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A Case Study on Bawana Common Effluent Treatment Plant, New Delhi

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Abstract—*The present study is focused on a Common Effluent Treatment Plant (CETP) located at Bawana (New Delhi). The CETP is implemented by DSIIDC and maintained and operated by Bawana Infrastructure Development Pvt. Ltd. Wastewater from about 20000 small and medium scale industries majorly comprising of plastics, textile, paints and dye industries are treated in this CETP. The common effluent treatment plant is based on the state-of-the-art technology having three-tier treatment i.e. primary, secondary and tertiary treatment. A detailed study of the CETP was conducted to review the effectiveness of the treatment being carried out for the industrial wastewater. Inlet and outlet samples for various parameters are analyzed. Parameters analyzed are pH, total suspended solids (TSS), total dissolved solids (TDS), oil & grease, chemical oxygen demand (COD) and biochemical oxygen demand (BOD). The current paper gives the details of the review study. It is confirmed that the treated water is fit for reuse for horticulture and will be used in the green belts and parks in the nearby areas.*

1. INTRODUCTION

Bawana common effluent treatment plant is located in the Bawana industrial area of New Delhi and is one of the thirteen CETP developed by DSIIDC [1]. The common effluent treatment plant of 35 MLD capacity is constructed to take care of the effluent from more than 20000 small and medium scale industries of plastics, textile, paints, dye and chemicals etc. Keeping in view the flat terrain of the industrial area, pumping of sewage is proposed through three intermediate pumping stations. It will ensure an average flow of 35 MLD (with capacity of approximately 20 MLD, 6 MLD, & 9 MLD). The recycled water from CETP is considered fit for horticulture and can also be discharged into Bawana canal passing through the industrial area. It should be noted that the operation, routine & periodic maintenance for 15 years of conveyance network will be the responsibility of Bawana Infrastructure development Pvt. Ltd. [2].

2. PRESENT CONDITIONS OF CETP

The present CETP is designed for 35 MLD flow. However, the flow presently is significantly less than the designed capacity. The effluent is received from different industries through hume pipes and pumping stations are provided wherever required. The CPCB and DPCC disposal standards into ECP for COD, BOD, SS, and oil & grease are 250, 30, 100 and 10 respectively. It should be noted that the average values of COD, BOD, SS, and oil & grease after final treatment is observed to be 110, 30, 60 and 4 mg/l, respectively, which is below the above mentioned CPCB and DPCC disposal standards [3].

The layout of the plant and the sampling locations are shown in Fig. 1.

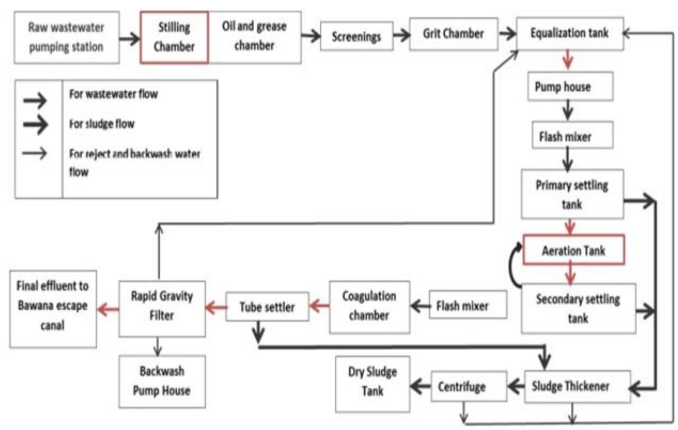

Fig. 1: Layout of plant and sampling locations

The effluent is tested for the various water quality parameters prior to being put in the equalization tank. From the equalization tank the effluent is lifted by pumps to the flash mixer where continuous dosing of polyalum and aluminium sulphate (sludge slurry) is carried out for flocculation and coagulation. After mixing the effluent is then transferred to the primary settling tank (PST). Later, two stage aeration followed by Secondary clarifier treatment process was provided. As the present effluent quantity is very less only one compartment of aeration tank is used. At tertiary treatment level, dual media filter tank and chlorination unit is provided. Table 1 shows the design parameters for Bawana CETP [4].

Table 1: Design Removal parameters for CETP

Parameter	PST	SST	Tube settler	Rapid Gravity Filter
Suspended solids	65%	90%	<15 mg/l	<4 mg/l
BOD	45%	95%	<7 mg/l	<2 mg/l
COD	45%	95%	<8 mg/l	<5 mg/l
Coli form	-	-	-	>99%

3. MATERIALS AND METHODS

Samples were collected periodically in plastic bottles and rinsed with effluent at the sampling site. Inlet samples consisted of waste effluent and outlet consists of treated effluent. The samples were collected at the inlet and outlet of treatment units as shown in Fig. 1. Samples were analyzed as per the standard methods for the examination of water and wastewater [3].

Parameters were analyzed for pH, COD, BOD, TSS, Oil & Grease [3]. Wastewater flowrate was measured through digital electronic flow meter. Method for analyses for other parameters are given in Table 2.

Table 2: Methods for sample analyses

Parameter	Method
pH	Electrometric
TSS	Filtration
COD	Reflux
BOD	Titration

Treatment Units

For meeting the standards of effluent wastewater CETP is based on the state-of-the-art technology having three-tier treatment i.e. primary, secondary and tertiary treatment (Physico-chemical, Biological processes).

Equalization and Preliminary Treatment

The wastewater is received in a wastewater collection sump having arrangement of screen chamber and grit removal chamber. Screen chamber and grit chamber is provided for the removal of coarse grit, floating matter and any suspended large particles which can cause damage to internal parts of pumps and other rotating equipment. From wastewater collection sump, wastewater is passed through oil and grease trap for the removal of floating and insoluble oil and grease particles. From oil and grease trap effluent is pumped to equalization tank for ensuring complete mixing of varying quality and quantity.

Chemical Treatment

Effluent from equalization tank is transferred to physicochemical treatment section of CETP using effluent feed pump. Chemical treatment is carried out by using chemicals and flocculants mainly to precipitate, flocculate and coagulate suspended solids and to remove these solids by using gravity settling in primary clarifiers. Effluent is first taken to two series of flash mixers for the mixing of effluent with lime slurry. The pH of effluent is in the range of 8.5 to 9.5. Effluent from flash mixer is then taken to flocculator, where ferrous sulfate is added for flocculation and coagulation of suspended and precipitated particles. From flocculator, effluent is passed through reaction channel where suitable polyelectrolyte is added to increase settling rate of flocculated and coagulated mass. Then the effluent is sent to primary clarifier for the separation of precipitated solids from the wastewater by settling under gravity. Clear overflow from primary clarifier is conveyed to Aeration tank for biological treatment. Settled sludge at the bottom of the primary clarifier is transferred to primary sludge sump.

Biological Treatment

Biological treatment is achieved by activated sludge process. In this treatment soluble BOD is stabilized by oxidation of organic matter by microorganisms. Nutrient and food is supplied to microorganisms for enhancing their growth. Oxygen required is provided by air blower through non-clog type membrane diffusers to achieve higher rate of oxygen transfer efficiency. Mixed liquor overflow from aeration tank is taken into secondary clarification process, for the separation of microorganisms under gravity. Bottom sludge from secondary clarifier is recirculated back in the aeration tank. Excess biomass is transferred into biosludge tank. Clear overflow from secondary clarifier is transferred to the tertiary treatment.

4. RESULTS AND DISCUSSIONS

The analysis of inlet and outlet sample for various parameters was carried out for a period of sixty days. It should be noted there is some ambiguity about the actual methods by which the treatment is happening. There is some concern that the treatment occurring is primarily due to physical processes and not biological processes as per the design of the CETP. However, it is expected to be a short term concern and long term the CETP will be operating as per the design setup. Irrespective of the type of treatment happening, it was observed that the overall removal is as per the design values set prior to the start of the CETP. The results are of the analysis is given in Table no. 3.

Table 3: Parameter values at sampling locations

Sampling point	Value of Parameters				
	pH	COD (mg/l)	BOD (mg/l)	TSS (mg/l)	Oil & Grease (mg/l)
Inlet	7.4	674	171	580	26
Equalization Tank	7.4	561	150	275	-
Primary Settling Tank	7.4	320	88	108	-

Aeration Tank (MLSS)	7.6	-	-	260	
Secondary Settling Tank	7.6	82	25	32	4
Outlet	7.6	66	21	21	-

The results given above show that the treatment of industrial wastewater at the CETP is satisfactory. The values of the wastewater parameters are well within the prescribed limits. The Environment Protection Act of 1986 defines the disposal limits for the treated wastewater [5]. Also the design removal rates as decided by the Delhi pollution control boards is being satisfied [6]. The following tables 4, 5 and 6 show the design removal percentage and also the present removal percentage being observed at the CETP.

Table 4: Removal % for COD

Sampling Location	COD (mg/l)	Design value	% Removal	Remark (Overall % removal)
Inlet	656	-	-	-
Primary Settling Tank	320	>45%	51.22	51.22
Secondary Settling Tank	82	>95%	74.37	87.50
Final Outlet	66	-	20.03	90.00

Table 4 show the actual removal percentage of COD and also the design removal rate for the same set by the CETP operation guidelines [6]. It can be seen that the actual overall removal value is 90% which is close to the design removal value of 95%. Similar removal values are observed for BOD as shown in Table 5 below.

Table 5: Removal % for BOD_3

Sampling Location	BOD3 (mg/l)	Design value	% Removal	Remark (Overall % removal)
Inlet	171	-	-	-
Primary Settling Tank	88	>45%	48.53	48.53
Secondary Settling Tank	25	>95%	71.60	85.38
Final Outlet	21	-	16.00	87.72

As shown in Table 5 above, the design removal expected was >95% whereas the actual performance value is approximately 88%. It is below the design removal value although still very much within the tolerance limits.

As shown in Table 6 below, the Total suspended solids (TSS) removal exceeds the design parameter. The overall design value set was >90% whereas the actual overall removal rate observed was more than 96%. The primary and secondary settling tanks are working much better than expected as evident from the high removal rates observed.

Table 6: Removal % for TSS

Sampling Location	TSS (mg/l)	Design value	% Removal	Remark (Overall % removal)
Inlet	580	-	-	-
Primary Settling Tank	108	>65%	81.38	81.38
Secondary Settling Tank	32	>90%	70.37	94.48
Final Outlet	21	-	34.37	96.38

5. CONCLUSIONS

In the present case study of the Bawana Common Effluent Treatment Plant (CETP), it was observed that the CETP is able to treat the industrial wastewater from the nearby 20000 small and medium plastic and textile units satisfactorily. The COD and BOD removal is slightly less than the design removal values. However, the TSS values exceed the overall design removal value considerably. Both the primary and secondary clarifiers were working satisfactorily.

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