

Wastewater Engineering

Lecture - 7



Engr. Nadeem Ullah
Department of Civil Engineering,
Iqra National University Peshawar

Wastewater Treatment

- Secondary Treatment
- Tertiary Treatment

Secondary Treatment

- Followed by primary treatment, **secondary treatment** is given which primarily aims at removing biodegradable organic solids that remain in the dissolved form.
- Removal of nitrogen and phosphorus is also sometimes a part of the secondary treatment.
- In practice, secondary treatment comprises of biological treatment of wastewater, wherein microorganisms that consume biodegradable organic solids for their metabolism are used to remove the dissolved organic solids.

Secondary Treatment

- However, secondary treatment may also be aimed at removing non-biodegradable organics or dissolved chemicals, in such cases, it consists of chemical or physico-chemical treatment of wastewater.
- Secondary treatment methods include a secondary clarifier to settle out and separate biological flocs or filter materials settled down in the secondary treatment bioreactor.

Processes / Methods for Secondary Treatment

- Activated Sludge Process (ASP)
- Oxidation Ponds
- Constructed Wetlands

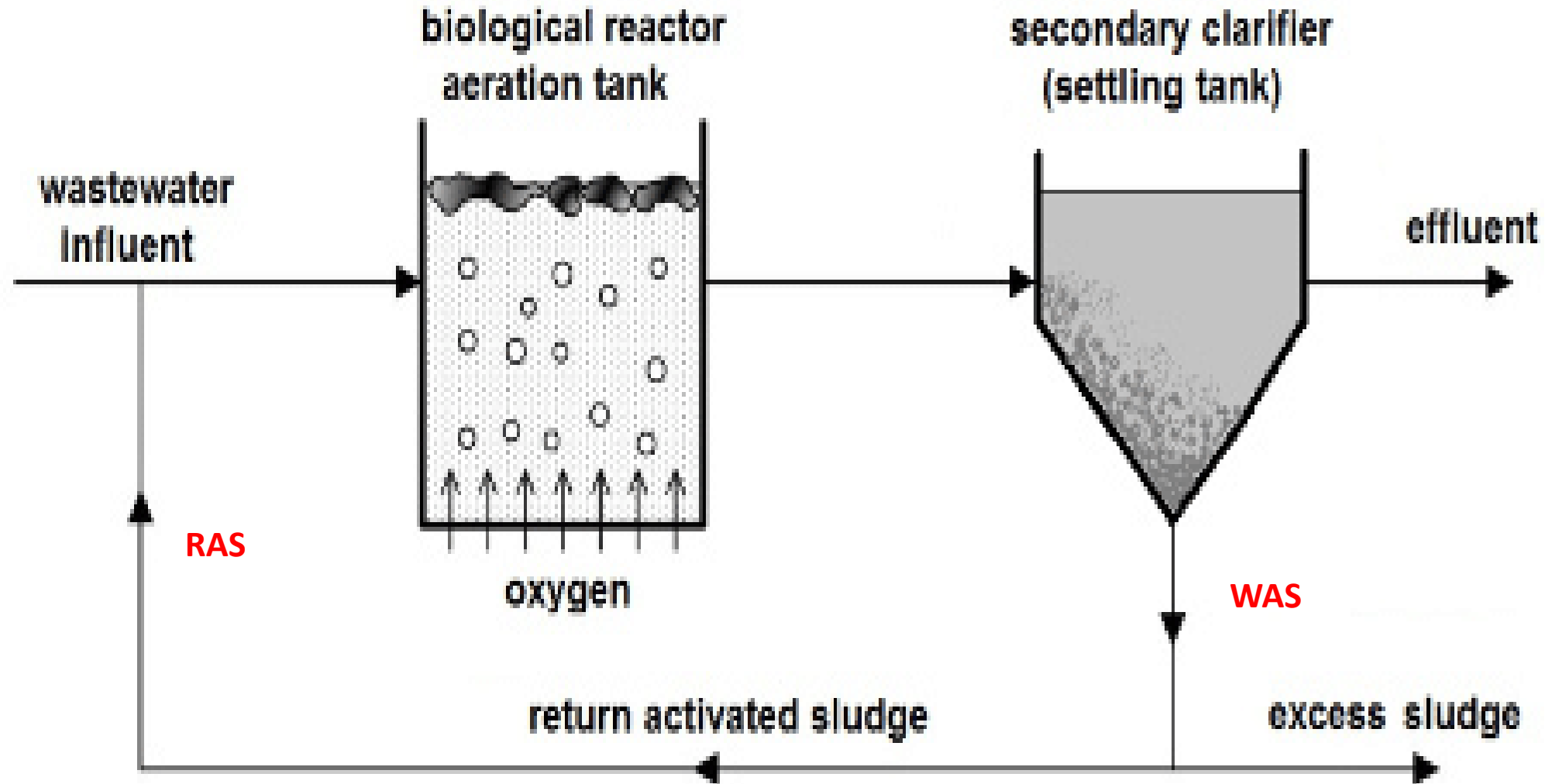
Activated Sludge Process (ASP)

- Microorganisms responsible for treatment are maintained in liquid suspension by appropriate mixing methods.
- Main constituents of ASP are Aeration tank in which oxygen is provided for the micro-organisms to grow. This aeration also helps to keep micro-organisms in suspension.
- Aeration tank is followed by Clarifier / Settler in which the micro-organisms form flocs and settled down at the bottom.

Activated Sludge Process (ASP)

- Formation of floc particles, ranging in size from 50 to 200 μm , removed by gravity settling, leaving relatively clear liquid as treated effluent;
- A part of settled bio flocs are recycled back to the aeration tank to maintain certain amount of micro-organisms in the system for efficient operation of the system. This is known as **Recycled Activated Sludge (RAS)**.
- Remaining settled bio flocs are removed from the system and is termed as **Wasted Activated Sludge (WAS)**.

Activated Sludge Process (ASP)



Activated Sludge Process (ASP)

- APS involves production of activated mass of microorganisms capable of stabilizing waste under aerobic conditions;
- In aeration tank, contact time is provided for mixing and aerating influent wastewater with microbial suspension, generally referred to mixed liquor suspended solids (**MLSS**).
- Typically 99% of suspended solids and up to 90 % of dissolved organics are removed by Activated sludge process.
- The main drawback associated with APS is its high electricity consumption particularly for aeration.

Oxidation Ponds

- **Oxidation ponds**, also called lagoons or stabilization **ponds**, are large, shallow **ponds** designed to treat wastewater through the interaction of sunlight, bacteria, and algae.
- Algae grow within the pond and utilize sunlight to produce oxygen during photosynthesis.
- This produced oxygen is utilized by aerobic bacteria in pond to stabilize organic wastes in the incoming wastewater.
- The broken down solids settled down at the bottom of the pond and results in a relatively treated effluent.

Oxidation Ponds

- Sufficient retention time (**HRT**) is provided to the influent for the treatment in the pond.
- Operational costs of oxidation ponds are less as compared to ASP and trickling filters but its treatment efficiency is also relatively too less.
- Its not a good option in areas if land is costly.



Constructed Wetlands

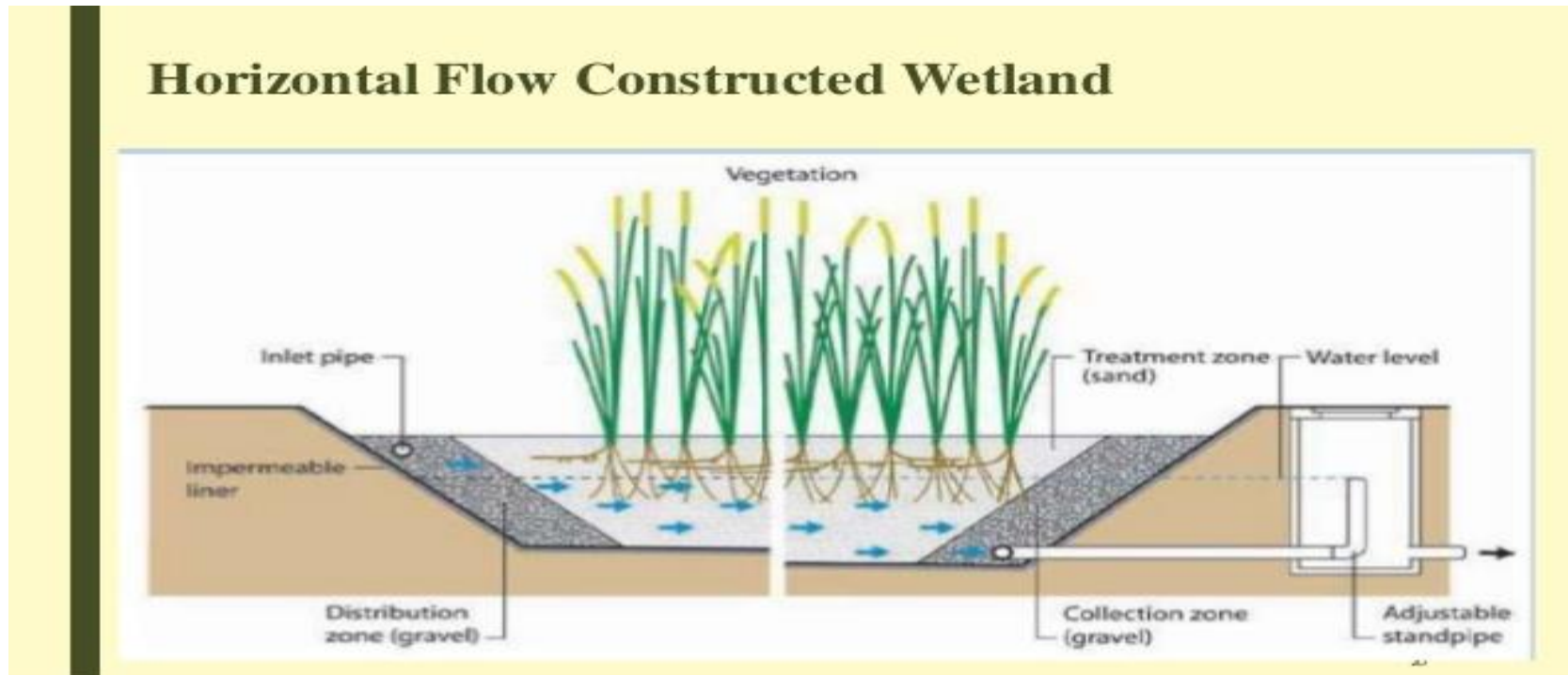
- A **constructed wetland (CW)** is an artificial wetland to treat municipal or industrial wastewater or stormwater runoff.
- Constructed wetlands are engineered systems that use natural functions vegetation, soil, and organisms to treat wastewater. Constructed wetlands have been used to treat both centralized and on-site wastewater.
- Primary treatment is recommended when there is a large amount of suspended solids or soluble organic matter (measured as BOD and COD).

Constructed Wetlands

- Similarly to natural wetlands, constructed wetlands also act as a biofilter and/or can remove a range of pollutants (such as organic matter, nutrients, pathogens, heavy metals) from the water.
- Constructed wetlands are a sanitation technology that have not been designed specifically for pathogen removal, but instead, have been designed to remove other water quality constituents such as suspended solids, organic matter and nutrients (nitrogen and phosphorus).

Constructed Wetlands

- All types of pathogens (i.e., bacteria, viruses, protozoan and helminths) are expected to be removed to some extent in a constructed wetland.



Tertiary Treatment

- **Tertiary treatment** is the final cleaning process that improves **wastewater** quality before it is reused, recycled or discharged to the environment.
- This treatment removes remaining inorganic compounds, and substances, such as the nitrogen and phosphorus.
- The main purpose of the **tertiary treatment** is to ensure that the **treated** wastewater which is to be released on to the environment is biologically accepted by all other fresh water organisms such as weeds and algae and also to follow discharge NEQs.

Methods used for Tertiary Treatment

- Trickling Filter
- Disinfection

Trickling Filter

- It is the most common type of attached growth process in which micro-organisms responsible for treatment are attached to some media such as rock, gravel, sand and wide range of plastic and other synthetic materials.
- Organic material and nutrients are removed from wastewater flowing past attached growth also known as biofilm.
- Wastewater is distributed over top area of vessel containing non submerged packing material.

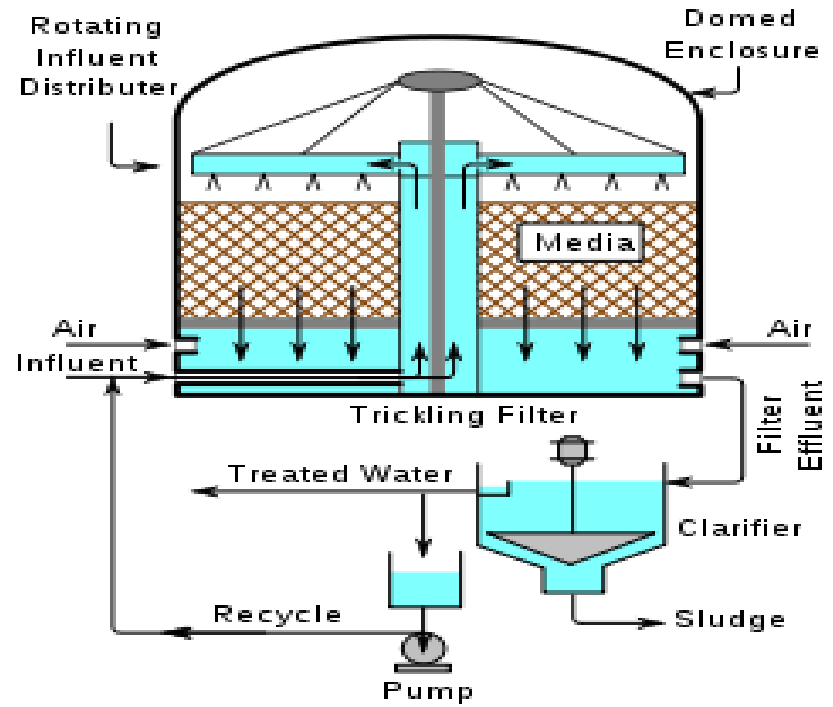
Trickling Filter

- Historically, rock was used with typical depths 1.25- 2 m.
- Modern trickling filters 5 to 10 m and filled with plastic packing material for biofilm attachment.
- 90-95% of volume in tower consists of void space.
- Air circulation in void space provides oxygen for microorganisms growing as attached biofilm.

Trickling Filter

- Excess biomass sloughs from attached growth periodically and clarification is required for liquid/solids separation.
- Treated wastewater (Effluent) is collected at the bottom of the trickling filter.
- Treatment efficiency is up to 75 % and is less energy consuming as compared to Activated Sludge Process.

Trickling Filter



Disinfection

- **Disinfection** prevents the spread of waterborne diseases by reducing microbes and bacterial numbers to a regulated / acceptable level.
- Disinfection is normally undertaken by chlorination, ozonation and ultraviolet (UV) radiation.

Thank you