PERFORMANCE EVALUATION OF 9 MLD SEWAGE TREATMENT PLANT AT GURGAON AND COST EFFECTIVE MEASURES IN TREATMENT PROCESS

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ABSTRACT

Sewage treatment plant under study has 9 MLD capacity and is located in Gurgaon. It receives sewage from the surrounding residential areas and after three stage treatment, treated effluent is supplied back to meet water requirement for various purposes. This has certainly reduced dependency on the precious underground water and thereby reducing the burden and saving environment. For performance evaluation of the sewage treatment plant samples were collected at various stages i.e., at inlet raw sewage, after primary treatment, secondary treatment and after tertiary treatment. Samples were tested to measure various parameters like pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total Suspended Solids (TSS), Total Kjedahl Nitrogen (TKN), Total Coliform, Phosphorous and Oil & Grease. Data on above parameters were observed and collected for three months November, 2014 to January, 2015. All these treatment are adding a huge cost to the recycled water. Hence the present study is aimed to provide alternatives to reduce the cost input. Also studies were made to find out ways by minimizing processes and stages of treatment.

KEYWORDS:

Sequential batch reactor, BOD, COD, DO, TSS, TKN, treated effluent, reuse

1. INTRODUCTION

Water requirement in this fast growing city are huge and government agencies have failed to supply adequate quantity of water to meet the demand. Almost half of the demand is met through underground water extracted by authorized and unauthorizedtube wells. Water table is falling sharply and people as well as government authorsities are worried about the grim situation that may arise in near future. Government has taken various steps to save underground water like to replenish underground water by creating recharge wells at suitable sites, have made rain water harvesting compulsory feature for all residential and commercial projects. Installing sewage treatment plant is mandatory for all major projects and reuse of treated effluent for irrigation, flushing in toilets and other construction activities purposes. All construction companies have

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been directed to source water from STPs for all construction activities, while this reduces dependency on underground water but also solves problem of handling and disposing large volumes of sewage. Research has been done on suggesting efficient technologies to treat the sewage and make it suitable for further reuse. [1-3]. Tertiary treatment is generally provided to the sewage to remove all the contaminants and to make it fit for reuse [4]

2. SEWAGE TREATMENT PLANT UNDER STUDY

This sewage treatment plant has been installed towards fulfillment of government directivesin aforementioned matter as well as to meet water requirement for irrigation, toilet flushing and construction activities in the surrounding area. Sewage received in STP contains mostly domestic waste water generated in toilets, toilet flushing, washrooms, kitchens apart from some quantity of waste water generated in commercial establishments i.e., shops, malls and offices. After treatment it is being used for irrigation purposes in residential areas as well as two golf courses, flushing water required in toilets, water required for cooling towers of air conditioning plants and water required for construction activities in this area. Entire sewage passes through three stages of treatment and requires further softening, pH-value adjustment and polishing through ultra filters to make it suitable and safe for human touch, resulting in higher cost of treatment process. This STP is based on Sequential Batch Reactor (SBR) technology. The treatment processes are described in figure 1 and the sequence of processes in figure 2.

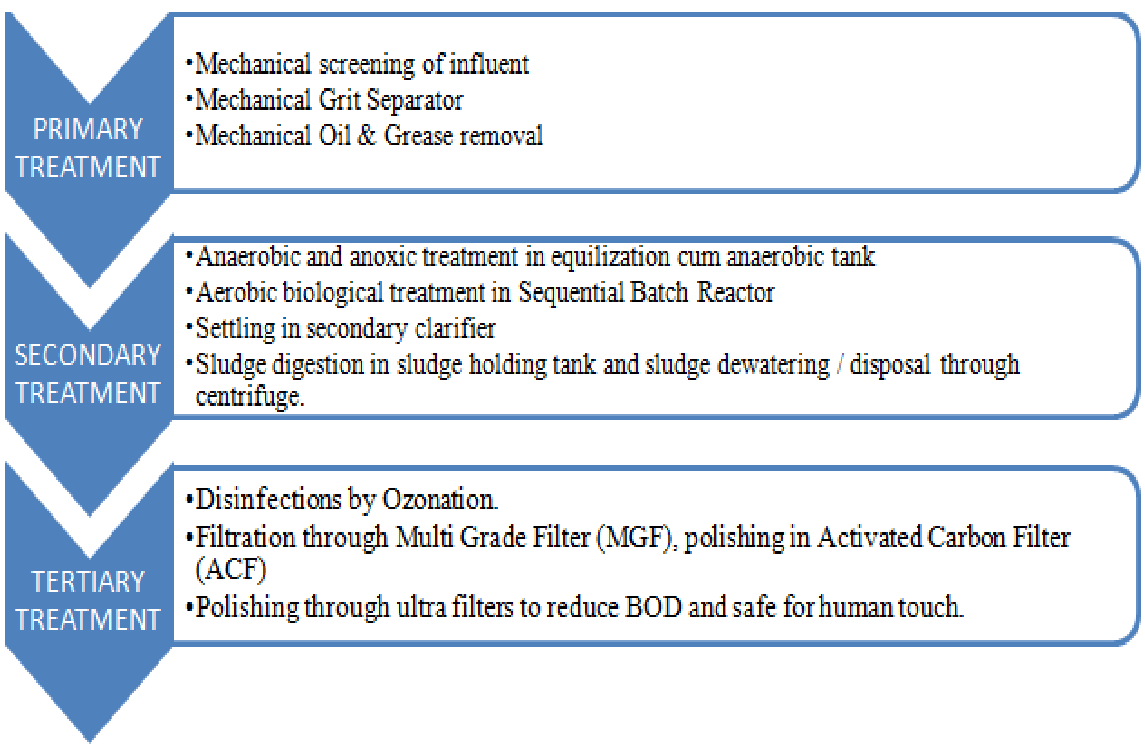

Figure 1: Treatment processes in the STP

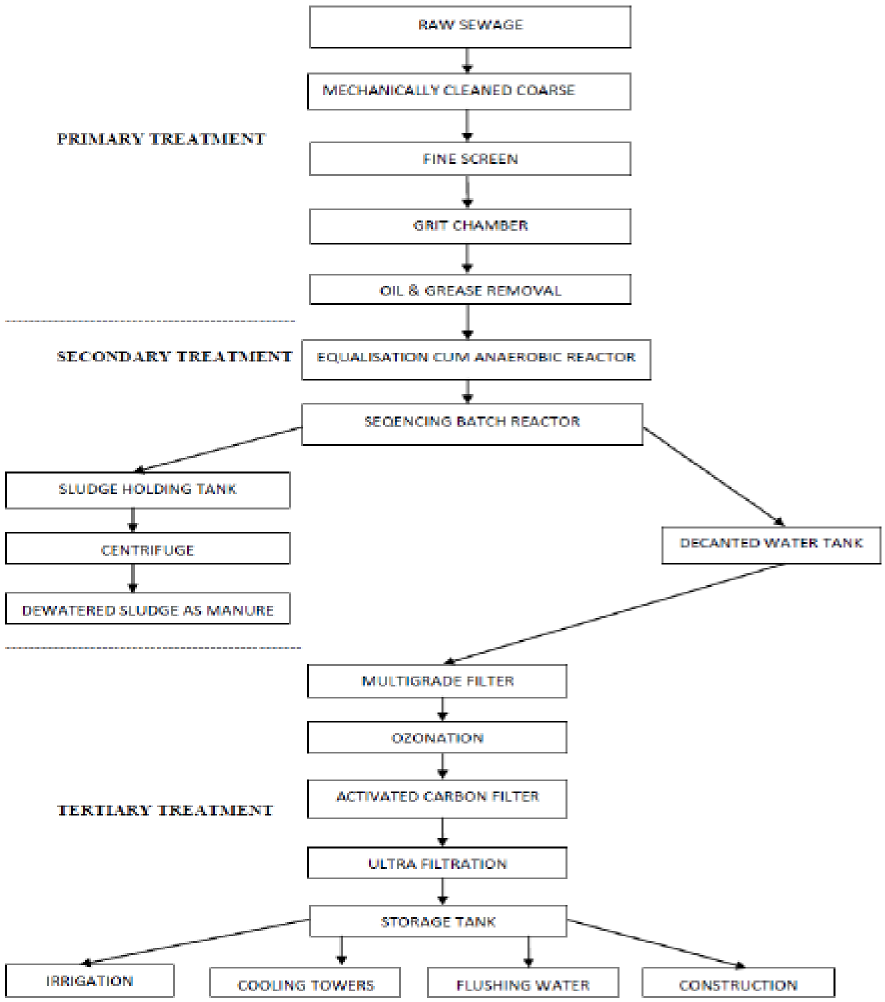

Figure 2: Sequence at the STP

3. METHODS AND METHODOLOGY

For performance evaluation of the sewage treatment plant, samples were collected at various stages i.e., at inlet raw sewage, secondary treatment (SBR outlet) and during tertiary treatment after Multi grade filters and Activated carbon filters and post Ultra filters. The sampling technique used was grab sampling. Samples were collected for three months from November 2014 to January 2015. After collection the samplers were preserved in the deep freezer maintained at a temperature of 4oC. All the testing procedure has been adopted form the standard methods, APHA [5]. Each parameter was tested on three samples and the average value is being reported. Any deviation of results more than 10% was discarded.

4. EXPERIMENTAL RESULTS

The average values of parameter for the samples collected from November 2014 to January 2015 have been shown in table 1. It can be seen that SBR has removed most of the inorganic and organic impurities as maximum reduction in TSS, TDS, BOD and COD have been observed. After post filters the left over impurities were further reduced due to the filtration mechanism of the media. The maximum reduction was observed for BOD. After membrane filter (ultra filtration) slight reduction in all parameter were observed. However, the pH and alkalinity increases slightly.

Table 1: Average results from November 2014 to January 2015

S. No	Parameters	Unit	Frequency	Average			
				Sewage inflow	SBR outlet	Post Filters	Post U/F
1	pH	*	Shift	7.89	7.39	7.42	7.52
2	Alkalinity (Caco3)	mg/l	Shift	314.82	202.56	202.30	206.88
3	COD	mg/l	Daily	456.50	26.58	23.33	19.29
4	BOD at 27°C	mg/l	Daily	201.48	20.17	5.08	4.88
5	TSS	mg/l	Daily	238.30	13.19	10.79	7.51
6	TDS	mg/l	Daily	497.78	434.01	434.14	432.76
7	Phosphorous	mg/l	Fortnightly	1.51	1.22	0.84	0.77
8	NO3-N	mg/l	Fortnightly	1.79	0.99	0.88	0.65
9	Oil & Grease	mg/l	Weekly	17.28	1.89	1.07	0.61

5. DISCUSSIONS

The observations from the result analysis is as follows:

1. Water quality at SBR outlet is found to be good enough for irrigation purposes as the pH value achieved i.e., 7.39, which is less than desired pH value of <8.5 for irrigation purposes as per CPCB and TSS at this stage is 13.19 and therefore may be supplied for irrigation purposes after disinfection by introducing Ozonation and need not be taken for further treatment through filtration and Ultra Filtration.

On further study to ascertain suitability of this water for use in artificial lake and watering in the Golf Course as regards any adverse effects on growth of plants, foul smells and mosquito breeding etc. Phosphorous and Nitrate levels are found to be 1.22 mg/L and 0.99mg/L respectively. It has been observed that there is no adverse effect on plants, no foul smell. Further with introduction of fishes into the lake mosquito breeding can be checked to a large scale. Water fountains may be used as aerator with periodical bio culture dosing to check algal bloom in lake water.

2. Water quality obtained Post Filters is even better with pH value of 7.42, BOD-5.08mg/L, COD-23.3mg/L, TSS-10.79 mg/L, TDS-434.14 mg/L, Phosphorous-0.84mg/L, NO3-N-0.88mg/L, the treated water after this stage may be diverted for use in cooling towers of air conditioned residential and commercial buildings after passing it through water softeners only and need not be taken further for polishing through Ultra Filters.

On further study for suitability of this water for use in cooling towers as regards any adverse effects like unpleasant odor and algal growth, it has been observed that that there is no bad smell, however due to higher nutrients there is possibility of algal growth therefore chlorination is required to control algal bloom before using this water in cooling towers.

3. Post Ultra Filters quality of treated water is very good with pH value of 7.52, BOD-4.88mg/L, COD-19.29mg/L, alkalinity-206.88mg/L, TSS-7.51 mg/L and may be recycled for flushing purposes in the group housings and for construction activities like mixing of concrete, mortars and curing of finished concrete / masonry structural works purposes.

On further study for suitability of this water specially for concreting and masonry works for any adverse effects on strength of concrete, bonding in masonry and staining and scaling etc. on plastered surfaces it has been found to be fit for use in construction as per IS 456-2000 requirements [6].

The cost analysis of the plant with existing system and with suggested modification is presented in table 2 and 3. The findings are as listed below:

1. 3900 KLD water is taken for irrigation of golf course and requirement in lakes after SBR itself.
2. 2550 KLD water is taken after MGF for uses in cooling towers.
3. 800 KLD for flushing of toilets + 1750 KLD for construction purposes only need to pass through UF.

This arrangement can save Rs. 45 lacs per annum for the STP unit.Assuming that life of MGF, ACF and UF increases if amount of water to be treated through these filters is reduced.Alternatively less number of filtration tanks may be required.

Table 2: Cost of filters used for 9 MLD plant per year (actual cost)

S.No.	Filters	Price (Rs.)	Useful life (yrs)	Cost/year
1	Multigrade filters	800000	5	160000
2	Activated carbon filters	1600000	5	320000
3	Ultra filters	30000000	5	6000000
Total		32400000		6480000

Table 3: Cost of filters used for 9 MLD plant per year after proposed changes in process

S.No.	Filters	Price (Rs.)	Expected life (yrs)	Cost/year	Saving (Rs.)
1	Multigrade filters	800000	8.8	90909	69091
2	Activated carbon filters	1600000	8.8	181818	138182
3	Ultra filters	30000000	17.6	1704545	4295455
Total		32400000		1977273	4502727

The suggested treatment and respective reuse of water is described by the water balance diagram in figure 3.

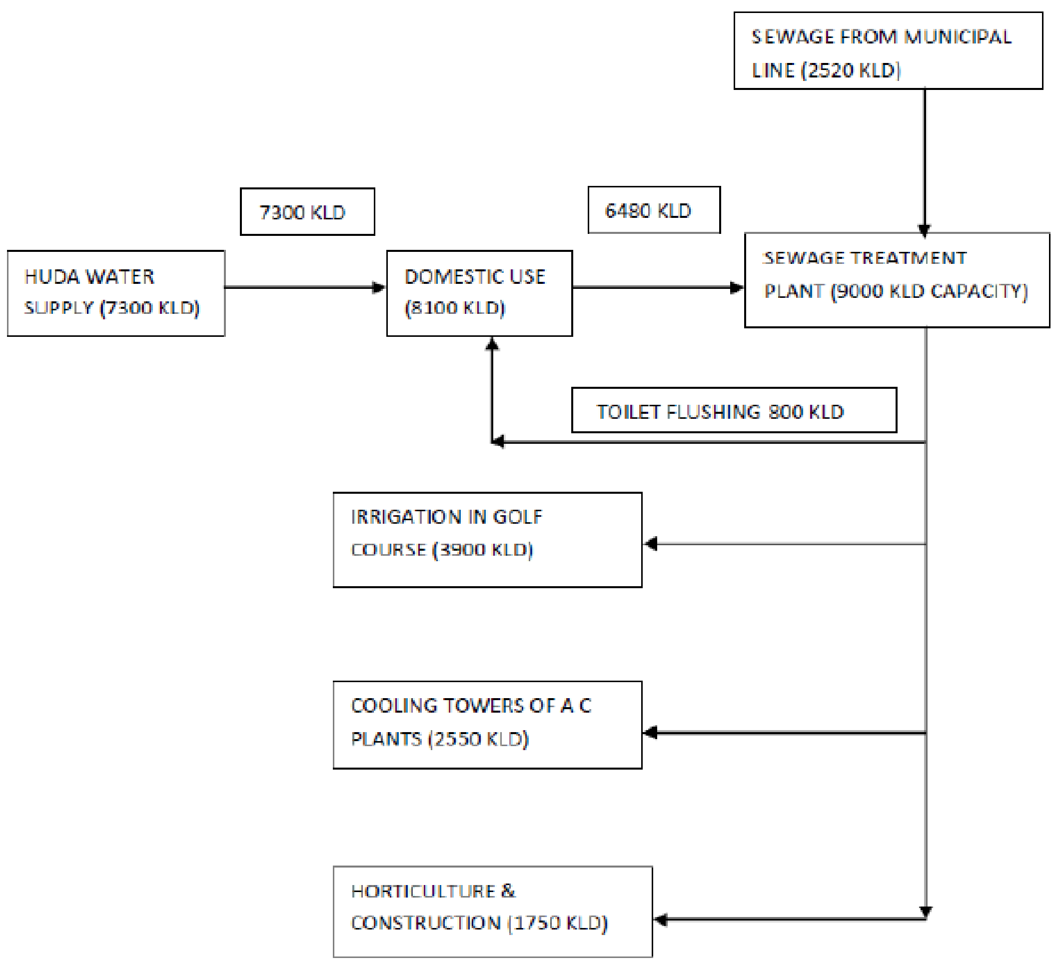

Figure 3: Suggested water reuse options

6. CONCLUSION

From this study it is concluded that to meet the increasing water demand the waste water should be recycled. Tertiary treatment of waste water is required to reuse it for various applications. Also the appropriate technology should be judiciously being chosen for a particular degree of treatment. The treated water based on its final quality can be further decided for different applications. The tertiary process should not be an economic burden on the society. Hence effective selection of the methods and full utilization is required.

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