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MONITORING AND EVALUATION OF SEWAGE TREATMENT PLANT AT SAS NAGAR CASE STUDY

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Abstract:- Environmental sanitation is of very important concern in the process of development of a country. Discharge of untreated sewage water is common a practice in many countries. This is common cause of pollution of surface and groundwater because of large gap between generation and treatment of wastewater. This paper helps in evaluate the overall performance of the Sewage Treatment Plant, UASB reactor and facultative pond. The results of the tests are coming out are under the guidelines of Punjab pollution control board. BOD, COD, MPN, nutrients in the treated effluent were 21.51 mg/l, 42.33 mg/l, 11.84 log units, 9.64 mg/l respectively. BOD, COD, pathogen, nutrients removal efficiency of the STP is 81.08%, 83.6%, 98.86% and 51.73% respectively.1

Keywords: Sewage Treatment Plant, UASB reactor and facultative pond.

1. Introduction

Environmental sanitation is of very important concern in the process of development of a country. Discharge of untreated sewage water is common a practice in many countries. This is common cause of pollution of surface and groundwater because of large gap between generation and treatment of wastewater. The wastewater discharged from residences, institutions and commercial establishments is termed as sewage or wastewater. Inadequate sanitation is one of the problems that the poor urban residents in the developing countries are facing. Domestic and municipal wastewater is composed of 99.9% water and 0.1% suspended, colloidal and dissolved solids.

Due to the growing environmental pollution, there is a need to decontaminate the waste water and thus resulted in the study of characterization of the sewage water. Earlier, domestic sewage waste water treatment was limited upto the carbon removal only. But increasing population has lead to the development and implementation of new treatment technologies to remove other pollutants present in wastewater.

During the past two decades, several new sewage treatment technologies have been developed in many developing countries across the world. Some technologies are Fluidized Aerobic Bed (FAB), Sequencing Batch Reactor (SBR), UP flow Anaerobic Sludge Blanket Reactor (UASB) etc. Every technology has some useful and some harmful effects, therefore it should be applied in accordance to local conditions.

Previously, many projects were done on Waste water treatment, Up flow anaerobic sludge blanket (UASB) reactor, UASB Reactor efficiencies and Facultative pond but no research work has been carried out on the overall performance of Sewage Treatment Plant, UASB reactor and facultative pond.

2. Research Program

The orientation for research program mainly focuses on:

- To evaluate the overall performance of the Sewage Treatment Plant.
- To evaluate the performance of UASB reactor.
- To evaluate the performance of facultative pond.

For achieving the objectives, the study work was planned as follows:

- Monitoring and Characterization of waste-water of STP
- Performance evaluation

Monitoring and Characterization of waste water of STP

For monitoring the STP, sampling locations were identified and the parameters for which samples should be analyzed were decided. Monitoring involves collection of samples on the monthly basis for 6 months. For MPN, the sample was collected in

the sterilized autoclaved bottles free from contamination. The collected samples were brought to laboratory immediately and were analyzed for various parameters and the samples were preserved until the analysis was over.

The samples were collected from:

- Inlet of STP
- Outlet of Baffled Anaerobic Reactor
- Outlet of Facultative pond
- Treated Effluent tank

The various parameters analyzed are discussed below:

S.No.	Parameter	Method
1.	pH	Electrometric Method
2.	Dissolved Oxygen	Winkler's Method
3.	BOD	5-day BOD test
4.	COD	Closed Reflux Method
5.	Ammonical Nitrogen	Preliminary distillation method followed by titrimetric method
6.	Organic Nitrogen	Macro-Kjeldahl Method
7.	Total Phosphorous	Stannous Chloride Method (UV spectro-photometer)
8.	Sulphates	Turbidimetric Method (Turbidity meter)
9.	Sulphides	Iodometric Method
10.	Most Probable Number MPN	Serial Dilution Method

Performance evaluation

Using the monitoring data both at whole plant level and at the individual treatment unit level, performance evaluation of STP was done. Performance evaluation was done for the removal of pollutants from the wastewater. By knowing the inlet and outlet concentrations of different parameters, plant removal efficiencies for various parameters were calculated.

Raw sewage sump and raw sewage pumps

The raw sewage sump is having 50 m3 sewage storing capacity. The dimensions of sump are 5m long, 5m wide and 2m liquid depth. The central suction pit is 1.2 m top diameter and 0.3 m deep. Three pumps each of 1.5 times the average flow (62.5 m3/hour) pumping capacity, are used for pumping the sewage from the sump to the baffled anaerobic reactor. The pumps are connected to an emergency supply source to ensure that the pumping of sewage from the sump and loading to baffled anaerobic reactor is not affected.

Fig.1. Raw Sewage Sump

Fig.2. Raw Sewage Pumps

Facultative Pond

The facultative pond is 1.5 m deep and is having 0.3 m free board. Surface area of the pond is 1050 m2. A pond of 35 m length and 30 m width is divided into 10 m wide facultative pond by two baffles. The pond include two diffused aeration zones, each of 22 m top length and 12 m top width and 10 m bottom length and 2 m bottom width. In these zones the liquid depth may vary from 1.5 m to 3.5 m. The system include two blowers each capable of delivering 100 Nm3/hr of air at around 0.45 to 0.5 kg/cm2 pressure. The air is supplied to both the diffused aeration zones and delivered into effluent through 10 diffusers each. Purpose of this is to ensure better and higher rates of surface re-aeration during nights when algae instead of contributing, consumes oxygen from the pond water. Diffused air also supplies some oxygen to the pond. Due to this aerobic conditions are improved and expecting healthy algal growth and more oxygen supply during daytime. All these facilities enhance surface loading of organic matter to the pond.

Fig.3. Facultative Pond

3. Results

Overall Performance analysis of STP: Performance of the STP was evaluated in terms of BOD, COD removal. Average BOD removal efficiency of STP is 71.10% and of treated effluent is 30.01 mg/L. Average COD removal efficiency is 78.74% and of treated effluent is 36 mg/L. BOD and COD removal efficiencies of the STP are quite satisfactory. This can be due to presence of high algal concentrations. Observations on nutrient removal efficiencies are variable. Organic nitrogen removal was very low (around 29%). Low ammonical nitrogen removal efficiencies are common with UASB reactors and facultative pond because nitrification and denitrification processes are very insignificant.
Total 6 samples were taken and their mean and standard deviation was calculated.

Table 4.1: Performance of inlet of STP

Parameters	Mean	Standard Deviation
Temperature (°C)	27.67	2.03
BOD(mg/l)	118.30	13.28
COD (mg/l)	266.50	46.74
Total-P(mg/l)	2.33	0.73
Ammonical- (mg/l)	19.91	2.56
Organic-N(mg/l)	0.44	0.11
Total-N(mg/l)	21.19	3.76
MPN (log)	16.35	1.55
Sulphates(mg/l)	4.11	0.95
Sulphides(mg/l)	2.12	0.50

Table 4.2: Performance of Baffled Anaerobic Reactor of STP

Parameters	Mean	Standard Deviation
Temperature (°C)	26.7333	2.31
BOD(mg/l)	83.0167	6.37
COD (mg/l)	176.5	17.38
Total-P(mg/l)	1.95167	0.43
Ammonical- (mg/l)	15.6	1.83
Organic-N(mg/l)	0.245	0.12
Total-N(mg/l)	16.3	2.10
MPN (log)	15.4167	2.05
Sulphates(mg/l)	2.69333	0.36
Sulphides(mg/l)	1.6	0.33

Table 4.3: Performance of Facultative Pond of STP

Parameters	Mean	Standard Deviation
Temperature (°C)	26.27	1.81
BOD(mg/l)	52.66	5.21
COD (mg/l)	108.35	17.01
Total-P(mg/l)	1.35	0.17
Ammonical- (mg/l)	13.32	3.89
Organic-N(mg/l)	0.16	0.07
Total-N(mg/l)	13.03	2.13
MPN (log)	12.42	1.74
Sulphates(mg/l)	2.12	0.39
Sulphides(mg/l)	1.77	0.49

Table 4.4: Performance of Treated Effluent of STP

Parameters	Mean	Standard Deviation
Temperature (°C)	26.22	2.90
BOD(mg/l)	21.53	2.80
COD (mg/l)	43.07	4.46
Total-P(mg/l)	0.80	0.41
Ammonical- (mg/l)	9.87	3.97
Organic-N(mg/l)	0.10	0.07
Total-N(mg/l)	9.46	4.14
MPN (log)	12.37	1.83
Sulphates(mg/l)	1.42	0.24
Sulphides(mg/l)	0.93	0.19

Table 4.5 Overall removal efficiencies of STP during 6 months

Parameters	Mean	Standard Deviation
BOD(mg/l)	82.23	3.48
COD (mg/l)	84.33	3.55
Total-P(mg/l)	75.20	8.33
Ammonical- (mg/l)	50.21	13.30
Organic-N(mg/l)	81.40	2.88
Total-N(mg/l)	52.33	15.23
MPN (log)	99.70	1.15
Sulphates(mg/l)	65.78	7.65
Sulphides(mg/l)	47.42	14.44

Table 4.6 Removal Efficiencies (%) calculation for the UASB reactor

Samples	COD	COD	BOD	BOD
	Calculated	Observed	Calculated	Observed
1	66.4	79.1	75.45	86.1
2	69	84.5	71	79.2
3	63.15	90.3	72.6	86.5
4	65.9	84.16	73.16	86.4
5	68.65	86.15	75.85	78.81
6	66.89	83.12	76.58	81.21

3. Conclusion

The treated effluent was found almost in accordance with the standards prescribed by Punjab Pollution Control Board. BOD, COD, MPN, nutrients in the treated effluent were 21.51 mg/l, 42.33 mg/l, 11.84 log units, 9.64 mg/l respectively. BOD, COD, pathogen, nutrients removal efficiency of the STP is 81.08%, 83.6%, 98.86% and 51.73% respectively. Overall performance of the STP plant was satisfactory.Low nitrogen removal efficiency may be due to high TSS contributed by algal cells resulting in the loss of greater amount of nitrogen in the effluent

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