MICROBES IN SEWAGE TREATMENT

(1) Cities and towns generate significant volumes of wastewater, primarily composed of human excreta, which is commonly referred to as sewage. Sewage contains high levels of organic matter and a variety of microbes, including pathogens.

(2) Due to its composition, sewage cannot be directly discharged into natural water bodies such as rivers and streams. Therefore, sewage undergoes treatment in sewage treatment plants (STPs) before disposal to reduce its pollutant levels.

(3) The treatment of wastewater relies on heterotrophic microbes naturally present in sewage. This treatment occurs in several stages, including primary, secondary, and tertiary treatments.

(a) Primary treatment: This stage involves a physical process aimed at removing large and small particles from sewage through filtration and sedimentation.

(i) Sequential filtration: Floating debris is eliminated through sequential filtration processes.

(ii) Sedimentation: Grit, such as soil and small pebbles, is separated from the sewage through sedimentation. The solids that settle form primary sludge, while the supernatant becomes primary effluent, which is then directed for secondary treatment.

(b) Secondary treatment or biological treatment:

(i) Primary effluent is introduced into large aeration tanks where constant mechanical agitation and aeration occur through the introduction of air.

Fig.: Secondary treatment

(ii) In aeration tanks, beneficial aerobic heterotrophic microbes undergo robust growth, forming aggregates known as flocs. These flocs consist of bacterial clusters intertwined with fungal filaments, creating mesh-like structures.

(iii) During their growth, these microbes metabolize a significant portion of the organic matter contained in the effluent. This leads to a considerable reduction in the Biochemical Oxygen Demand (BOD) of the effluent.

(iv) Biochemical Oxygen Demand (BOD) is defined as the quantity of oxygen consumed if all the organic matter in one liter of water were oxidized by bacteria. The BOD test evaluates the rate at which microorganisms in a water sample consume oxygen, thereby indirectly assessing the organic content in the water. Higher BOD levels in wastewater indicate greater pollution potential.

(v) Treatment of sewage water continues until the Biochemical Oxygen Demand (BOD) is substantially decreased. After significant reduction in BOD, the effluent from the aeration tank is directed into a settling tank, where bacterial flocs settle down. This sediment is known as activated sludge.

(vi) A portion of the activated sludge is recycled back into the aeration tank to act as inoculum. The majority of the sludge is transferred to large tanks referred to as anaerobic sludge digesters.

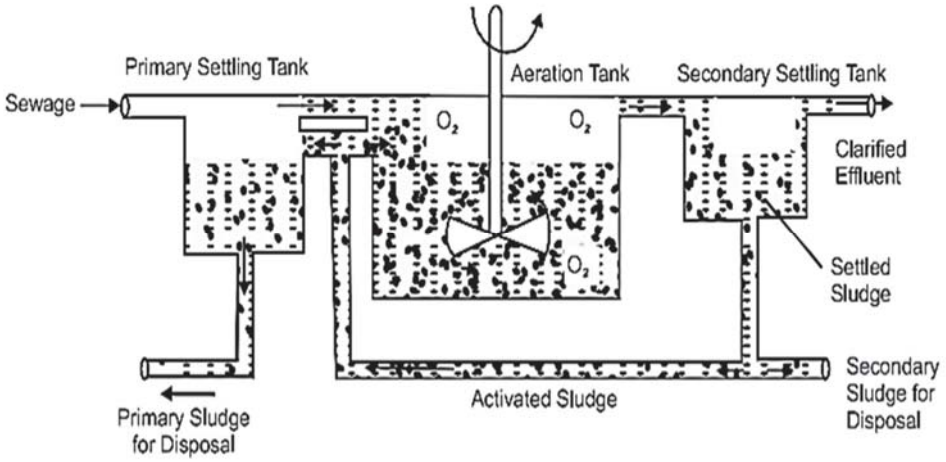

Fig.: Activated sludge method of sewage treatment

(vii) Anaerobic sludge digesters operate by utilizing anaerobic methanogenic bacteria to break down the bacteria and fungi within the sludge. Throughout this digestion process, a blend of gases, including methane, hydrogen sulfide, and carbon dioxide, is generated by the bacteria. These gases collectively form biogas, which serves as a combustible energy source.

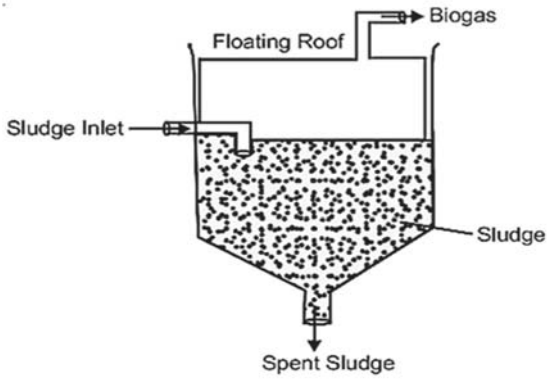

Fig.: Anaerobic sludge digester

(viii) Typically, the effluent from the settling tank of the secondary treatment plant is discharged into natural water bodies such as rivers and streams.

Figure : An aerial view of a sewage plant

Thus, microbes are pivotal in processing millions of gallons of wastewater daily worldwide. This approach has been employed for over a century across nearly all regions

of the world. To this day, no artificial technology has matched the effectiveness of microbial sewage treatment.

(c) Tertiary treatment: When wastewater is intended for domestic use, tertiary treatment is essential. This stage involves a physico-chemical process employing various methods such as chlorine gas, ozone gas, zirconium, perchlorate salts, ultraviolet (U.V.) rays, or reverse osmosis. These techniques are employed to eliminate contaminants like DDT, pesticides, pathogens, and turbidity from the wastewater.

River Action Plans

(1) With urbanization on the rise, the production of sewage has surged to unprecedented levels. Unfortunately, the infrastructure for sewage treatment plants has not kept pace with this surge, leading to the discharge of untreated sewage directly into rivers. This unchecked discharge is a major cause of river pollution and contributes to the spread of waterborne diseases.

(2) To address this pressing issue, the Ministry of Environment and Forests launched the Ganga Action Plan in 1985 and the Yamuna Action Plan, aimed at preserving these vital rivers from pollution. These initiatives propose the construction of numerous sewage treatment plants to ensure that only treated sewage is released into the rivers.