DESIGN, COMMISIONING & MAINTENANCE OF SEWAGE TREATMENT PLANT

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Abstract - *Clean water is one of the most important nature resources. Expanding population, quick urbanization and growing industry are creating the need for effective water treatment solutions. The sewage treatment plant uses primary, secondary and tertiary treatment units for treating predominantly domestic sewage. The treated effluent is used in irrigating agricultural farms for growing animal fodder and in landscape irrigation. The stabilized sludge is used as a soil conditioner. Samples are collected regularly at the plant inlet as well as before and after each treatment process. The raw sewage is characterized by high dissolved solids, medium strength BOD, and low COD/BOD ratio, high concentration of chloride, sulphate and sulphide due to septic sewage. These are typical characteristics of the sewage in this region. The plant is designed, operated and maintained so as to ensure safety and reliability in the treated effluent quality. Any overloading of the treatment processes is handled effectively. The reclaimed water quality meets the international standards and guidelines for landscape irrigation and farming. No evidence of disease amongst workers or the public has been observed from the water reuse. Extensive research activity in this field has led to significant improvement and diversification in the processes and methods used for waste-water treatment and sludge management. The present study begins with brief descriptions of the various technologies commonly used for waste-water treatment and in this project the Moving Bed Biofilm Reactor (MBBR) Technology is used in the aeration tank, it is a biological process alternative to Activated Sludge process and after treating the waste water which is re-used for landscaping, coolant and other domestic purpose, this water is further treated to bring it to drinking water standards by passing through which is like reverse osmosis.*

***Key Words*: Ultrafiltration, Moving Bed Biofilm Reactor (MBBR) Technology, Activated Sludge process, reverse osmosis.**

1. INTRODUCTION

Water is one of the world's most vital resources, yet it is under construct menace due to climate change and resulting drought explosive growth and waste one of the most promising efforts to stem the global water crisis is industrial and municipal water reclaimation and reuse. The water reuse Association defines reused, recycled or reclaimed water as "water that is used more than one time before it passes back in to the natural water cycle" Thus water recycling is the reuse of treated waste water for valuable purposes such as agricultural and landscape, irrigation ,industrial processes[1], toilet flushing or replenishing a ground water basin . water reuse allows communities to become less dependent on ground water and surface water sources and can decrease the diversion of water from sometimes eco system additionally water reuse may reduce the nutrient load from waste water discharges as in to water ways there by reducing and preventing pollution[2]. This new water source may also be used to replenishment overdrawn water sources and rejurenate or restablish those previously destroyed. The objective of this paper is to give insight in to the appropriate technology for treatment of waste water[3]. The paper discusses waste water treatment system in the context of urban area development system .

Sewage treatment generally involves three stages, called primary, secondary and tertiary treatment. Primary treatment consists of temporarily holding the sewage in a quiescent basin where heavy solids will settle to the bottom whereas oil, grease and lighter solids float to the surface. The settled and floating materials are removed and therefore the remaining liquid may be discharged or subjected to secondary treatment. Secondary treatment removes dissolved and suspended biological matter. Secondary treatment is usually performed by indigenous, water-borne micro-organisms in a managed habitat. Secondary treatment could need a separation process to get rid of the micro-organisms from the treated water prior to discharge or tertiary treatment. Tertiary treatment is typically defined as something additional than primary and secondary treatment in order to permit rejection into a highly sensitive or fragile ecosystem (estuaries, low- flow rivers, coral reefs,). Treated water is sometimes disinfected chemically or physically (for instance, by lagoons and microfiltration) previous to discharge into a stream, river, bay, lagoon or wetland, or it can be used for the irrigation of a golf course, inexperienced method or park. If it is sufficiently clean, it will also be used for groundwater recharge or agricultural functions.

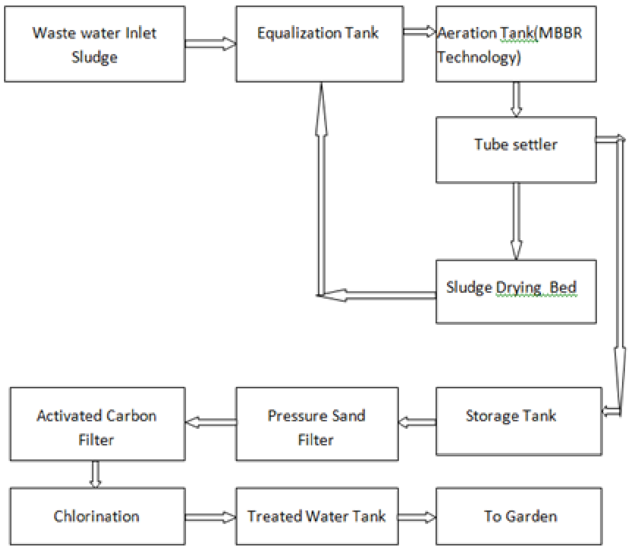

Fig- 1 : Scheme of Treatment

2. METHODOLOGY

2.1 Sewage Treatment Plant (MBBR)

Since land could be a premium in property development, the apparent concern of the developer was that the STP Plant had to consume lesser area and an automatic technology that might be lesser operator dependent. Another concern expressed was that the plant would be consistent in its outlet parameters without the requirement for continuous monitoring. Being the latest technology accessible at that point, in a sewage Treatment process, Moving Bed Bio reactor (MBBR) was chosen because of its top quality output water and its little footprint. Fontus Water offered to treat their sewage and reuse the treated water for horticulture for environmental concerns. The basic premise for using this technology was that the Moving Bed Bio reactor (MBBR) has lesser retention time in the process reactor. Moving Bed Biofilm Reactor systems (MBBR) delivers a effective flexible values and easy-to-operate which deals with needs of current wastewater and therefore expandability to meet future hundreds or additional stringent discharge requirement at intervals a compact style.

Fig- 2 : MBBR System

2.2 Ultrafiltration

Ultrafiltration could be a separation process using membranes with pore sizes within the range of 0.1 to 0.001 micron. Typically, ultrafiltration can remove high molecular weight substances, colloidal materials, and organic and inorganic polymeric molecules. Low molecular-weight organics and ions like sodium, calcium, magnesium chloride, and sulfate aren't removed. Because only high-molecular weight species are removed, the osmotic pressure differential across the membrane surface is negligible. Low applied pressures are so sufficient to attain high flux rates from an ultrafiltration membrane. Flux of a membrane is defined as the number of permeate produced per unit space of membrane surface per unit time. Generally flux is expressed as gallons per square foot per day (GFD) or as cubic meters per square meters per day.

Fig- 3 : Ultrafilters

Ultrafiltration membranes can have extremely high fluxes but in most practical applications the flux varies between 50 and 200 GFD at an operating pressure of about 50 psig in contrast, reverse osmosis membranes only produce between 10 to 30 GFD at 200 to 400 psig.

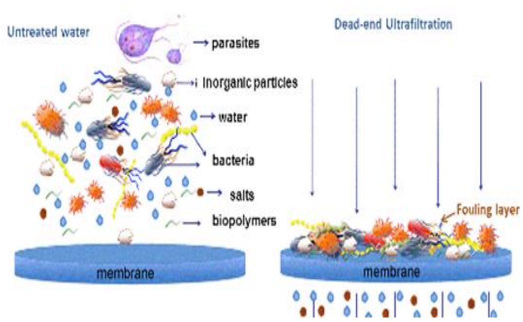

Fig- 4 : Filtration Principle

Ultra filtration, like reverse osmosis, could be a cross-flow separation method. Here liquid stream to be treated (feed) flows tangentially along the membrane surface, thereby manufacturing two streams. The stream of liquid that comes through the membrane is termed permeate. The kind and quantity of species left in the permeate can depend on the characteristics of the membrane, the operating conditions, and the standard of feed. The alternative liquid stream is named concentrate and gets progressively concentrated in those species removed by the membrane. In cross-flow separation, Therefore, the membrane itself will not act as a collector of ions, molecules, or colloids however merely as a barrier to these species.

Conventional filters like media filters or cartridge filters, on the other hand, solely take away suspended solids by trapping these in the pores of the filter-media. These filters thus act as depositories of suspended solids and have to be cleaned or replaced frequently.

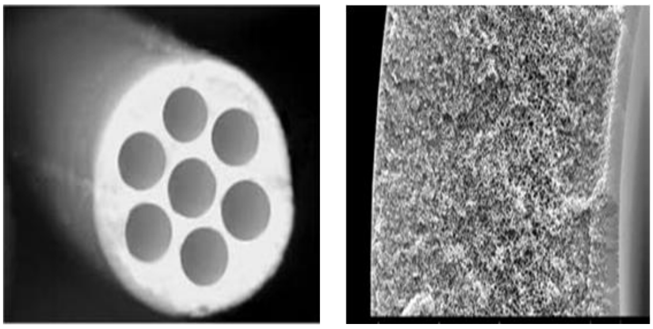

Fig- 5: Membrane modules

Conventional filters are used upstream from the membrane system to remove relatively giant suspended solids and to let the membrane do the duty of removing fine particles and dissolved solids. In ultra filtration, for several applications, no pre filters are used and ultrafiltration modules concentrate all of the suspended and emulsified materials.

2.3 Concentration Polarization

When a membrane is used for a separation, the concentration of any species being removed is higher near the membrane surface than it's in the bulk of the stream. This condition is referred to as concentration polarization and exists in all ultrafiltration and reverse osmosis separations. The results of concentration polarization is the formation of a boundary layer of substantially high concentration of gear being removed by the membrane. The thickness of the layer and its concentration depend on the mass of transfer conditions that exist within the membrane system. Membrane flux and feed flow velocity are both vital in controlling the thickness and therefore the concentration in the boundary layer. The boundary layer impedes the flow of water through the membrane and therefore the high concentration of species in the boundary layer produces a permeate of inferior quality in ultrafiltration applications comparatively high fluid velocities are maintained along the membrane surface to reduce the concentration polarization impact.

2.4 Ultrafiltration Membranes

Ultrafiltration Membrane modules come in plate-and-frame, spiral-wound, and tubular configurations. All configurations have been used successfully in several process applications. Each configuration is specially fitted to some specific applications and there are many applications where a lot of than one configuration is appropriate. For high purity water, spiral-wound and capillary configurations are typically used. The configuration selected depends on the sort and concentration of colloidal material or emulsion. For a lot of targeted solutions, more open configurations like plate-and frame and tubular are used.

2.5 Membrane Materials

A variety of materials have been used for commercial ultrafiltration membranes, but polysulfone and cellulose acetate are the most common. Recently thin-film composite ultrafiltration membranes have been marketed. For high purity water applications the membrane module materials must be compatible with chemicals such as hydrogen peroxide used in sanitizing the membranes on a periodic basis.

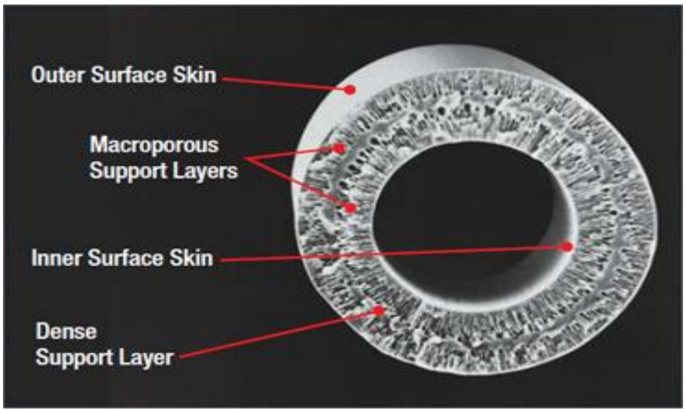

Fig- 6: Membrane Cross-section

3. RESULT ANALYSIS

3.1 Stage wise reduction in BOD,COD and TSS by various treatment

In this chapter there is a discussion of the reduction of the parameters such as BOD, COD and TSS that is the initial characteristics of waste water and the parameters of the treated water .The reduction percentage in the initial characteristics values are described briefly in below paragraph that is the percentage reduction in the values of BOD,COD and TSS. The BOD value reduces to 94.50% after the MBBR process and The COD value reduces to the 86.54% after the MBBR process and the TSS value reduces to

79% after MBBR process .After the chlorination process the BOD value reduces to 94.50%, the COD value reduces to 94.24% and the TSS value reduces to the 90%. After the Ultra filtration process the BOD value reduces to 98.05% The COD value reduces to 97.12%,The TSS value reduces to 97.1%. These values are tabulated in below.

Table No 1 : Stage wise reduction graph of BOD,COD & TSS

Sl. No	Treatment	PH	BOD	COD	TSS	%BOD	%COD	%TSS
1.	Raw Sewage	7.4	322	521	300	-	-	-
2.	After MBBR Process	7.4	23	70	63	94.50	86.54	79
3.	After Chlorination	7.4	18	30	30	94.50	94.24	90
4.	After Ultra filtration	7.4	3	15	4	98.05	97.12	97.1

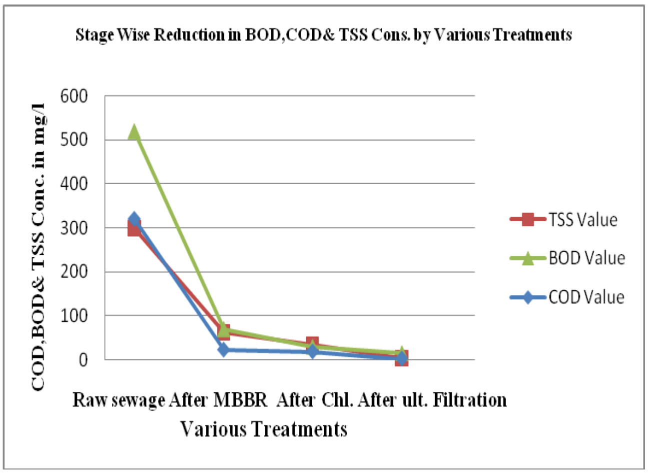

Chart -1: Stage wise Reduction Graph

3.2 Result Obtained from the Experiment

After doing the experiment the parameters present in the effluent are pH, total percentage of Alkaline, chlorine, Osmotic Agent, percentage of conductivity, Total dissolved solids ,Total suspended solids, BOD present ,COD present, Total Ammonium present, Phosphate and BOD/COD ratio.

3.3 By Plotting the Graphs

1. Sludge Volume Index

Sludge Volume Index (SVI) is used to describe the settling characteristics of sludge in the aeration tank in Activated Sludge Process. It is a process control parameter to determine the recycle rate of sludge. It was introduced by Mohlman in 1934, and has become the standard measure of the physical characteristics of activated sludge processes. It is defined as 'the volume (in ml) occupied by 1 gram of activated sludge after settling the aerated liquid for 30 minutes.

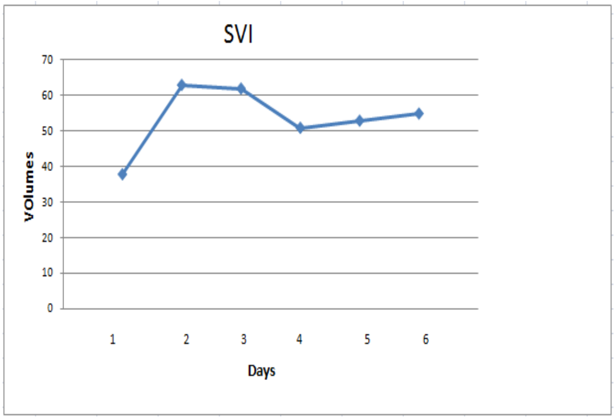

Chart -2: SVI Graph

2.Sludge Age Graph

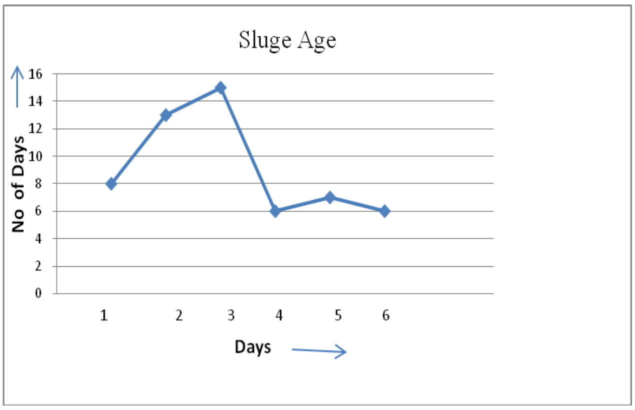

Chart -3: Sludge Graph

3. Phosphate Reduction Graph

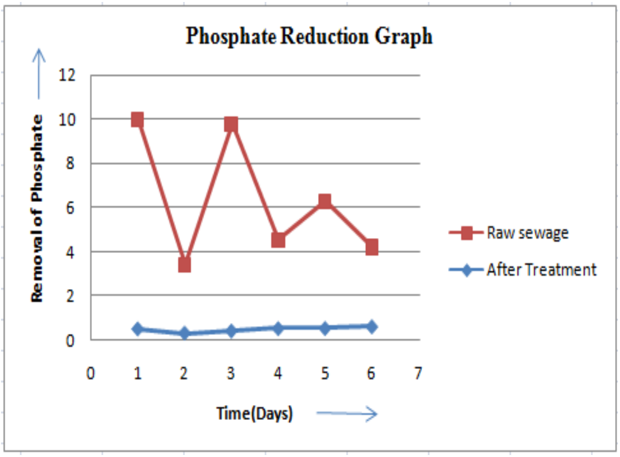

Chart -4: Phosphate Reduction Graph

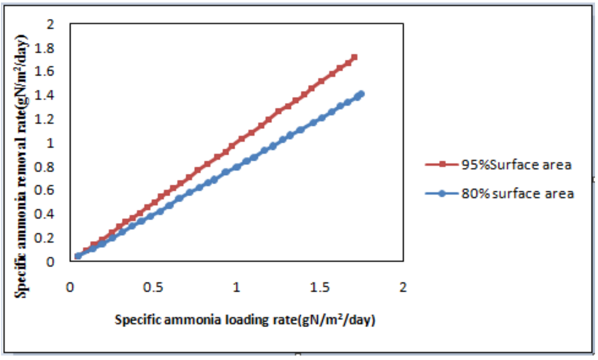

Chart -5: Surface Area Loading Rate Vs Removal Rate

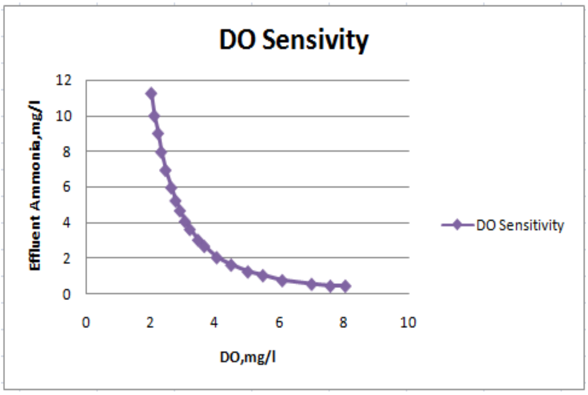

Chart -6: DO sensitivity

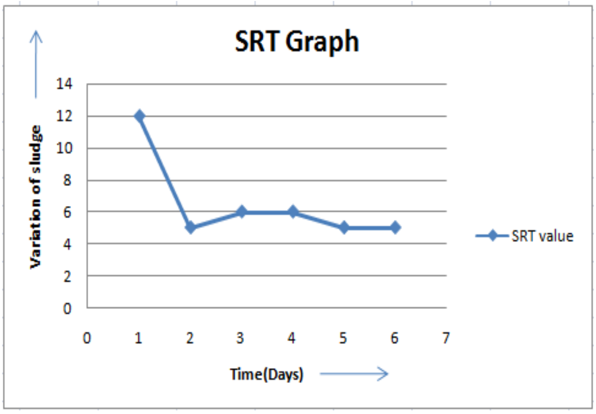

Chart -7: SRT Graph

4. CONCLUSIONS

Effective waste-water collection and treatment are of nice importance from the standpoint of both environmental and public health. Extensive analysis activity in this field has led to important improvement and diversification within the processes and methods used for waste-water treatment and sludge management. The gift study begins with brief descriptions of the varied technologies commonly used for waste-water treatment and in this project report we tend to use Moving Bed Biofilm Reactor (MBBR) Technology in the aeration tank, it's a biological process different to Activated Sludge process and after treating the waste water that is re-used for landscaping, coolant and other domestic purpose, this water is any treated to bring it to drinking water standards by passing through Ultrafiltration which is like reverse osmosis.

REFERENCES

[1] Qu. Xiaolei ,"Application of Nano technology in water and waste water treatment," Vol no.-47, Aug. 2002, Pp-3931-3946.

[2] Chong. Meng Nan "Recent Developments in photocatalitic water technology"-A review, Vol. no- 44, Aug. 2004,Pp-2997-3027.

[3] Lea. Kian Mun, "Recent developments of zinc oxide based photocatalitic in waste water treatment technology": A review, Vol no-88, July. 2005, Pp-428-448.

[4] F. Lauren Greenlee, "Reverse osmosis desilination water resources technology and todays chalanges," Vol.no-45, Aug. 2006, Pp-2931-2939.

[5] B. Patrie , "A Review on emerging contaminents in waste water and the environment:" Current knoledge under study areas and recommendation for future monitoring ,Vol no-72, July.2007,Pp-3-27.

[6] N.Wakode Prachi, "Performance evolution of 25MLD sewage treatment plant at Kalyan," Vol no-03, Aug. 2008,Pp-310-316.

[7] Sanjeev Kumar Sinha, "A study on the waste water treatment technology for steel industry: Recycle and Reuse," Vol no-05, July.2008, Pp-415-675.

[8] N.Muthukumaran, "Waste water treatment and management in urban areas" –A case study of Tiruchirapalli city Tamilnadu , Vol no-54, July. 2009, Pp-284-289.

BIOGRAPHIES

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