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Preliminary Investigation on Fluidized Aerobic Bed (FAB) Reactor Technology Sewage Treatment Plant Operation with Particular Emphasis on its Sewage Treatment Efficiency

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Abstract: *The world famous Dal Lake located in north-east of Srinagar city is facing accelerated degradation due to influx of sewage, surface runoff and other anthropogenic activities which have converted this lake into a waste sink. In order to conserve the lake some remedial measures have been taken up by Lakes and Waterways Development Authority (LAWDA) including interception of sewage through sewers and installation of small scale sewage treatment plants (STPs). This study was aimed at to check the wastewater treatment efficiency of the sewage treatment plants installed by LAWDA. Out of the three (3) installed STPs catering 42% of the sewage load to the lake one located at Laam Nishat having maximum capacity to treat 4.5 MLD of wastewater was selected for analysis of untreated and treated wastewater. The results showed satisfactory removal of BOD, however, the removal of pollutants like COD, TDS and TSS was found to be low against the designed removal efficiency of the sewage treatment plant.*

Keywords: Dal Lake; degradation; removal of pollutants; sewage influx; sewage treatment plants

I. INTRODUCTION

Due to daily human activity and also various agricultural and industrial operations, wastewater is produced in enormous quantity. Due to lack of management and treatment facilities most of the municipal wastewater generated in Indian cities is discharged into aquatic systems without treatment, making the receiving body unfit for its desired use in the years to come. Inadequate treatment facilities for sewage have deteriorated the water quality of aquatic resources (Kumar 2009). In India different lakes receive heavy influx of sewage, industrial effluents, domestic and agricultural waste which consists of varying hazardous chemicals and causing deleterious effects on fish and other aquatic organisms. Among these wastewaters, domestic sewage is the major contributor of pollution load (Popat and Chakravarty, 2008). The latest study carried out by the Central Pollution Control Board (CPCB) indicates that about 26,254 million litres per day (Ml/d) of wastewater is generated in the 921 Class I cities and Class II towns in India (housing more than 70% of urban population). The municipal wastewater treatment capacity developed so far in India is about 7044 Ml/d – accounting for 27% of wastewater generation in these two classes of urban centers. The situation is much worse because most of the states show that wastewater generated is directly discharged into the nearby surface water (Kumar 2009).

The world famous Dal Lake of Kashmir is situated in the north-east of Srinagar city at mean latitude of 34º 7′ N and longitude of 74º 52′ E at an altitude of 1584 amsl. It is bounded by Zabarwan Mountains in the east overlooked by Shankaracharya hillock in south-east and Kohi-Maran hillock in the south-west making its surroundings very attractive and beautiful. However, this world famous lake is subjected to accelerated degradation due to variety of human activities (Ahmad and Bhat, 2008). Encroachment, silting, weed infestation unchecked entry of solid and liquid wastes has converted this lake into a waste sink. Of late some remedial measures have been taken up by Lakes and Waterways Development Authority (LAWDA) including interception of sewage through sewers and installation of small scale sewage treatment plants (STPs). Three (3) numbers of STPs catering 42% of the sewage load to the lake are

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functioning. These are of Fluidized Aerobic Bio (FAB) Reactor technology and are generally considered not to be suitable keeping in view the temperate climatic conditions of Kashmir valley. Their efficiency is also been under the scanner of Honorable High Court of Jammu and Kashmir.

Scope of work

The present study was made on one of the STPs of LAWDA located at Laam Nishat having maximum capacity to treat 4.5 MLD of wastewater. The study comprised the analysis of untreated (influent) and treated (effluent) wastewater for parameters including Temperature, pH, TSS, TDS, BOD and COD. The study may form a part of baseline study to check the efficiency and suitability of already installed STPs and adequacy of proposed STPs because if massive investment is done on establishing sewage treatment plants and then found not suitable, the entire exercise will become futile.

II. METHODOLOGY

In order to determine the background, design and process description of the STP, LAWDA authorities were consulted and information was obtained from their head office. For studying the quality of untreated and treated wastewater, samples were collected twice a week at scheduled time from the Laam STP. Time gap of two hours between collection of influent and effluent samples was given keeping in view the hydraulic retention time taken by the treatment plant during various treatment processes. The collected samples were immediately brought to the laboratory and analyzed using standard methods of APHA (1998), and Gupta (2000).

Observations and Discussion

1. Background information of the STP

The sewage treatment plant under study is located at Laam Nishat area of Srinagar city. The plant having a capacity to treat 4.5 MLD of waste water was commissioned in November 2006. The plant is designed to treat upto 200 mg/l BOD and to cater 30000 souls. At present the plant is catering about 25000 souls of its catchment with 79% household connectivity. The Agency (LAWDA) has laid 4.92 km of main sewer line and 21-55 km out of total 32.62 km of lateral sewers stand completed (Anonymous, 2009).

The STP is of Fluidized Aerobic Bio (FAB) Reactor technology. As reported by LAWDA the 1FAB Reactor was preferred over conventional Activated Sludge Process (ASP) because the later required very large tanks and long hydraulic retention time to degrade the waste and could not be installed due to limitation of space and that ASP needed almost 10 times higher space than what was available. Moreover, FAB reactor requires very less chlorination and is considered the most successful and cost effective technology (AHEC, 2000).

2. Process Description

Wastewater is about 99 percent water by weight and is generally referred to as influent as it enters the wastewater treatment facility. At wastewater treatment plants, this flow is treated before it is discharged to the environment. Most treatment plants have primary treatment (physical removal of floatable and settleable solids) and secondary treatment (the biological removal of dissolved solids). The treatment scheme at the treatment plant to treat the raw sewage is split into three distinct parts including:

Pre-treatment: this comprises of screening and grit removal.

Biological treatment: comprising of fluidized aerobic bio-reactor followed by clarification, nitrification and de-nitrification.

Sludge treatment: comprising of thickening and dewatering using centrifuge.

3. Analysis of untreated (influent) and treated (effluent) waste water

The main purpose of this part of study was to assess the removal of TSS, BOD and COD after treatment of sewage water. Some other parameters were also assessed and the results obtained are given in Table 1. The results showed slight increase in pH values of treated wastewater which may obliviously have resulted due to removal of organic pollutant during biological treatment. But the pH values were not high enough as low pH may cause soaring of reactor during digestion process. There was decrease in the values of TSS, TDS, BOD and COD with the passage of time from peak hours to the normal hours of the day. The BOD values were significantly low in the influent during mid day which

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can be related to lesser domestic activities and weak wastewater with very less organic matter/fecal matter reaching the treatment plant from the catchment. The removal of TSS, TDS and COD after treatment was found to be very less. However BOD removal was ranged between 80 – 86% as against 85 – 90% designed removal efficiency of the treatment plant. The poor removal of COD can be attributed to the non-availability of tertiary treatment facility. Tertiary treatment includes processes to remove nutrients such as nitrogen and phosphorus, and carbon adsorption to remove chemicals thereby decreasing COD content. In a Lake Health Bulletin LAWDA (Anonymous, 2008) claimed the raw water containing 116 mg/l and treated water 36mg/l COD at Laam STP which is unlikely owing comparatively higher BOD in the wastewater. The bulletin further claims the treated water containing 342 µg/l of total phosphorous and 999 µg/l of ammonical nitrogen which is on an average higher than the lake water quality itself (Kundangar and Abubakr, 2004; Iqbal *et al*., 2006). Therefore, the higher values of COD, TSS and TDS may be attributed to incorrect operation or lack of tertiary treatment of the STP.

III. CONCLUSION

The results of the present study showed satisfactory performance of the STP in terms of BOD removal. Concentrations of TSS, TDS and BOD though were not high in both the untreated and treated wastewater, yet their removal was not satisfactory and puts a question mark on overall efficiency of the STP. However, there is further need of regular/systematic analytical studies at least on seasonal basis to fully establish the overall efficiency status of the STP. It is well known fact that the climate of Kashmir valley is temperate and the temperature dips to sub-zero level during winter season and it may affect the working of the STP. It is in this context it is suggested that an integrated anaerobic-aerobic system to treat municipal wastewater would be viable in this temperate climate area.

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Table 1. Untreated (influent) and treated (effluent) wastewater quality at STP, Laam Nishat

Parameters	Influent	Effluent	Removal (%)
Sample I		***Sample I***	
Temp. (˚C)	18	20	
pH	6.2	6.5	
TSS (mg/l)	92	40	56.52
TDS (mg/l)	65	57	12.30
BOD (mg/l)	104	18	82.69
COD (mg/l)	280	153.6	45.14
Sample II		***Sample II***	
Temp. (˚C)	21	19	
pH	6.3	6.4	
TSS (mg/l)	72	48	33.33
TDS (mg/l)	79	54	31.64
BOD (mg/l)	100	14	86
COD (mg/l)	204	81.6	60
Sample III		***Sample III***	
Temp. (˚C)	19	16.5	
pH	6.2	6.6	
TSS (mg/l)	76	48	36.84
TDS (mg/l)	65	56	13.84
BOD (mg/l)	20	4	80
COD (mg/l)	88	34.3	61