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Performance Evaluation of Effluent Treatment Plant of Textile Wet Processing Industry: A Case Study of Narol Textile Cluster, Ahmedabad, Gujarat

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Abstract: ***The present study has been undertaken to evaluate performance efficiency of an Effluent Treatment Plant (ETP) of a textile industry located in Narol , Ahmedabad (Gujarat). An effluent treatment plant is operating on Conventional Effluent treatment method with an average wastewater inflow of 630 m3/day. has been considered for case study. The wastewater is analyzed for the major water quality parameters, such as pH, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) Total Dissolved Solids (TDS),Total Suspended Solids (TSS)and Ammonical Nitrogen (NH_3-N) The composite samples were collected on a hourly basis for one day . The raw wastewater pH was highly alkaline it was then bringing down to neutral which was helpful for biological treatment. The BOD, COD, TDS, TSS, NH3-N of the treated effluent reduced significantly, where as very small reduction was observed in dissolved solids (61.25 %). Most of all the parameters were above the permissible limits of Gujarat Pollution Control Board, Gujarat, India.***

Key words: **Effluent Treatment Plant, Parameters of ETP, Textile Effluent, Wet Processing Industry.**

I. INTRODUCTION

The textile industry is one of the leading sectors in the Indian economy as it contributes nearly 14 percent to the total industrial production (business.mapsofindia.com). The untreated textile wastewater can cause rapid depletion of dissolved oxygen if it is directly discharged into the surface water sources due to its high BOD value. The effluents with high levels of BOD and COD values are highly toxic to biological life. The high alkalinity and traces of chromium which is employed in dyes adversely affect the aquatic life and also interfere with the biological treatment processes [1] also textile processing units contains a complex mixture of dyes , which are highly resistant to convention treatment technology [2] .The quality of such effluent can be analyzed by their physico-chemical and biological analysis. Monitoring of the environmental parameters of the effluent would allow having, at any time, a precise idea on performance evaluation of ETP and if necessary, appropriate measures may be undertaken to prevent adverse impact on environment. The obtained results were very much useful in identification and rectification of operational and maintenance problems and it can be also utilized to establish methods for improved textile industry and plant waste minimization strategies. The textile industry uses high volume of water throughout its operation, from the washing of fibers to bleaching, mercerizing, dyeing, and printing and washing of finished products [3].

II. LITERATURE REVIEW

Performance evaluation has the benefit of assessing the performance of the wastewater treatment plant after commissioning the plant based on the removal efficiency of major parameters such as BOD, COD, TSS and TDS. Suitable remedial measures can be adopted to improve the performance of treatment plant. [4]Carried out the study on evaluating efficiency of the treatment plant by studying water samples, which were collected at different stages of treatment units. Parameters like BOD, COD, TSS and TDS were studied. Performance efficiency of each unit was calculated, which is the evidence that CETP has been working with the norms of MPCB and meeting the standard discharge limits. *[5]* Carried out to evaluate performance efficiency of the treatment plant. Water samples were collected at different stages of treatment units and analyzed for the major water quality parameters, such as pH, BOD, COD, TSS and TDS.

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The performance efficiency of each unit in treating the pollutants was calculated. The generated data presented evidence to that the common effluent treatment plant has been working with the norms of TNPCB and meeting the discharge standard limits. [6] Evaluate the performance of central wastewater treatment plant in terms of BOD_5, COD, TSS, TDS, oil and grease and ammonical nitrogen removal. Moreover, the performance of the CWWTP related to pre treatment of wastewater in those industries, so performances of pre treatment were also included in this study. samples of wastewater were collected from the CWWTP This study revealed that average concentrations of BOD_5, COD, TSS, TDS, oil and grease, and ammonical nitrogen in the effluent of CWWTP which did not meet the effluent standards for BOD_5, COD and TSS. [7] Study the performance of CETP for tannery effluent in terms of BOD, COD, TSS, TDS, . ETP showed removal efficiency of BOD-66%, COD- 21%, TSS-21% and TDS-5%. The study revealed that ETP has to be redesigned based on the characteristics of influent wastewater in order to meet the Pollution Control Board prescribed standard limits for ETP.

Table - 1: Effluent Characteristics from Textile Industry

Process	Effluent composition	Nature
Sizing	Starch, waxes, carboxymethyl cellulose (CMC), polyvinyl alcohol (PVA), wetting agents.	High in BOD,COD
Desizing	Starch,CMC,PVA,fats,waxes,pectins	High in BOD,COD,SS,dissolved solids(DS)
Bleaching	Sodium hypochlorite,Cl_2, NaOH,H_2O_2, acids, sudfacts,$NaSiO_3$, sodium phosphate, short cotton fibre	High alkalinity , high SS
Mercerizing	Sodium hydroxide, cotton wax	High pH, low BOD, high DS
Dyeing	Dyestuffs urea, reducing agents, oxidizing agents, acetic acid, detergents, wetting agents.	Strongly colored, high BOD, DS,low SS, heavy metals
Printing	Pastes,urea,starches,gums,oils,binders,acids,Thickeners,cross-linkers, reducing agents,alkali	Highly colored, high BOD, oily appearance, SS slightly alkaline, low BOD

Source: [8]

III. MATERIALS AND METHODS

Monitoring and analysis was done to understand the performance evaluation of the ETPs. For facilitating this, the sampling location were identifies and the for which the samples should be analyzed were decided .Sampling location named as S1,S2,S3 and S4.It involves Collection of composite samples (at an hour intervals over Eight hours) 9.30 am to 5 .30 pm, at the following different Sampling locations of the ETP and analyzing them for the different major physiochemical parameters The results obtained from the monitoring and evaluation studies were compared with the effluent standards prescribed in order to assess compliance. Even pH of the collected samples was measured on site; The samples from different sampling location were collected in plastic bottles. Until the analysis was over the samples were stored in deep freeze. Generally textile wet processing industry which is located at Narol, Ahmedabad mostly are small scale industry & medium scale industry. They operate their ETPs up to primary treatment or secondary treatment or some may be operate up to tertiary treatment also. In ETPs of textile industry wastewater coming from different process are collected in to the collection sump and from the collection sump it passed into the neutralization cum equalization tank where pH is bring down to neutral and flow is equalized for the further treatment and after that effluent is passed into the chemical reaction tank where chemical dosing is applied mainly coagulant is applied for coagulation and flocculation process.

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After coagulation and flocculation it passed into primary settling for sludge settlement and supernatant passed into the aeration tank for biological treatment and air is supplied by means of blower and after providing sufficient HRT in aeration tank it drained into the secondary clarifier for further sludge settling and treated effluent is discharged into mega pipeline. Mega pipeline of 27 km is provided for treated effluent of industrial cluster Vatva, Naroda, Odhav and Narol. Mega pipeline from Naroda to Pirana has carrying capacity of 90 MLD.

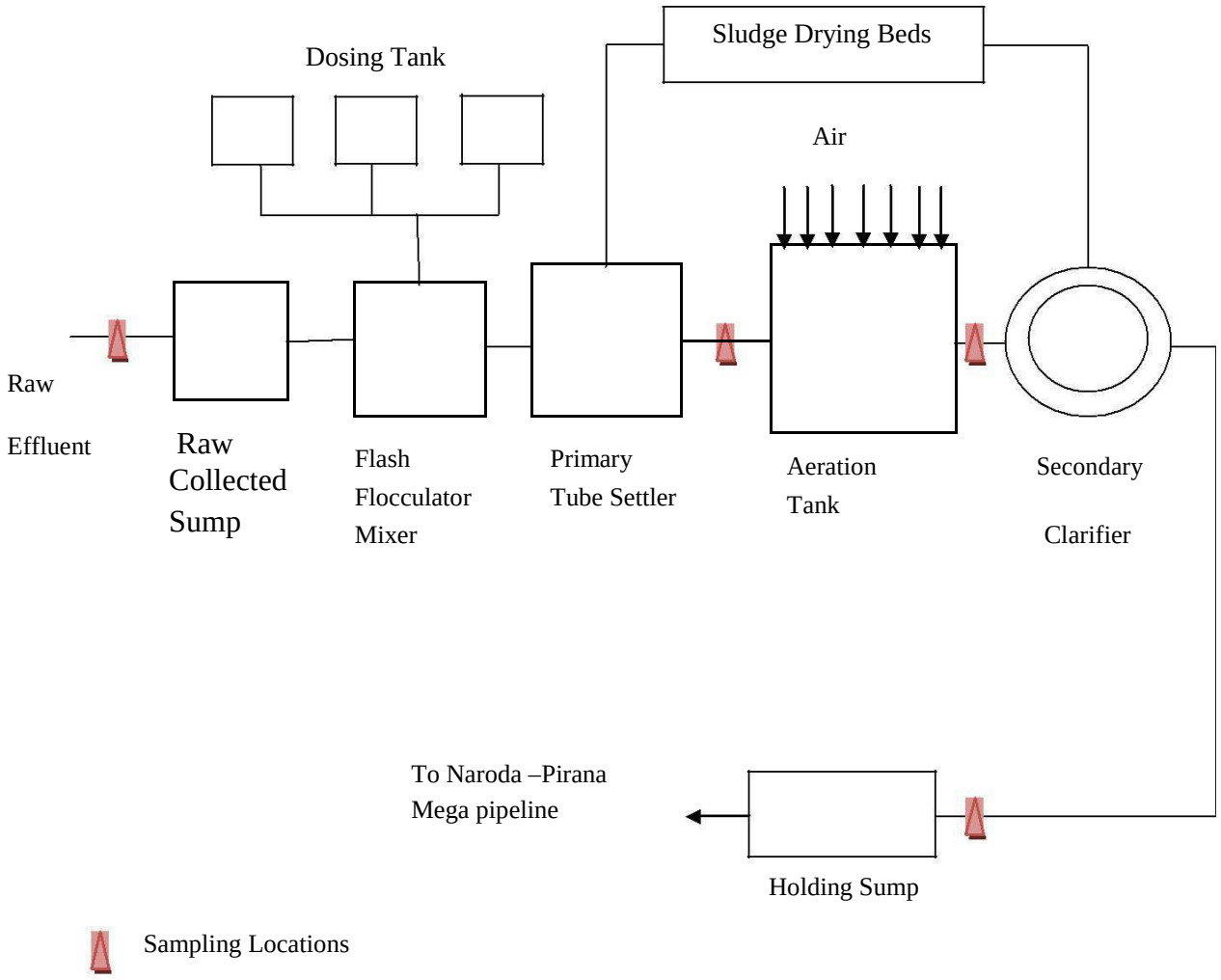

Fig-1: Flow diagram of effluent treatment plant with sampling location

At present, the treated effluent from industrial units of this cluster is discharged into mega pipeline and mixed with treated sewage coming from Pirana sewage treatment plant of Ahmedabad Municipal Corporation before final discharge into river Sabarmati. The mega pipeline has, since last few years, carrying excess of capacity and as a result, frequent overflows in upstream locations is being observed. The textile units in Narol are registered to discharge around 114 MLD as effluent but at present about 265 MLD, of industrial effluents is generated by textile units in Narol alone posing serious survival questions for water bodies in the vicinity.

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Table-2 : Inlet norms for mega pipeline (GPCB)

Parameters	Permissible Limit
pH	**6.5-8.5**
Temperature	**40^{0}C**
Colour	**100 Units**
Suspended Solid	**100 mg/L**
Oil & Grease	**10 mg/L**
Ammonical Nitrogen	**50 mg/L**
BOD (5 Days at 20^{0}C)	**30 mg/L**
COD	**100 mg/L**
Chlorides	**600 mg/L**
TDS	**2100 mg/L**
Sulphates	**1000 mg/L**

IV. RESULT AND DISCUSSION

Table-3: Parameter to be characterised at different sampling location of ETP

Parameters	Sampling Location			
	Raw Influent (S1)	Inlet Aeration Tank(S2)	Inlet Secondary Clarifier (S3)	Final Treated Effluent (S4)
pH	9	7.7	7.5	6.5
COD(mg/L)	2840	1760	951	370
BOD(mg/L)	478	316	112	71
TSS(mg/L)	6000	850	670	275
TDS (mg/L)	7020	2920	2850	2720
NH_3-N(mg/L)	78	25	14	8

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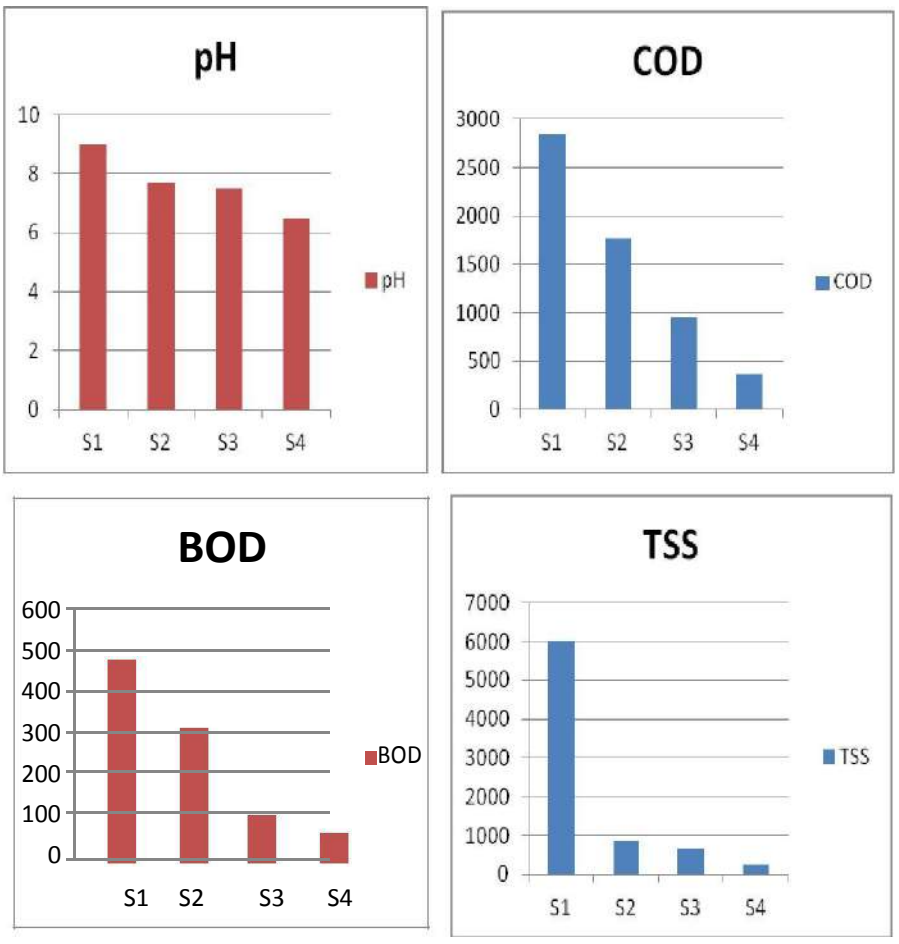
Table -4: Removal Efficiency

	BOD	COD	TSS	TDS	NH_3-N
Primary Tube Settler (S1- S2)	33.89 %	38.0%	85.83 %	58.4 %	67.94 %
Aeration tank (S2-S3)	64.55 %	46.0 %	21.17 %	2.3 %	44.00 %
Secondary Clarifier (S3-S4)	36.60 %	61.09 %	59.00%	4.5 %	42.85 %
Total Removal (S1-S4)	85.14 %	86.97 %	95.41 %	61.25%	89.74 %



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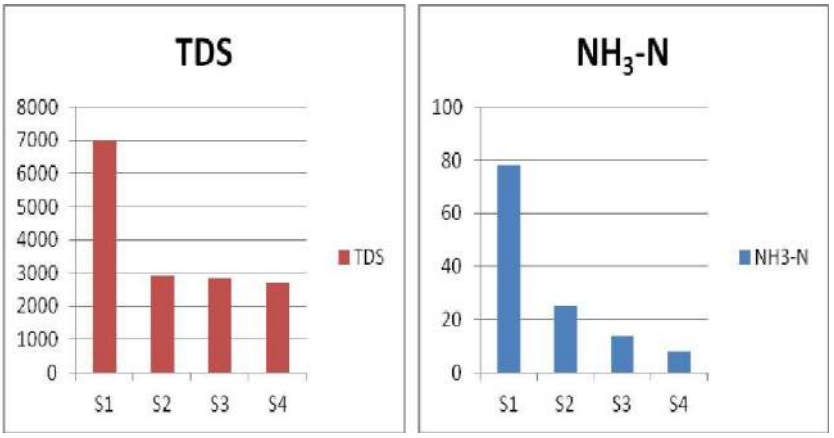

Fig -2: Characteristics pattern of BOD, COD, NH_3-N, TDS, TSS, pH at different unit of ETP

The capacity of treatment unit 740 m^3/Day and influent discharged through mega pipeline is 630 m^3/Day. Effluent treatment plant schematic sketch given in Fig. 1.The maximum TDS was present 7020 mg/L in raw effluent (S1) followed by TSS 6000 mg /L ,COD 2840 mg/L ,BOD 478 mg/L and NH_3-N 78 mg/L . The reduction in values of all parameters were in the same trends as given in raw influent (S1) the cumulative reduction in parameters were observed in final effluent (S4).The maximum reduction 95.4 % was observed in TSS followed by NH_3-N, COD, BOD and then TDS which is 89.7 %, 86.9 %, 85.1 % and 61.2 % respectively[9].*Ali et,al (2005)* and *Sharif et, al (1999)* also observed maximum efficiency and found in their experiments values are enough to meet national (BD) or international (USEPA). Above reduction indicates that removal efficiency ranges between 61.2 % to 89.7 % which is quite high. It was observed from the table that primary tube settler having more reduction than aeration tank except BOD and COD. In primary tube settler removal of TDS is 58.4 %, TSS 85.83 % as the removal of TDS was more than the BOD and COD reduced to 33.89 % and 38 % respectively. Whereas in case of aeration tank reduction of TDS is only 2.3 % and TSS 21.17 %, due to this reason BOD and COD found increased which was 64.55 % and 64 % respectively. In secondary clarifier 61.09 % maximum removal was observed followed by TSS, NH3-N,BOD and TDS which was 59 %,42.85%,36.6% and 4.5 respectively The industry had good removal efficiency in all parameter in all sampling locations which ranges from 61.2 % to 95 %. [10]*Desai and Kore (2011)* also studied the performance evaluation of textile industry and found that BOD, COD reduced significantly whereas TDS reduction was very small.

V. CONCLUSION

Based on the results obtained from this study, the following points are concluded: At present, effluent treatment plant of textile industry in narol textile cluster have low performances. The main reasons for plant failure are:

- Overloading to the existing treatment plant's capacity.
- Lack of skill for operation and maintenance for ETPs.
- The operating conditions are different from designed values.

Lack of adequate equalization leads to fluctuations in quantities and quality of effluent in various treatment units of ETP, due to which the treatment unit may not perform as desired. Poor performance of primary and secondary settling units often leads to overall poor performance of ETPs.

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