

Wastewater Treatment plants

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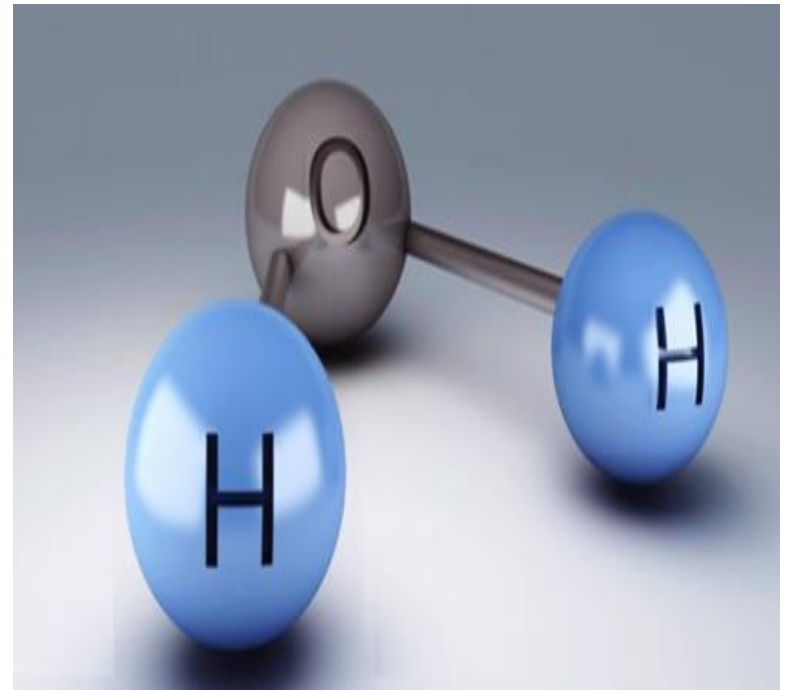
Introduction :

- * Wastewater is water whose physical, chemical or biological properties have been changed as a result of the introduction of certain substances which render it unsafe for some purposes such as drinking.
- * Wastewater management is an important process in the water sector which supplemented water budget with non-conventional water sources and protect the environment to ensure public health, economic, social and political soundness.

Why Treat Wastewater ?

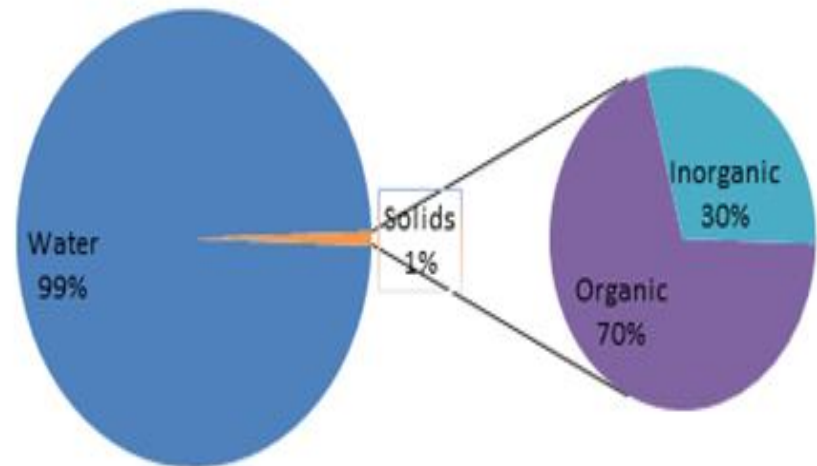
➤ Water Polarity

- * The chemical composition of the water molecule consisting of two hydrogen atoms, chemically linked with one oxygen atom (H_2O), is highly polar in nature, that giving it a superior ability to dissolve most organic substances (e.g. proteins, fats, etc.), inorganic (e.g. salts, phosphorus, etc.), as well as Atmospheric gases (e.g. nitrogen, oxygen).



➤ Wastewater Components and properties

- * Wastewater contains 99.9% of the water, and the rest is organic, inorganic materials and gases that added to it, as a result of the permanent movement of water in nature and its superior ability to dissolve most of the materials.



Components Of Wastewater

➤ Pollutant sources

The water is contaminated with different kinds of impurities, As a result of:

- * 1. Dissolving a large amount of gases, dust and fumes in the air during rainfall.
- * 2. Dissolve part of the contents of the soil, rocks, human, animal and plant residues during runoff on the surface of the earth and the inner soil layers.
- * 3. Disposal of different types of pollutants due to different uses of water in homes, industrial and agricultural processes, and trade and transport purposes.



➤ Causes of wastewater Treatment

- * One of the difficult challenges facing the world today is water scarcity, as a result of the large increase in the rate of water consumption, where this increase is linked to the increase in industrial progress, and increase in population numbers, as well as the risk of sewage disposal directly to surface water or groundwater sources

➤ Causes of wastewater Treatment

It contributes to the achievement of many objectives:

- * 1. Environmental conservation.
- * 2. protection water bodies and groundwater from contamination.
- * 3. Stop the spread of epidemics and diseases that are formed because of the presence of pathogens in the wastewater.
- * 4. Reuse of wastewater after treatment in many human activities.



➤ Types of wastewater

Wastewater can be described as in the figure below :



➤ Types of wastewater

Stormwater Runoff : is water from streets, open yard, etc after a rainfall event which run through drains or sewers.

Industrial wastewater : is liquid waste from industrial establishments such as factories, production units etc.

Domestic wastewater : also known as municipal wastewater is basically wastewater from residences (homes), business buildings (e.g. hotels) and institutions (e.g. university). It can be categorized into greywater and blackwater.

Greywater : also known as sullage is liquid waste from washrooms, laundries, kitchens which does not contain human or animal excrete.

Blackwater : is wastewater generated in toilets. Blackwater may also contain some flush water besides urine and faeces (excrete). Urine and faeces together is sometimes referred to as night soil.

Process of wastewater treatment

➤ Process of wastewater treatment

- * Due to the nature of contaminants in wastewater—physical, chemical and biological, The units operations and processes in Waste-water treatment are summarized as follows :

- 1. Physical Treatment Processes**
- 2. Biological Treatment Processes**
- 3. Chemical Treatment Processes**

1. Physical Treatment Processes

- Physical treatment methods depend on the natural properties found in nature itself without human intervention, which are the natural characteristics observed and discovered by humans within the surrounding environment, most Physical unit operations are :
 - * Screening
 - * Sedimentation
 - * flotation
 - * centrifugation
 - * milling

2. Biological Treatment Processes :

- Biological treatment depends on the biological activity of microorganisms present in wastewater such as germs, bacteria, fungi, algae and others in the disposal of pollutants, the success of the microorganism process is dependent on the ability of these organisms to reproduce and analyze the organic matter, most Biological unit operations are :
 - * Activated sludge process
 - * Trickling filters
 - * biological Rotary discs
 - * Membrane bioreactors
 - * natural pounds
 - * Anaerobic digestion

3. Chemical Treatment Processes :

- These are processes in which liquid waste pollutants are removed or diverted by the addition of chemicals or by chemical reactions, most Chemical unit operations are :
 - * Chemical deposition
 - * Adsorption
 - * Disinfection
 - * Dechlorination

Wastewater Treatment Units



➤ Plant design

- Several design studies are conducted to determine the type or number of units or methods required for waste water plants, taken into consideration these cause :
 1. The quality and characteristics of the water entering the plant (domestic, industrial ,)
 2. Population and population growth rate
 3. The nature and topography of the area
 4. The amount of water flow entering the plant and the rate of rainfall
 5. The place of discharge of treated water (for agricultural purposes, irrigation of public parks, for cooling purposes,.....)

➤ Levels of wastewater treatment

➤ Wastewater treatment are divided into four levels :

1. Preliminary and primary Treatment
2. Secondary Treatment
3. Tertiary Treatment
4. Advanced Treatment

1. Preliminary and primary Treatment

➤ Preliminary treatment :

- * removes coarse suspended and grits. These can be removed by screening, and grit chambers respectively. This enhances the operation and maintenance of subsequent treatment units.

➤ Primary treatment

- * removes settleable organic and inorganic solids by sedimentation and floating materials (scum) by skimming. Up to 50% of BOD₅, 70% of suspended solids and 65% of grease and oil can be removed at this stage.

➤ Screens :

- * The main objective of screens in wastewater treatment is to remove large-scale materials such as wood, stone, rocks, and plant and animal residues in order to protect the plant's facilities (pumps, basins, pipes,.....).



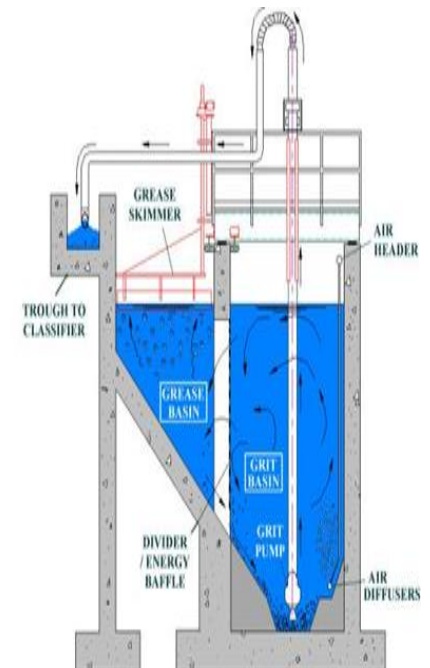
➤ Sand and grit removal :

- * The principle of operation based on sedimentation of sand, gravel and materials that can be deposited, most of which are inorganic, so that they are difficult to remove biologically and have a negative effect on treatment processes, causing blockage of pipes and manhole and damaging the operation of the pumps.



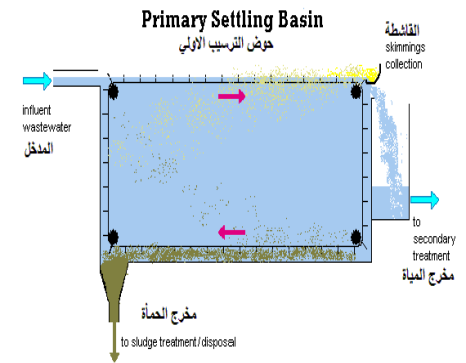
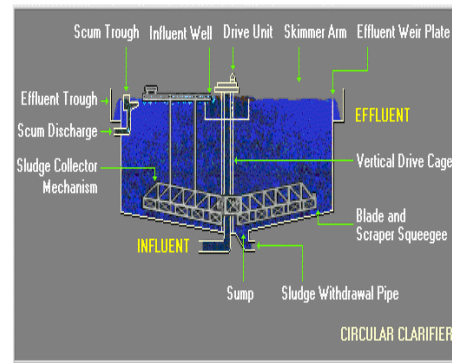
➤ Grease and Fat removal :

- * Grease and oil are removed in a floating way as a result of the physical properties that allow these substances to float over the water, in some case can use compressed air to help them float, and we use special scrappers to collect them, and the aim of this process is to protect the equipment and preserve the efficiency of the plant.



➤ Primary Settling Tank :

- * Wastewater is collected and stored for a certain period of time allowing heavy solids to be deposited to the bottom of the tank in preparation for removal, and allows low-density materials (light) to float on the surface of the tank and removed by special scrappers.



2. Secondary Treatment

- * Secondary treatment units are the most important treatment units where organic residues are digested and separated from water, it contains two units :
 1. Biological basins
 2. Secondary clarifier
- * is the further treatment of primary effluent to remove residual organics and suspended solids. Also biodegradable dissolved and colloidal organic matter is removed using aerobic biological treatment processes.

2. Secondary Treatment

➤ **Methods of Biological treatment:**

- * Activated sludge process
- * Trickling filters
- * Membrane biological reactor (MBR)
- * Natural Ponds

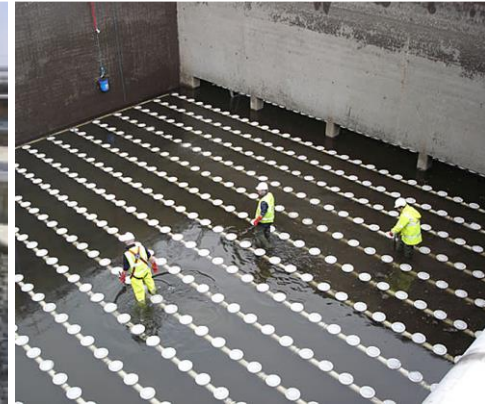
➤ Activate sludge process

- * It is one of the most common systems in wastewater treatment, which is based on mixing wastewater with activated sludge (micro-organisms) in special basins, this process (oxidation process) destroy organic substances that found in wastewater and convert them into water, carbon dioxide and new bacterial cells in an aerobic environment.



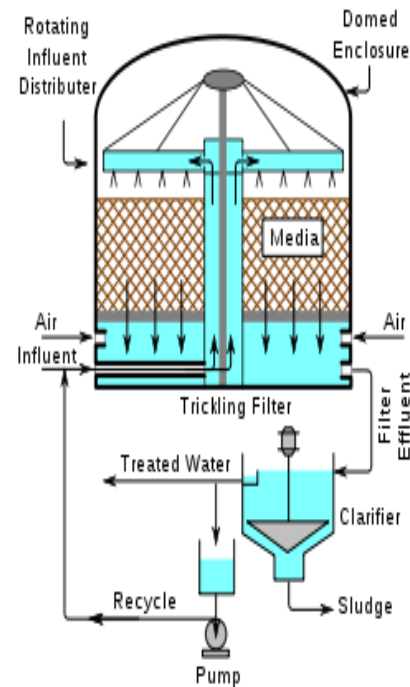
➤ Activate sludge process

- * Aerobic conditions are provided by diffused air or surface aerator, after enough remaining time in the aeration basin, the mixture is transported to the secondary sedimentation basin to separate the biomass from it by deposition.



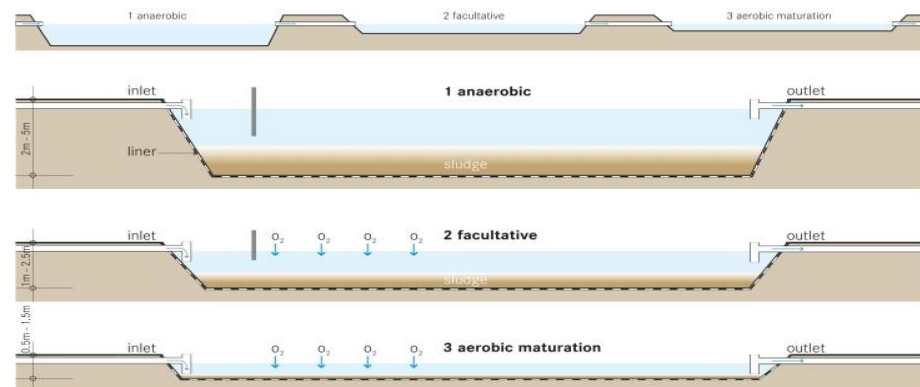
➤ Trickling Filters

- * The system of biological filters use media that contains the appropriate environment for micro-organisms which destroy the organic substances that found in the wastewater and convert it into materials has ability to sedimentation.



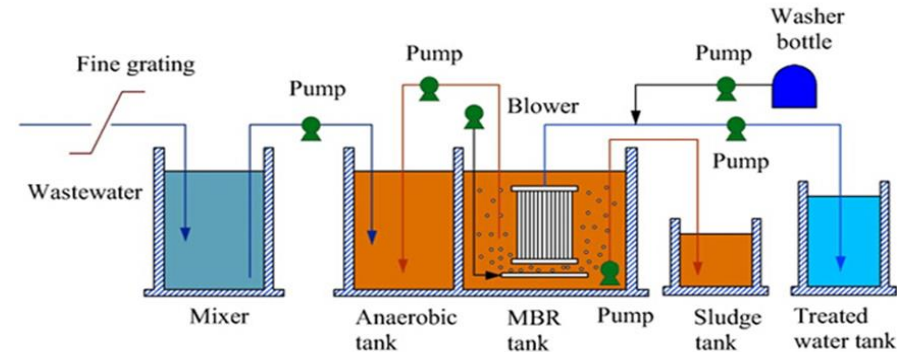
➤ Natural Ponds

- * This type of treatment is called natural treatment, containing many different ponds in sizes, shapes and functions, these ponds are connected with either straight or parallel, in a way that allows the water to flow from one pond to another.
- * types of ponds :
 - a. Aerobic ponds
 - b. Anaerobic ponds
 - c. Facultative ponds



➤ Membrane biological reactor (MBR)

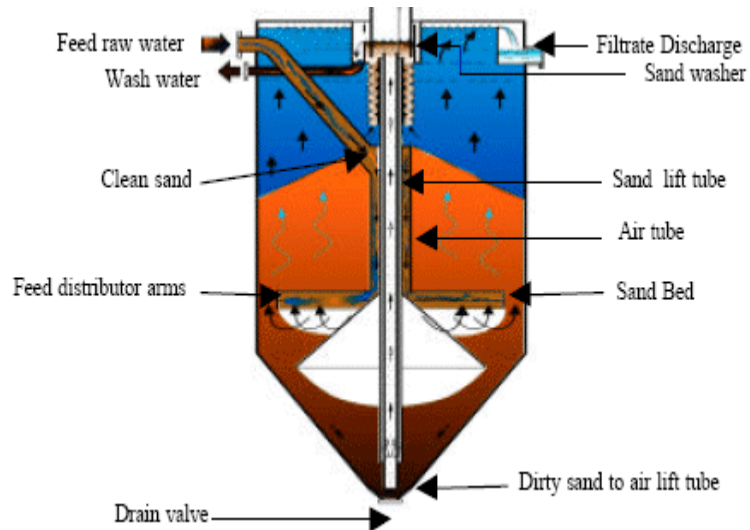
- * It is a special system that combines the biological treatment and membrane system, which has ability to achieve superior treatment, so that both secondary sedimentation and advanced treatment are excluded, because of its high efficiency.



3. Tertiary Treatment

- * The aim of these units is to improve the quality of the outside water, and to eliminate the remaining inorganic substances and harmful compounds, and many different types of bacteria and viruses that affect the health and human life.
- * Most common :
 1. Dynamic Sand Filter
 2. Ceramic Vacuum Disc Filter
 3. Activated Carbon Filter

3. Tertiary Treatment



1. Carbon
2. Gravels & Pables
3. Strainer Plate
4. Strainers
5. Hand hole
6. Service Inlet
7. Service Outlet
8. Air vent
9. Davit Arm
10. Backwash Inlet
11. Air Scoring

Activated Carbon Filter



4. Advanced Treatment

- * It is a complementary unit to the tertiary units, in which water is disinfected and sterilized, so that most pathogens and other harmful neighborhoods are eliminated.
- * Most common :
 1. Chlorine disinfection
 2. UV sterilization
 3. Ozone sterilization

4. Advanced Treatment

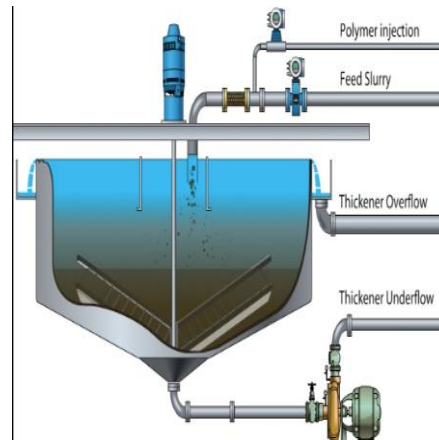
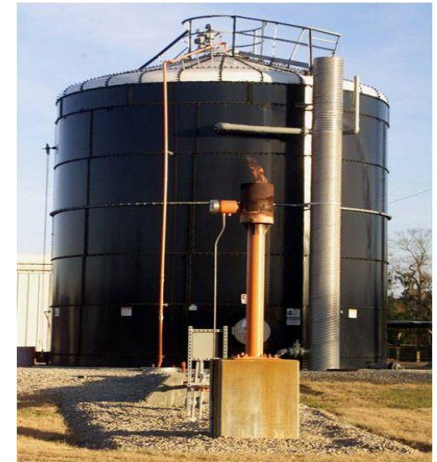
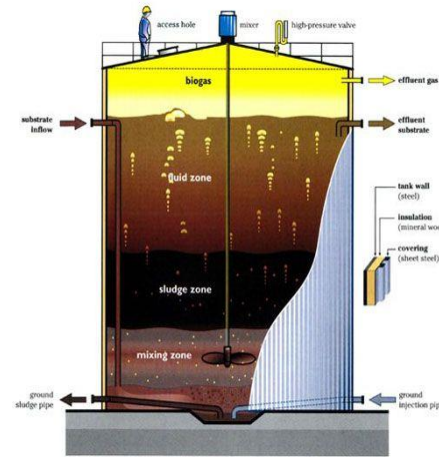


Sludge Treatment



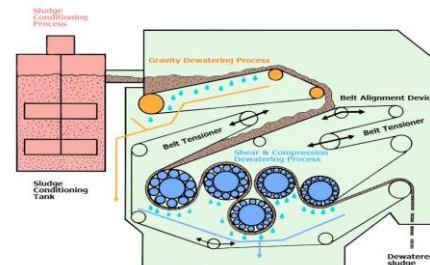
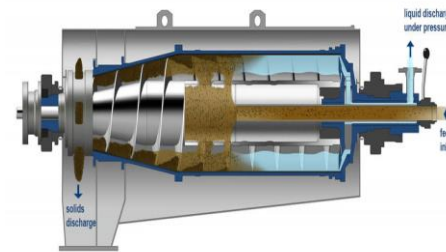
➤ Sludge treatment

- * In order to keep the integrity of the wastewater treatment system, excess sludge should be eliminated within the system, excess sludge should be transferred either to the digesters or the thickeners to raise the concentration of the solid materials and make them more stable.



➤ Sludge treatment

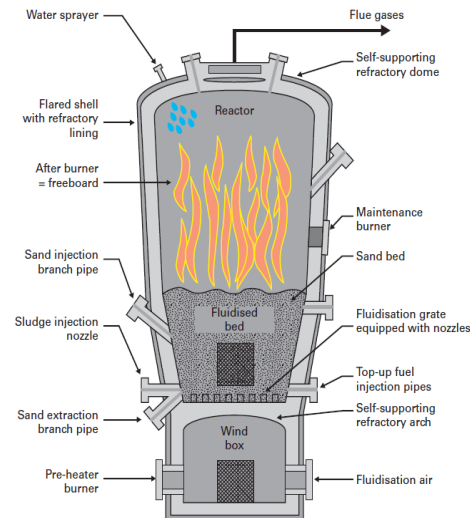
- After the sludge staying in the thickeners for a certain period of time, they are transported for drying either naturally in special basins called drying beds, or mechanically by centrifuges and belt filter presses.



➤ Sludge treatment

➤ Uses of dry sludge

1. fertilizer preparation
2. soil equivalent (land reclamation)
3. power generation (by burning it)



The End
Thank you