EWCE 333
Wastewater Engineering and Sanitation

Lecture 13

Instructor

Lt Col Kazi Shamima Akter, Ph.D., Engrs

Associate Professor

Department of EWCE, MIST

Lecture Outline

Topics	Reference
• Types of biological treatment process • Activated sludge process • Significance of F/M ratio in activated sludge process	Water Supply and Sanitation - Feroz Ahmed and Mujibur Rahman ITN -BUET

Biological Treatment Processes

Suspended Growth Processes

- In suspended cultures, the microorganisms are suspended in the wastewater either as single cells or as clusters of cells called flocs.
- The microorganisms are surrounded by the wastewater which contains their food and other essential elements.
- Examples: Activated Sludge process, Waste Stabilization Ponds, Oxidation Ditches etc

Biological Treatment Processes

Attached Growth Processes

- Attached culture consists of masses of organisms adhered to inert surfaces with wastewater passing over the microbial film.
- Example: Trickling Filter process, Bio-Towers, Rotating Biological Contractors (RBC), Submerged Anaerobic Filters, Fluidized Beds etc.

Activated Sludge Process

- In the activated sludge process, raw sewage or primary effluent is brought into an aeration basin (reactor).
- In the aeration tank, air is bubbled into the wastewater mixture (mixed liquor) and aerobic bacteria metabolise the dissolved and suspended organic material.
- From the aeration basin, the effluent flows into a secondary sedimentation tank, where the cell mass are settled out.

Activated Sludge Process

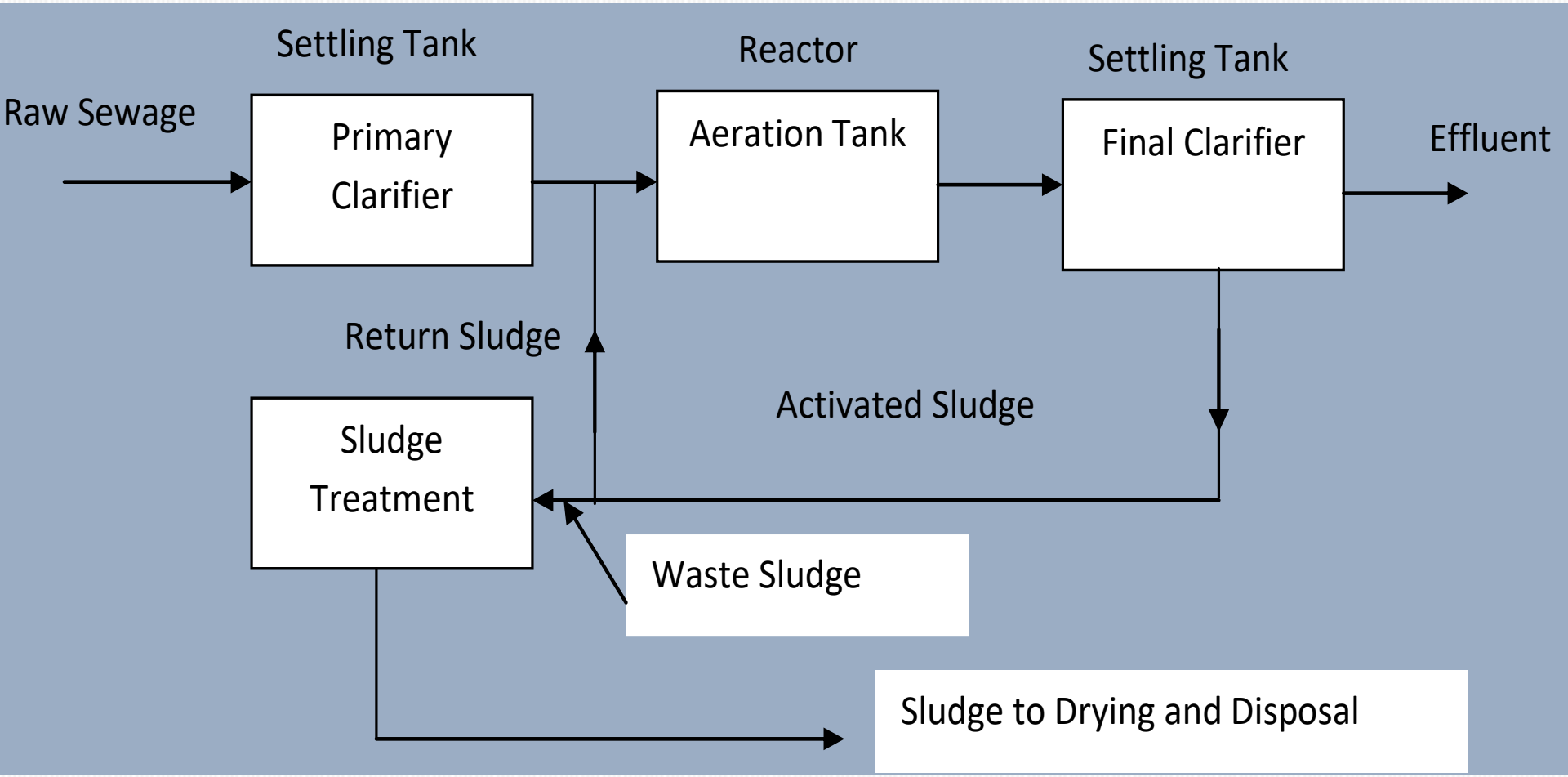


Figure: Schematic Diagram of the Activated Sludge Process

Activated Sludge Process

- Part of the settled biomass is wasted, and some of it is returned into the aeration basin to maintain a viable biomass concentration.
- The setteled sludge, containing living or active microorganism, which is returned to the aeration tank, is called activated sludge.
- This activated sludge increases the amount of available biomass and speed up the reaction.

Activated Sludge Process

Process Design Consideration

1. Mixing the activated sludge with the wastewater to be treated (mixed liquor).

2. Aeration and agitation of this mixed liquor for the required length of time.

3. Separation of the activated sludge from the mixed liquor, in the final clarification process.

4. Return the proper amount of activated sludge for mixture with the wastewater.

5. Disposal of the excess activated sludge.

Significance of F/M on Activated Sludge Process

At a high F/M ratio –

- Microorganisms are in the exponential growth phase, characterized by excess food and maximum rate of metabolism.

- Although the exponential growth phase is desirable for maximum rate of organic matter removal. The microorganisms are in dispersed growth such that they do not settle out of solution by gravity.

Significance of F/M on Activated Sludge Process

- Consequently, the settling tank is not effective in separating microorganisms from the effluent for return to the aeration lank.
- Again, there is excess unused organic matter in solution which cannot be removed by sedimentation and passes out in the effluent.
- Operation at a high F/M ratio results in poor BOD removal efficiency.

Significance of F/M on Activated Sludge Process

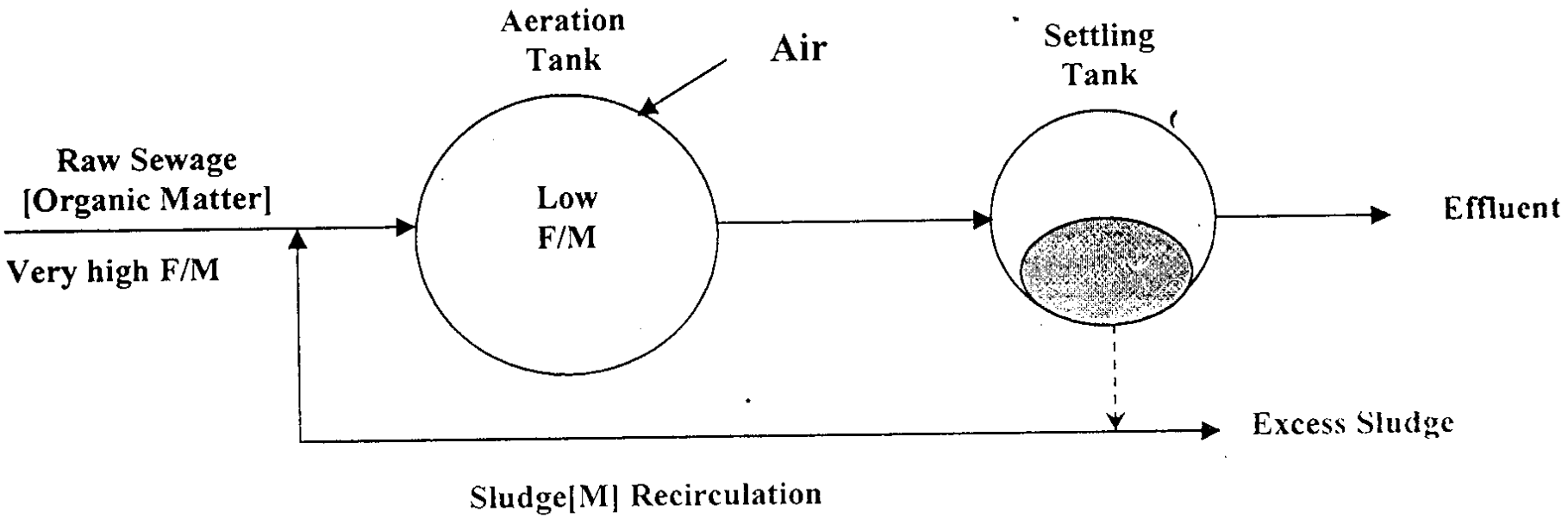


Figure: Food/Microorganism ratio in Activated Sludge Process

Significance of F/M on Activated Sludge Process

At a low F/M ratio –

- Overall metabolic activity in the aeration tank may be considered endogenous.

- Although initially there is rapid growth when the influent food and return microorganisms are mixed, competition, for the small amount of food made available to the large mass of microorganisms results in near-starvation conditions for the majority of microorganisms within a short period of time.

Significance of F/M on Activated Sludge Process

- Under these conditions, continued aeration results in auto-oxidation of the microbial mass through autolysis and re-synthesis.

- Although the rate of metabolism is relatively low in the endogenous phase, metabolism of the organics nearly complete and the microorganisms flocculate rapidly and settle out of solution by gravity.

- The good settling characteristics exhibited by activated sludge in the endogenous phase make operation in this growth period desirable where a high BOD removal efficiency is desired.

Activated Sludge Process

Design Criteria

- The mixed liquor suspended solids concentration (MLSS) ranges from 1,500 to 3,000 mg/L.
- The hydraulic detention time is from 6 to 24 hours.
- The solids residence time is from 3 to 20 days.