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Role of microorganism in waste water treatment

Wastewater can be defined as water sample which is contaminated to the degree that it is no longer beneficial, and must be treated before it can be used or released back into the environment. Four major types of wastewater are as follows- domestic/municipal wastewater industrial, urban runoff and agricultural runoff.

Waste water system usually refer to sewage treatment, or domestic wastewater treatment. Process of removing contaminants from wastewater, both runoff and domestic to produce water that is safe for environment includes physical treatment, biological treatment and chemical treatment. Biological wastewater treatment involves use of microorganisms such as bacteria, viruses and protozoa which are metabolize the biological content (dissolved organic matter) of the sewage. The contaminants of organic substances are digested as food along with other energy source by the cell. There are two different types of digestion process. Aerobic digestion which need oxygen generate carbon dioxide and anaerobic digestion do not require oxygen and capable of producing biogas. There are Three main approaches of waste water treatment system. **A. Fixed Film systems** which usually grow microorganisms on substrates such as rocks, sand or plastic. Then wastewater is spread over the substrate ex: trickling filters, rotating biological contactors.

In case of **a) Trickling filters bed** media made of coke or limestone chips or specially fabricated plastic media. And microbes are attached to the media in the bed and form a bio film over it. The wastewater is spread over this bio film of aerobic microorganisms which oxidize the organic matter.

Trickling filters has components like septic tank for removal of the solids present in the wastewater, clarifier used to settle out biological materials of the wastewater and application system that distributes treated wastewater to the proper site.

Whereas **b) Rotating biological contactors** consists of disc, bio film and aerobic reactor system solid media encourages microbial growth in a static bio film. primary function of it is reduction of organic matter.

B. Suspended film systems on the other hand stir and suspend microorganisms in wastewater and settled out as a sludge which then pumped back into the incoming wastewater ex: activated sludge, extended aeration.

a) In Activated sludge type, primary wastewater mixed with bacteria rich (activated) sludge and air or oxygen is pumped into the mixture. Here mixed community of microorganisms is used. Both aerobic and anaerobic bacteria make up about 95% of the activated sludge biomass and they grow in wastewater by consuming biodegradable materials such as proteins, carbohydrates, fats

and similar compounds. Components of activated sludge process consists of aeration tank where oxygen is introduced into the system. aeration source is meant for adequate oxygen supply into the tank and provided pure oxygen or compressed air. Clarifier / settler separates activated-sludge solids from the surrounding wastewater.

Activated sludge outflow line pump activated sludge back to the aeration tank and effluent outflow line discharged effluent into tertiary treatment plant.

b) Membrane bioreactors: It is an improvement of the conventional activated sludge process where secondary clarifier is replaced by a biological aeration basin followed by membrane unit for the separation of treated water from the mixed solution in the bioreactor. Membrane fibers have numerous microscopic pores on the surface and the pores form a barrier to allow pure water molecules to pass.

c) Facultative stabilization pond has shallow ponds typically 1-2m deep. Symbiotic action of algae and bacteria are used for decomposition. Top layer is aerobic while the bottom layer is anaerobic. Here algae utilize CO₂, sulphates, nitrates, phosphates, water and sunlight and gives oxygen that is available to bacteria and other microbes.

d) Constructed wetlands is a small artificial wastewater treatment systems consisting of one or more shallow treatment cells, with herbaceous vegetation to enhance pollutant removal from storm water runoff • microbial, biological, physical and chemical processes to treat wastewater.

C. Free water surface systems microorganisms mostly bacteria and fungi live on the surface of the aquatic plants and soils. During decomposition, oxygen is utilized by microorganisms attached to the aquatic plants below the level of the water subsurface flow systems. Soil, sand, or gravel is used as substrate for plant growth • water flow passes through substrate and root system. Organic matter is biologically decomposed e.g. nitrogen can be denitrified and heavy metals and phosphorous are fixed to the soil.

Biotechnological engineering approach of wastewater systems

The microbes have a natural ability to degrade pollutants from wastewater. Thus advanced technologies using microbes must be applied such as advanced oxidation processes (AOPS) and membrane separation technologies, and their combined application may constitute the best option for wastewater treatment and their reuse.

Role of microorganism in sewage treatment

sewage is defined as waste matter carried in sewers or drains. It is a “mixture of water and solids separated from various types of water as a result of natural or artificial processes”. Sewage could be sludge or wastewater which come from: – domestic used water and toilet wastes, rainwater (surface runoffs), industrial effluent and agricultural wastes.

Purpose of treatment of sewage includes– elimination of potential pathogens and toxins, decreasing nutrient content or reduction of microbial growth and removal of odour and chemical contaminants.

Nature and characteristics of sewage: The properties of sludge of urban sewage wastewater treatment differ from place to place and it depends on the structure of the population and its eating

habits, season, diversity of industrial and agricultural units which overflow the wastewater into the urban sewage, on the way of its treatment in the purification plant etc. Sewage is 99.9% water and 0.02-0.04% solids and sewage sludge is formed at the wastewater sewage treatment plants. It contains mineral, organic, and biological impurities and microorganisms in soluble, insoluble and colloidal forms. The important physical, chemical and biological properties of sewage are: temperature, the Ph, colour, odour, solids, nitrogen, phosphorus, chlorides, toxic metals and organic material.

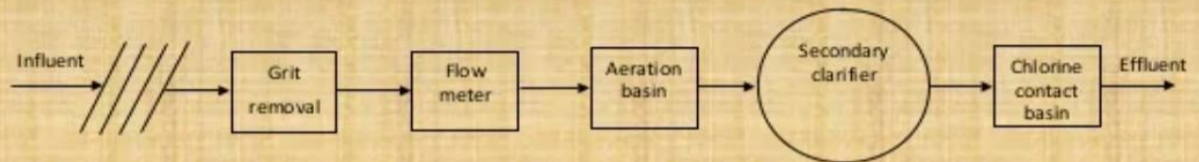
Microorganisms found in sewage: Bacteria- *Salmonella typhimurium*, *Vibrio cholerae*, *Clostridium botulinum*, *Escherichia coli* etc. Nematodes, Viruses, Protozoa- *Entamoeba histolytica*, *Cryptosporidium parvum* etc.

B.O.D- It is the amount of oxygen required for microbial decomposition of organic matter in sample. Oxygen is removed from water when organic matter is consumed by bacteria. Low oxygen conditions may kill fish and other organisms. B.O.D of Raw sewage is 300 to 400 mg/liter, natural water body is 5-10mg/l.

Large scale wastewater treatment is multi-series process. It includes primary treatment, secondary treatment and advanced treatment

Effluent or treated liquid is discharged into water bodies. Sludge (solid) is further treated in anaerobic digester and disposed off Primary treatment filter & settle solids and remove ~50% of solids. In Anaerobic sludge digestion, anaerobic organisms act on solids (sludge). Here various populations act sequentially. Then remaining sludge dehydrated and disposed for incineration, landfill or making of fertilizer. Secondary treatment eliminates most of remaining impurities by the process of microbial degradation of organic material. In Tertiary or advanced treatment physical, chemical or biological processes increased over primary and secondary treatment. Removal of ammonia, nitrates and phosphates are done. Ammonia stripping is a process liberates gaseous ammonia from water, denitrification is the process /which uses bacteria for creation of Nitrogen gas). chemical precipitation refers to phosphate removal. Disinfection performed before effluent is discharged. Use of chlorine, ozone and ultraviolet light reduce numbers of microorganisms and viruses .

Overview of Wastewater Treatment System



NB. Include name of some microorganisms and relevant

Wastewater Treatment Categorization

Primary	Secondary	Advanced
<ul style="list-style-type: none">• Primary clarification• Chlorination	<ul style="list-style-type: none">• Activated sludge• Trickling filter• Rotation biological contractor	<ul style="list-style-type: none">• Unit operations• Unit processes• N, P, SS, etc

diagrams.