Comparative Case Study Of Functional Sewage Treatment Plants In Lucknow City

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Abstract- *The study was done to compare the functional sewage treatment plants in Lucknow City, the capital of Uttar Pradesh, India. Currently, there are two functional STPs in Lucknow. One is situated in Daulatganj whose capacity is 56 MLD and the second one is situated in Bharwara whose capacity is 345 MLD. The Daulatganj STP is based on Fluidized Aerobic Bioreactor (FAB) and the Bharwara STP is based on Upflow Anaerobic Sludge Blanket (UASB) process.*

Keywords- BOD, Bharwara, COD, Daulatganj, Fluidized Aerobic Bioreactor, LPCD, Sewage, TSS, Upflow Anaerobic Sludge Blanket.

I. INTRODUCTION

Lucknow city is the capital of Uttar Pradesh state of India which is situated on the north-western shore of the Gomti river. The area of Lucknow city is 2528 km^2 which is bounded in the north by Sitapur and Hardoi, on the south by Raebareli, on the east by Barabanki, and on the west by Unnao. The current population of Lucknow is around 37,65,000. According to IS: 1171-1971 an average domestic consumption of water under normal conditions is 135 lpcd (liter/capita/day) in India. Hence for the population of 3.765 million people, the dependency on the natural groundwater should be reduced and for the works in which the treated sewage water could be used, natural groundwater should not be used.

Sewage Treatment is a kind of wastewater treatment whose objective is to remove contaminants from sewage to make it usable for various purposes. Sewage contains wastewater from industries, households, offices, commercial buildings, cinema halls, shopping complexes, etc. A setup in which the treatment of the sewage takes place so that it can be used for different purposes is called a Sewage treatment Plant. The treatment of sewage takes place in three most common steps i.e., Primary, Secondary, and Tertiary treatment.

In primary treatment, the sewage from different sources is stored in which the solid contaminants can settle down and lighter contaminants can rise to the top. It involves screening, grit removal process, and sedimentation. The screen is made up of long, closely spaced, and narrow metal bars. These restrict the large-sized particles to pass through it. A grit chamber is a long narrow tank that slows down the flow of sewage so that solids such as sand, eggshells, etc. will settle down. The solids (suspended) that pass the screen and grit chamber are taken off from sewage during sedimentation process in sedimentation tank.

Secondary treatment includes the removal of soluble organic matter that escapes the primary treatment process. The secondary treatment process involves a trickling filter, activated sludge process, and oxidation. A trickling filter is a tank with a layer of stones in the bed of it. The sewage is sprayed at the stones and the trickled water is taken for further treatment. The secondary clarifiers follow a trickling filter that removes microbes that remain in the sewage. For increasing efficiency, two or more trickling filters can be connected in series. Then comes the activated sludge process that consists of an aeration tank. Oxidation ponds are used to treat the wastewater by interacting the sewage with bacteria, algae, and sunlight.

Tertiary treatment is the final stage of sewage treatment that removes viruses, bacteria, inorganic compounds, parasites, etc. after the secondary treatment. After the tertiary treatment, thewater becomes ready to be reused or release for various activities.

II. BASIC STUDY

S.NO.	NAME OF STP	AFFECTED AREAS	CAPACITY	STATUS
1.	Bharwara	Trans Gomti side	345 MLD	Functional
2.	Daulatganj	Chowk, Hardoi Road, Cambell Road, Dubagga	56 MLD	Functional
3.	Mastemau	Remaining Gomti side	270 MLD	Proposed (For 2040)
4.	Khwajapur	Amausi and Sarojini Nagar	108 MLD	Proposed (For 2040)

III. TECHNOLOGY USED

Currently, there are two technologies that are being used by the STPs of Lucknow to treat the sewage produced in the city, these are UASB (Upflow Anaerobic Sludge Blanket) and FAB

(Fluidized Aerobic Bioreactor). The STP situated in Bharwara is UASB based that has a total capacity of 345 MLD and this was commissioned under the Gomti Action Plan Phase II. The second STP that is situated in Daulatganj is a FAB-based STP whose capacity is 56 MLD, it was commissioned under the Gomti Action Plan Phase I and was later extended under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). The entire Sewerage network of Lucknow city contains 26 major drains which directly drain the raw sewage into the Gomti River before these STPs grew up. Out of 26 drains, 4 drains are directed to Daulatganj STP and the remaining 22 are to be directed to Bharwara STP. UASB uses anaerobic process and it is a type of anaerobic digester. It includes forming a blanket (layer) of granular sludge which gets suspended in the tank. Sewage water flows upwards through the blanket and is degraded by the anaerobic microbes. In the FAB reactor, bacterial growth takes place. FAB reactor contains a special type of media called as FAB media which increases the surface area for the growth of bacteria. These bacteria decompose the complex impurities in the sewage.

IV. WATER QUALITY VARIABLES

Some of the most basic and important water quality parameters studied in this are BOD (Bio-chemical Oxygen Demand), COD (Chemical Oxygen Demand), and TSS (Total Suspended Solids). According to a detailed study of a number of samples collected from both the STPs, it was concluded that: -

1. BOD removal capacity of Sewage Treatment Plant at Daulatganj is better than that of Bharwara STP.
2. TSS removal capacity of Sewage Treatment Plant at Daulatganj STP is better than that of Bharwara STP
3. COD removal capacity of Sewage Treatment Plant at Bharwara STP is better than that of Daulatganj STP.

V. COST ANALYSIS

The analysis of operational costs for both the STPs is described in the table below: -

S.NO.	DESCRIPTION	BHARWARA STP	DAULATGANJ STP
		AMOUNT (in crore)	
1.	Staff	0.74	0.14
2.	O/M of Works	2.6	3.2
3.	O/M of Chemicals	0.68	0.038
4.	Electricity Cost	1.6	3.71
5.	Diesel Cost	0.7	-
6.	Revenue generated from sale of sludge	0.19	0.08
	Net Cost	**6.13**	**7.008**

From the above represented table, it is clear that the operational cost of the Daulatganj STP is more than that of Bharwara STP.

VI. LIFE CYCLE COST ANALYSIS (LCC)

From the life cycle cost analysis for a period of 20 years of FAB based STP at Daulatganj and UASB based STP at Bharwara, it was observed that the LCC of Bharwara STP is lower than the LCC of Daulatganj STP in two cases i.e., when the capacity remains constant and when the cost of land remains same. It was also seen that the rate of increase of LCC is more for Bharwara STP.

VII. BRIEF COMPARISION

S.NO	DESCRIPTION	UNIT	BHARWARA	DAULATGANJ
1.	Technology	-	UASB	FAB
2.	Capacity	MLD	345	56
3.	Plant Construction Cost	Rs. (Crore)	169.71	22.39
4.	Land Required	Ha	48.56	2.02
5.	Yearly Power Cost	Rs. (Crore)	2.22	3.61
6.	Net Yearly O/M Cost	Rs. (Crore)	5.99	6.86
7.	Sludge Production	TPD	40	16
8.	Biogas Generation	m^2/h	Not Enough	NIL

VIII. CONCLUSION

Two functional STPs of Lucknow city i.e., UASB based STP at Bharwara and FAB based STP at Daulatganj were selected for the comparative study, and the conclusions extracted from the study are given below:

1. Both the STPs are functioning properly.
2. More plants are required in Lucknow as whole sewage water is not treated.
3. Anti-foaming agents must be used as foam was observed in Bharwara STP.
4. Despite disposing the treated water to Gomti River, it may be used for various industrial and agricultural purposes.
5. LCC is higher for FAB-based STP at Daulatganj.
6. Highly diluted sewage is received at STP due to a weak sewerage network.
7. Biogas production must be focused.
8. For Lucknow, UASB based Bharwara STP is better due to low LCC.

IX. BIBLIOGRAPHY

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