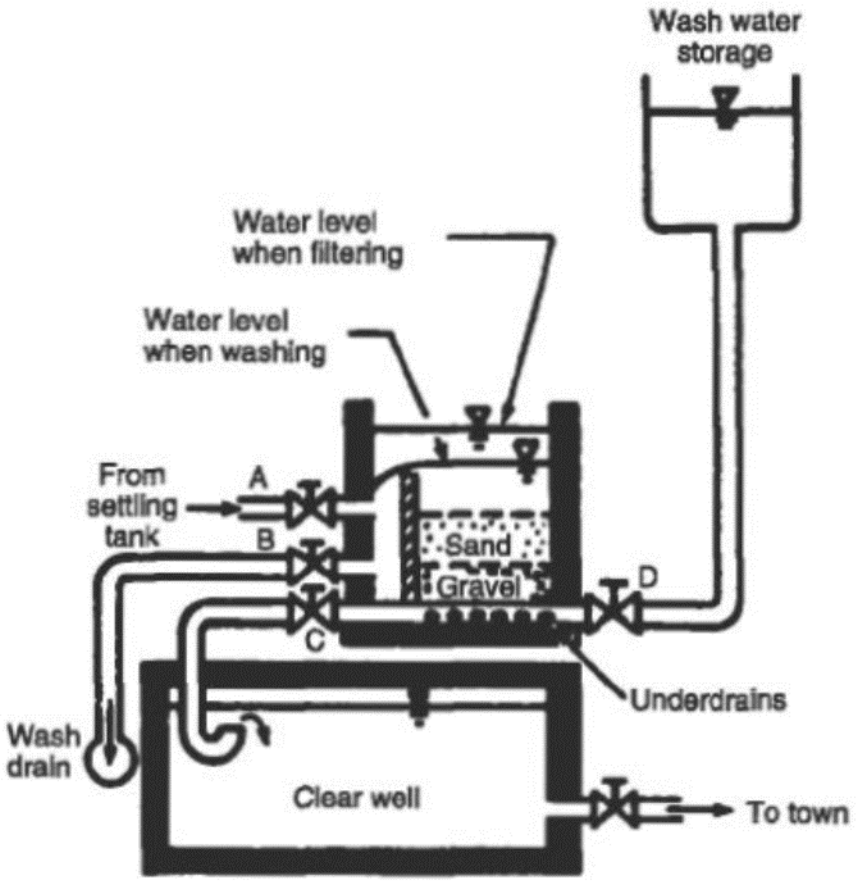


Water Treatment

- Filtration:

➢ The actual process of separating impurities from carrying liquid by rapid sand filtration involves two processes: filtration and backwashing.

- The rapid sand filter eventually becomes clogged and must be cleaned. Cleaning is performed hydraulically.



Wastewater Treatment

- The objective of wastewater treatment is to reduce the concentrations of specific pollutants to the level at which the discharge of the effluent will not adversely affect the environment or pose a health threat.

- Moreover, reduction of these elements need only be to some required level.
- For any given wastewater in a specific location, the degree and type of treatment are variables that require engineering decisions.
- Often the degree of treatment depends on the capacity of the receiving water equipment.

Wastewater Treatment Systems

- On-site Wastewater Treatment:

➢ Septic tank.

- Central Wastewater Treatment:

➢ The treatment system selected to achieve the effluent standards

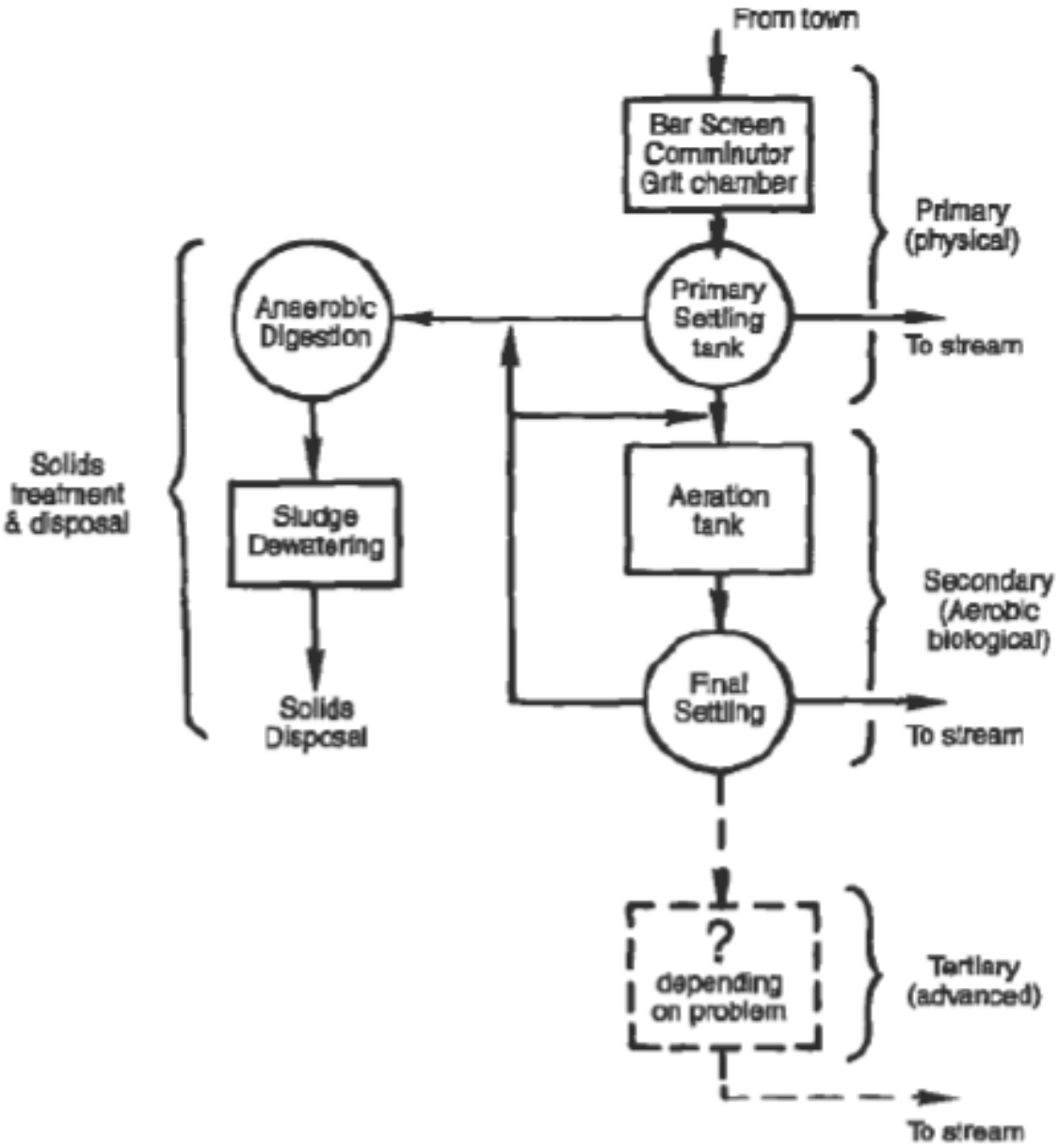
includes:

1. Primary treatment: physical processes that remove non-homogenizable solids and homogenize the remaining effluent.

2. Secondary treatment: biological processes that remove most of the biochemical demand for oxygen.

3. Tertiary treatment: physical, biological, and chemical processes that remove nutrients like phosphorus, remove inorganic pollutants, deodorize and decolorize effluent water.

Central Wastewater Treatment Plant



Wastewater Treatment Plant's Performance:

- Well-operated plants produce effluents that are often much less polluted than the receiving waters into which they are discharged. However, not all plants perform that well.

- Many wastewater treatment plants are only marginally effective in controlling water pollution, and plant operation is often to blame.

- Wastewater treatment requires proper plant design and proper operation.

- One without the other is a waste of money.