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STUDY ON IMPROVING THE EFFICIENCY OF SEWAGE TREATMENT PLANTS AT SRM UNIVERSITY, INDIA

PALJOR NAMGYAL BHUTIA[1], K. PRASANNA[2] AND J.S. SUDARSAN[3]

SRM University, Hotel Greenland, Pelling, Sikkim, India

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ABSTRACT

SRM University Kattankulathur campus hosts three Sewage Treatment Plants (STP) within the premises which are located behind the dental college, behind the SRM General hospital and beside girls hostel. These plants are designed and constructed such that it minimizes and removes organic matter, nutrients, solids (both suspended and dissolved), disease carrying organisms and other domestic sewage constituents before it is disposed on land. It was revealed from the performance study of the STPs from October 2013 to March 2014 that the capacity of STP I is lesser compared to the daily inflow and the removal efficiency of all the three treatment plants in terms of TDS was very low to almost negligible. In STP I BOD, COD, TSS, TDS and turbidity average removal efficiency were 78.30, 80.71, 58.225, 2.61 and 73.78 %, while in STP II BOD, COD, TSS, TDS and turbidity average removal efficiency were 44.55, 42.80, 50.96, 3.786 and 70.59% and in STP III BOD, COD, TSS, TDS and turbidity average removal efficiency were 85.88, 88.975, 60.19, 8.29 and 92.22%. The order of efficiency of the three sewage treatment plants were STP III > STP II > STP I. Additionally, the methods for improvement in efficiency is discussed.

KEYWORDS : Sewage treatment plant, Removal efficiency, Domestic sewage

INTRODUCTION

Sewage treatment is a process for removing the unwanted constituents from the sewage by biological, chemical and physical process which is done to remove biological, chemical and physical contaminants present in it. The aim of this process is to convert the sewage into an environmentally friendly liquid and solid waste (sludge) which can be safely disposed of on land and in sea.

Study Area

The study area for this project were the three sewage treatment plants located at SRM University Kattankulathur campus, STP I was located behind the SRM General Hospital, STP II was located beside girls hostel and STP III ocated behind SRM Dental college. Fig 1 shows the location of the three STPs.

MATERIALS AND METHODS

The samples from the inlet and outlet of the three sewage treatment plants were taken for analysis of efficiency from the month of Oct 2013 to Mar 2014. The parameters analyzed were BOD, COD, TSS, TDS, pH and Turbidity. BOD test was done by Winkler's method, COD by Closed reflux titration method, TSS and TDS by Potentiometric method, Turbidity by Nephelometric method and pH analysis by pH meter. The details regarding the number of students in each hostels, number of students and faculties in each institutional blocks,

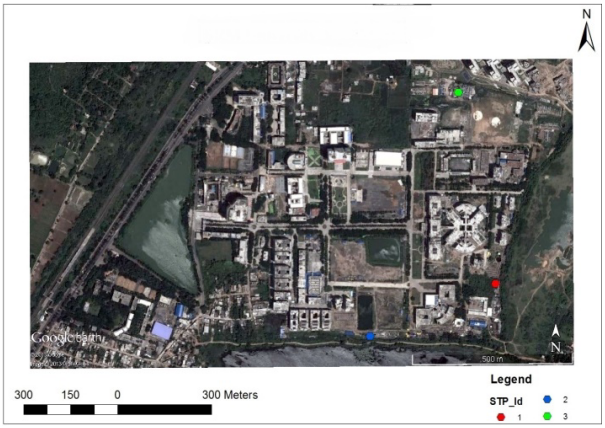

Fig. 1. Location of the three STPs

number of faculty residence and their strength were taken from the SRM estate office, these were required for knowing the amount of Sewage being produced by each block and the amount of inflow per day for each sewage treatment plant. The permissible limit for on land sewage disposal is given in Table 1.

Table 1. General standard for discharge of treated sewage on land for irrigation.

Parameter	Permissible limit
BOD	100
COD	250
pH	5.5 to 9
TDS	2100
TSS	200
Turbidity	–

Source : MOEF (www.envfor.in)

The detail about the inflow sewage to each STP was calculated by accounting the amount of water usage per day from each block. The Hi-Tech block which is an institutional building was taken as a reference to find out the amount of water usage per day per person in institutional blocks. The volume of the overhead tank at Hi-Tech block was 63130 L and is filled twice daily, comparing it with the amount of moving population in that block the amount of water usage by person in institutional blocks was calculated which was 56 lpcd. The average water use for hostels and faculty residence was taken as 98 lpcd as per CPCB (Central Pollution Control Board, India). From the total water used 80% was taken as sewage produced as per CPHEEO (Central Public Health and Environmental Engineering Organization).

RESULTS AND DISCUSSION

Table 2 compares the amount of inflow calculated for each STP in Liters Per Day (lpd) and its present capacity. It is obvious from the Table that the inflow for STP I is greater than its capacity.

Figure 2 shows the variation of BOD in the three treatment plants for the month of Oct 2013 to Mar 2014 and the plant's removal efficiency for the three STP denoted by I,II and III. The BOD of sewage at SRM campus ranged from 290 mg/L to 30 mg/L. The average removal efficiency for BOD for STP I,II and III were 78.30, 44.55 and 85.88%. The STP I and STP III were having higher values for BOD in inlet because STP I is connected to SRM General Hospital as organic compounds are more in antibiotics and drugs, it was even found out that the capacity of the STP is lesser than what is required. STP III is connected with more hostels, canteens and with SRM Hotel so for these reasons the organic content was more. The graph shows the reduction of BOD for STP III after January as a new STP IV was built just beside it and the inflow was divided. STP II is connected more with administrative blocks as compared with STP I and STP III so for that reason the BOD is very less for STP II.

Table 2. STP capacity and inflow

	Inflow per day	Capacity
STP I	6,10,853 Lpd	5,00,000
STP II	7,13,990 Lpd	22,00,000
STP III	14,68,237 Lpd	36,00,000

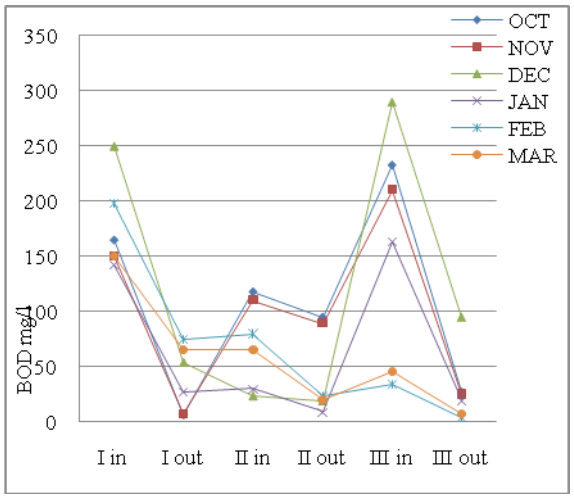

Fig. 2. Variation of BOD

Figure 3 shows the variation of COD for the month of Oct 2013 to Mar 2014 and the treatment plant's removal efficiency for the three STP denoted by I, II and III. The COD level ranged from 937 mg/L to 67.9 mg/L. The average removal efficiency for COD for STP I, II and III were 80.71, 42.8 and 88.975%. STP I to SRM hospital and the source of organic compounds for a hospital can be from clinical laboratories, research laboratories, hospital laundries they also include disinfectants and drugs. The main source of Organic compounds for STP I and STP II are hostels, canteens and bathrooms as they are connected with administrative, hostel and residential blocks. STP II being connected to fewer blocks as compared with STP III the organic content is less.

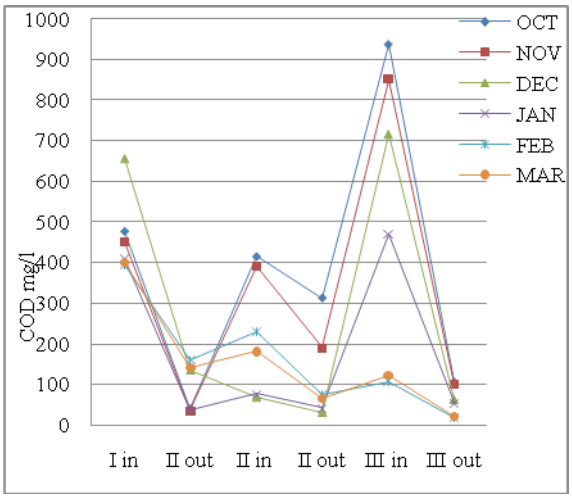

Fig. 3. Variation in COD

Figure 4 shows that TDS removal efficiency of the three treatment plants are not at all good, the methods they are adopting for TDS removal is sand filter and carbon filter. The sand filter used can filter dissolved solids up to 20 micron whereas the size of TDS can be up to 2 micron. For better efficiency backwashing should be regularly done and any rise in head loss should be immediately checked and the filter media should be changed or cleaned. The other methods they can use for TDS removal are reverse osmosis, distillation and deionization. The average removal efficiency for TDS for STP I,II and III were 2.61, 3.786 and 8.29%. The most cost effective method of them all is Reverse Osmosis, RO treatment is effective in removing silt, sand, algae, clay, protozoa (5 to 15 microns), bacteria (0.4 to 30 microns), viruses (0.004 to 6 microns), organic/ inorganic chemicals, humic acids, and most aqueous

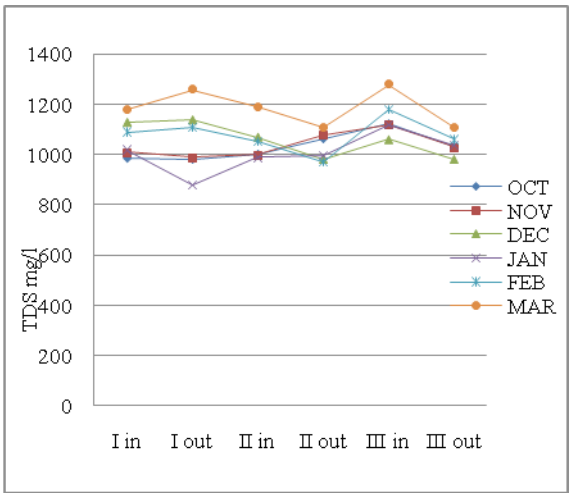

Fig. 4. Variation in TDS

salts and nonmetal/metal ions. Removal efficiency of TDS by RO is around 99% and for TSS is almost 100% for TDS. In the Barnett Shale, Marathon Oil Company, using RO technology developed by GPRI, they constructed and operated a facility which produced 714,000 gallons per day. The cost was reported to be less than $2.50 per 1,000 gallons. Based on these facts the total cost for including a RO process in the STP's would be Rs. 24,382/- for STP I, Rs. 31,932/- for STP II and Rs. 59,872/- for STP III.

Figure 5 shows the variation of TSS in sewage treatment plants located at SRM University and also its removal efficiency. The inlet TSS ranged from 400 mg/L to 136 mg/L for STPs at SRM campus. TSS is removed in SRM STPs in clarifier and sand filter, overall the removal efficiency of TSS is good , as the concentration of the TSS in the treated water is within permissible limits. The average removal efficiency for TSS for STP I, II and III were 58.22, 50.96 and 60.19%. Use of processes like coagulation, flocculation, and air flotation can help enhance the performance in removal of TSS.

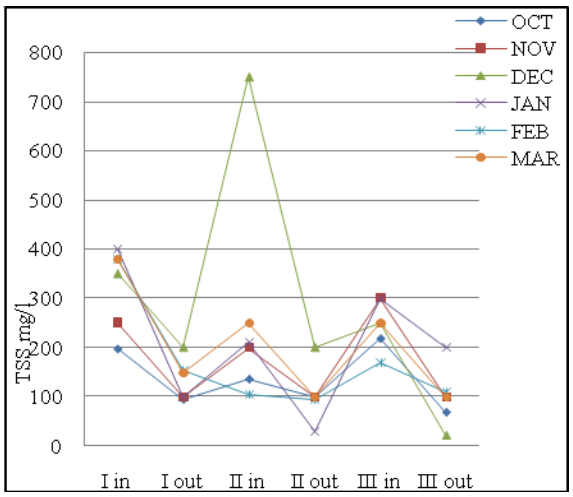

Fig. 5. Variation in TSS

Figure 6 shows the variation of pH in the three STPs at SRM campus and also its equalization efficiency. The permissible limit for pH for treated sewage is 8.5-5.5, the overall equalization of pH is very good in the STPs, the pH was as low as 4.37 and as high as 7.59, the average pH was 6.25.

Figure 7 shows the variation of turbidity in the STPs. The range of turbidity is as high as 440 NTU to as low as 37 NTU. The turbidity depends on the amount of suspended solids, dissolved solids and color of the sample so if the removal efficiency of these three parameters is good eventually the

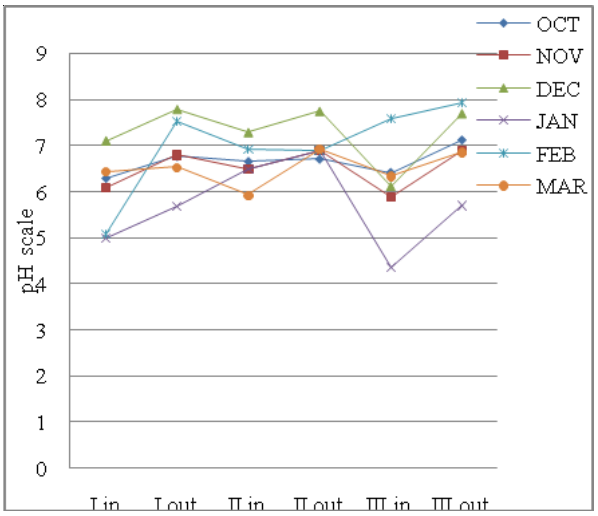

Fig. 6. Variation in pH

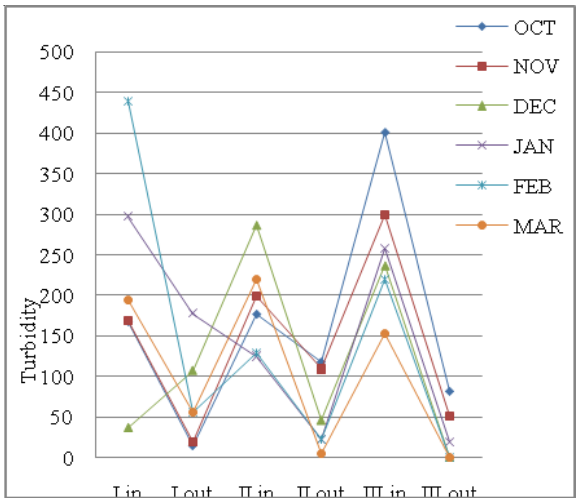

Fig. 7. Variation in Turbidity

turbidity of the sample will be low.The average removal efficiency for COD for STP I,II and III were 73.78, 70.59 and 92.22 %. Overall the removal efficiency of STP III is the best.

CONCLUSION

The efficiency studies were on Sewage Treatment Plant I, II and III located at SRM University campus at Kattankulathur. The sewage analysis was conducted from the month of October 2013 to March 2014. The parameters analyzed were total suspended solids, total dissolved solids, chemical oxygen demand, biological oxygen demand, pH and turbidity. In the survey done to calculate the inflow per day in order to check whether the capacity of the STPs is ok it was known that the capacity of STP I was lesser than what is needed, the other two STPs were efficient in terms of capacity, they were almost double of what was needed, reasons listed were due to the lower capacity of the Sewage Treatment Plant compared to its inflow per day, as hospital sewage is different from domestic sewage so its method of treatment is different compared to treatment of domestic sewage, methods like oxidation through ozonation, activated oxidation process, powered activated carbon and granulated activated carbon were suggested for its better efficiency as most of the inflow was from SRM General Hospital, SRM Medical College and Dental College and mainly consisted of hospital waste water. Sewage Treatment Plant II and Sewage Treatment Plant III were efficient in terms of capacity and removal of all the parameters except for total dissolved solids, the removal efficiency of total dissolved solids was as low as 0 % in all the three sewage treatment plants, so for proper removal of total dissolved solids reverse osmosis was suggested as it was very cost efficient and is efficient both for total dissolved solids and total suspended solids removal. Removal efficiency of TDS by RO is around 99% and for TSS is almost 100%. According the cost for the establishment of the reverse osmosis process was calculated for the three treatment plants, Rs. 24,382/- for STP I, Rs. 31,932/- for STP II and Rs. 59,872/- for STP III.

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