



Waste Water Treatment

Sewage

- ▶ Waste water often contains high levels of organic matter from industrial, agricultural and human wastes.



Sewage

- ▶ Sewage is a collection of all domestic, industrial and storm-water run-off



Sewage

- ▶ The treatment of human waste-impacted waters, with many pathogens that may be present is very important



Wastewater

- ▶ Defined combination of liquid or water carried wastes removed from residences, institutions, and commercial and industrial establishments
- ▶ If left untreated, can spread diseases



BOD

- ▶ Efficiency of waste removal is expressed in terms of reduction of BOD
 - ▶ BOD – biochemical oxygen demand – amounts of dissolved oxygen consumed by microorganisms
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BOD

- ▶ The dissolved oxygen content of the sample, with or without dilution is measured before and after incubation at 20 °C for 5 days

Sewage treatment

- ▶ Use of modern sewage treatment, together with chlorination has led to major reduction in the world wide spread of pathogens



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Sewage treatment

- ▶ Sewage treatment involves
 - Primary
 - Secondary
 - Tertiary

Major steps in the treatment of wastes

- ▶ Primary Treatment
 - ▶ Involves removal of insoluble particulate materials by
 - Screening
 - Addition of alum
 - Addition of other coagulation agents
 - Physical procedures
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Primary Treatment

- ▶ Primary treatment can physically remove 20–30% of the BOD that is present in particulate form
 - ▶ Settle able solid materials are removed by holding the sewage in sedimentation units (tanks and basins)
 - ▶ The resulting solid material from the primary treatment is called sludge.
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Primary Settling Tanks



Secondary Treatment

- ▶ Involves biological removal of dissolved organic matter.
 - ▶ About 90–95% of the remaining BOD and many bacterial pathogens are removed by this process
 - ▶ Various techniques are involved. All involve similar microbial activities
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Secondary Treatment

- ▶ Types
 - Trickling filters
 - Activated sludge method
 - Lagoons
 - Extended aeration systems
 - Anaerobic digesters

Trickling filters

- ▶ The waste effluent is passed over rocks or other solid materials upon which microbial films have developed
 - ▶ Microbial community in these films degrades organic waste
 - ▶ Passage of waste water through the filter causes the development of zoogeleal film (bacteria, protozoa, etc.)
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Trickling Systems



Organisms in Trickling Filters

- ▶ Zooflagellates
 - Especially in highly loaded systems
- ▶ Amoebae
 - Different species in different systems
- ▶ Ciliates
- ▶ Nematoda
- ▶ Diatoms



Activated Sludge Method

- ▶ Involves horizontal flow of material with a recycle of sludge
- ▶ Sludge is the active biomass formed when organic matter is degraded and oxidised by microorganisms.



Activated Sludge Method

- ▶ Two systems
 - Low rate – low nutrient input/unit of microbial biomass. Produce good quality effluent
 - High rate – high nutrient input/unit of microbial biomass. Produce poor quality effluent

Activated Sludge Method



Lagoon Systems

- ▶ Shallow basins which hold wastewater for several months to allow natural degradation of sewage
- ▶ Relies heavily on interaction of sunlight, algae, microorganisms and oxygen.

Aeration System



Anaerobic Digestion of Wastes

- ▶ Reduce the bulk of sewage sludge
 - Sludge from aerobic sewage treatment together with materials settled out in primary treatment are further treated by anaerobic digestion

Anaerobic Digestion of Wastes

- ▶ Sludge from aerobic sewage treatment together with materials settled out in primary treatment are further treated by anaerobic digestion

Anaerobic Digestion of Wastes

- ▶ Anaerobic digesters are large fermentation tanks designated to operate anaerobically with continuous input of untreated sewage and removal of final stabilised sludge product.
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Anaerobic Digestion

- ▶ Three steps
 - Fermentation of sludge components to form organic acids, including acetate
 - Production of methanogenic substrates
 - Acetate
 - CO₂
 - Hydrogen
 - Methanogenesis by methane producers. Resulting methane is removed by vents

Anaerobic Digesters

- ▶ Microbial biomass used for methane production
 - ▶ Sludge occupies less volume and dries easily
 - ▶ Accumulation of heavy metals and other environmental contaminants in sludge
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Anaerobic Digesters



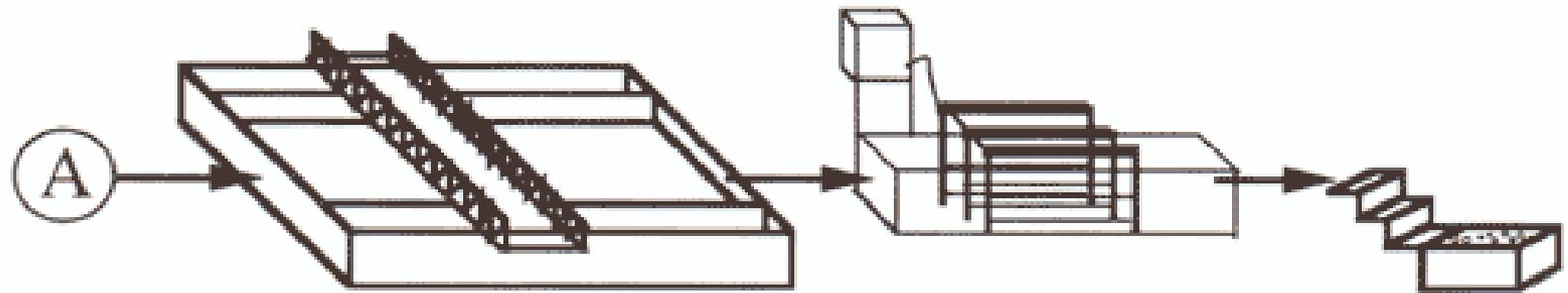
Tertiary Treatment

- ▶ Most complete method of treating sewage but not widely adopted
- ▶ Expensive
- ▶ Wastewater is nutrients removed completely that it is unable to support growth

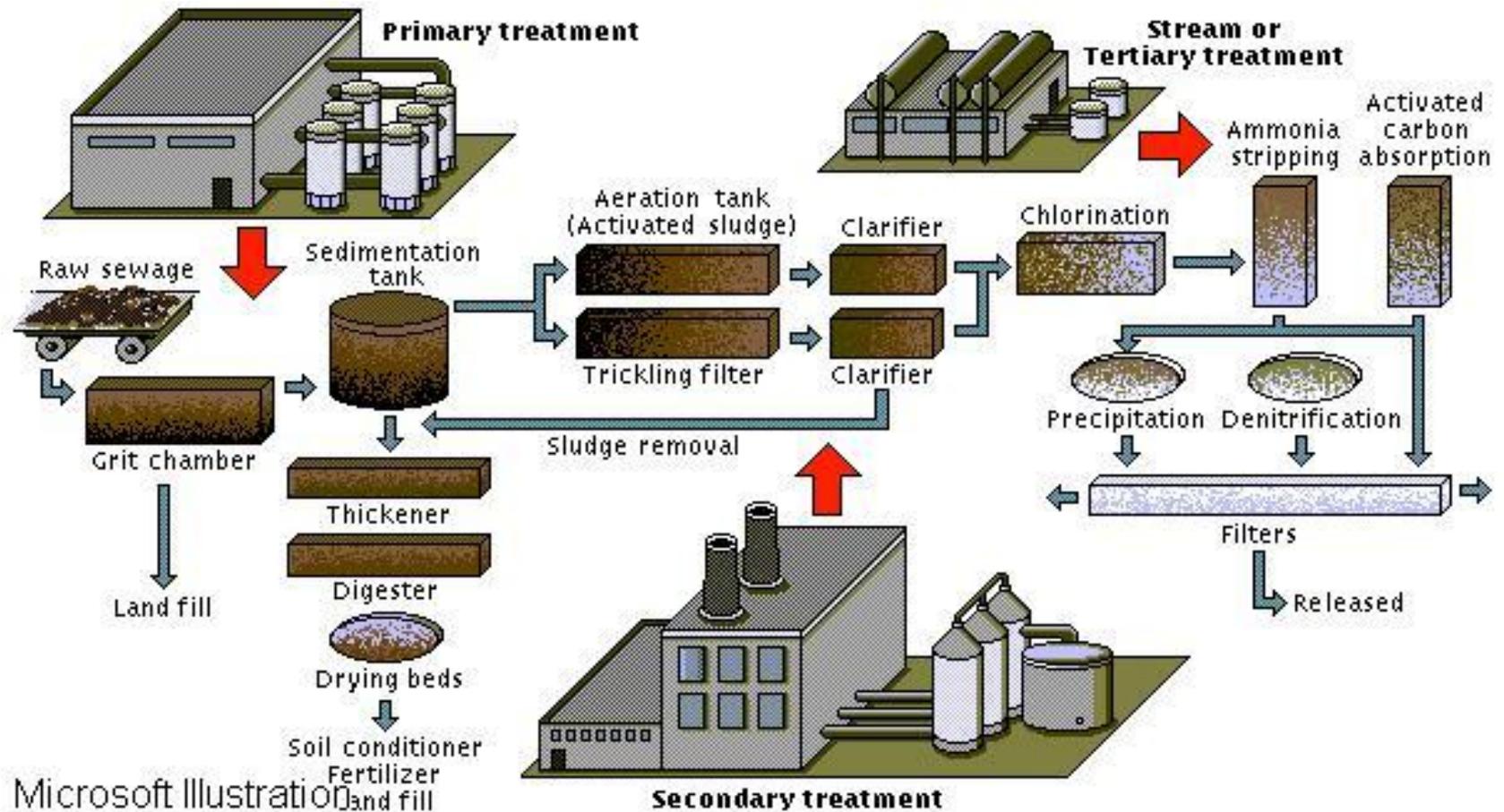
Tertiary Treatment

- ▶ Becoming more popular in areas where water is a shortage
- ▶ Remove nutrients
 - Ammonia stripping
 - Denitrification
 - Phosphate precipitation
- ▶ Removed dissolved solids
 - Reverse osmosis
 - Electrodialysis

Tertiary Treatment



Summary of Wastewater Treatment



Microsoft Illustration