

## *Principles of Unit operations and processes in water and wastewater treatment and disposal*

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Water and waste water differ only in the way that solids concentration will be more in waste water and which will be there in water too if the same is taken from the river water which makes the treatment process to both the same except that filtration is on straining the finer particles in water treatment and is towards biological action of bacteria on the trickling filter to remove organic solids.

Unit operations are the physical operations to remove the impurities present in the water and waste water where as the unit processes are the chemical and biological conversion on the status of the impurities that they will be converted to a form that can be easily separated. Both are applied especially to make the fine colloidal particles to coalesce and grow in size to be removed from the water or waste water. There is no impurity that can be categorized as inorganic, it is named so for it takes time to disintegrate and had been to this hard form, free from decomposable matter with the ecological factors. We can find metal eating bacteria these days that makes the accelerated form to human use get decelerated to favour nature accommodate effectively as indigenous.

Screens are in use from the intake structure where they prevent the floating matter to enter into the pumping units, and fine and coarse screens are in use to treat waste water to prevent the entry of floating wastes and coarse solids into the treatment.

Sedimentation is simply detaining water for a sufficient time mostly in stagnant or relatively stagnant position to make the flow velocity of water less than the settling velocity of the solid particles that they without being driven by horizontal force settles down by gravity. The efficiency of the process depends on the detention time, how long the waste water remains within the sedimentation tank. When applied to individual units we need not reduce the flow velocity but make it stagnant as fill and draw type that the efficiency will be more. In the continuous flow type the flow velocity is reduced to the level of the minimum velocity which will not carry the particles with it according to stokes law that the vertical velocity, which is the settling velocity of the particle will be more than the

horizontal drag velocity and the particle settles down. Mostly the tanks will be rectangular and we also have circular tanks where the flow will be from centre to periphery. Whatever may be the shape of the tank, it is the surface area which makes the travel of particles independent of others which makes the settling efficient that the depth has to be considered taking into effect the sludge accumulation and to prevent the reentry of particles back to flow.

Coagulants are added to the water that the flocculent particles grow bigger in size which is by chemical reaction by rapid mixing and slow mixing and the coalescent particles which grew in size gets removed by settling. The coagulant we add changes the quality of water and the sludge volume too, and some of the coagulants add to bulking of sludge where the removal of moisture is difficult. Lime water instead of lime reduces the volume of sludge which is to all the solid coagulants. Liquid coagulants have more influence readily on coagulant particles than the solid coagulants which itself will take time to dissolve and react with the particles.

Filtration is to the removal of fine particle sand dissolved solids where the fine sand layer and coarse sand layer below serves as the media to remove colloidal solids and the water remains completely free of solids. In trickling filters the waste water that trickles down gets oxidized that the organic matter grows in size and retained over the sand medium and bacteria assimilate on the organic matter to form layer on the surface which grows thicker and thicker to give more bacterial mass to act upon the organic solids. The bottom most layer becomes deprived of oxygen in due course of time that it sloughs and the same reaches the secondary settling tank where the same gets settled for its increased density. The activated sludge process is by induced aeration where the reactor is completely mixed with sludge and air, that there will be complete oxidation after which the waste water enters the secondary settling tank.

When all solids are removed the minerals present in the water and waste water is removed by reverse osmosis, demineralization process which is basically ion exchange process.

Odour and colour present in water and waste water are removed by aeration and adsorption process. The odour and colour causing elements are adsorbed and aerated that the water is free from impurities for use and waste

water for reuse and recycling. Toxic chemicals and metals too get adsorbed with suitable media for adsorption.

The waste water if not intended for recycling or reuse, they can be altered with low cost biological treatment as septic tank, cess pools, oxidation ponds and ditches which are long time process and adds nutrient value to the soil and can be used for agriculture and this leads to lot of troubles as soil sickness, fly nuisance and skin diseases when the sewage directly comes into contact with the plants.

The unit operations and processes can be applied in individual units of houses, colonies and industries that it gives fewer problems to the environment and handled with more efficiency. The entire process of sedimentation, filtration and hardness removal can be done at home, for removal of hardness we need not go for reverse osmosis which is much expensive on installation and maintenance but the simple lime soda process or boiling serve the purpose of both disinfection and hardness removal as the water from the top stratum of aquifer will not be saline in nature with chlorides and sulphates of calcium and magnesium as is seen common with river water discharged with domestic and industrial wastes. The lime soda solution can be sold commercially to separate salts in the tank and that can be removed very frequently. There are plant extracts that helps removing salinity too. Grass extracts, barley are a few of them that will help removing salinity from water.

Apply the lean concepts to treat water and waste water and which will lead to a compact cost effective unit which is holistic and beneficial in the long run for which the perspectives must be in line with the nature, Nature has answers to all in a much simple way and we think we are superior to nature which makes us live a life with complications. We cannot put the burden on government and make them work for us which are proving futile neither we nor the government show the inclusion for which we experience inefficiency all through.

### **Threads**

1. Study the structure of an intake unit and find whether the same to take water from the bottom of the river is right for the purpose or not. If not from where the water should be drawn?

2. Discuss on the water quality parameters.
3. Discuss on the principle of sedimentation and the types of settling.
- 4, What do you mean by flocculation?.What are the ways to improve coagulation?
5. What are the different types of filtration? Explain the problems associated with filtration?
7. How could you combine filtration with hardness removal?
8. Narrate an individual water treatment unit for a dwelling?
9. Explain how the waste water treatment train is completely incorporated in septic tank and cess pools which can be accommodated to any type of activity.
10. How do you handle the wastes from hospitals and pharmaceutical wastes?. Streptococci group is flesh eating and helps in most of the activities that handle flesh laden wastes. Comment and elaborate on this.
11. Metal eating bacteria are there which is viewed as due to mutagenic activities. Discuss on this and their efficacy.
12. Grass has a particular type of enzyme that promotes bacterial growth that helps in waste assimilation to a great extend for which cow and hoarse dung are used as seed. Discuss on this.
13. Prebiotic and probiotics bacteria helps in easy digestion of organic wastes which dominate and adds the toxic wastes removal too. Comment on this.
- 14.Lemon juice, detoxifying juice with beet root, carrot, cabbage detox the body which shows the enzymes present in them are for the removal of toxins. Discuss on this.
15. Human life system is natural towards eating raw plant food and milk. The waste handling became complex with changed life styles on flesh eating habits. Discuss on this.

16. Common effluent treatment is not an effective waste treatment method. Discuss the problems associated with the same.

17. Each situation is different and each scenario is new that we cannot simply carry on the routine form simple to complicated procedures of life in personal and professional arena. We cannot have a hard and fast procedure of design with traits which need to be viewed holistic to find the root cause which gives us better alternates that we can merge, club and have different combinations of treatment to meet the purpose. Discuss on this.

**We can simplify all those complex procedures what the rapid routine of globalization towards socio economic development has offered that we come back to progressive growth with inclusion of all stake holders.**

