International Journal of Research in Advent Technology, Vol.6, No.6, June 2018
E-ISSN: 2321-9637
Available online at www.ijrat.org

Performance Evaluation of Textile Effluent Treatment Plant

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Abstract: Control of wastewater pollution is an important scientific research area now a days. Textile industry is one among the major pollution causing industries in Solapur district. The organic compounds which are coloured characterize a minor fraction of the organic components of wastewater but their colour resulted its undesirable appearance. Treatment of textile wastewater using traditional physico-chemical methods are expensive, large quantities of sludge is generated and usually it needs the addition of toxic chemicals. Textile effluents have high COD and low BOD. Present study analyzed the physico-chemical parameters and metals of inlet and outlet samples of textile. The percentage removal efficiency of textile of pH, COD, BOD,TDS, TSS, chloride, Chromium, and Cadmium were found to be 18.98 %, 66.64 %, 71.62%, 0.51%, 87.12%, 8.46%, 31.79% and 100 % respectively. The overall efficiency of the textile was good with respect to removal of COD, BOD, TSS and Cadmium. The study aims to evaluate the performance towards efficiency of textile over a period of three years i.e. January 2015 to December 2017**.**

Key words: Textile, wastewater, Performance, Effluent, Pollution and Treatment.

1. INTRODUCTION

In India, the textile companies has got an important place. It has a big contribution to the economy of the country. It also contributes to the companies output, employment generation and earning of foreign exchange. The value addition in the manufacturing sector is 20% and the contribution to GDP is from 4 to 5% and export earnings by the Textile industry in India is more than 30% of the total export. Textile companies spread from rural areas to the big towns like Ahmedabad, Mumbai, Calcutta, Chennai etc. In rural areas handlooms are busy in producing of cloth. In small cities, thousands of power looms are working in the textile field. Lakhs of poor people are getting their livelihood by manufacturing cloth. During the period from1960 to 1980, Solapur city's industrialization picked up a new momentum. In the meantime, due to the lack of modernization, the pioneer Mill of Seth Gokuldas closed down in 1964. In fact, for more than a generation and half, Solapuri Chaddar was a house hold name in Maharashtra, Karnataka and Telangana. Today, Solapur city is equally reputed for its terry towels. The textile industry in the city experienced its Golden Age until 1992. In 1992, Government granted expansion of the municipal boundaries of Solapur Municipal Corporation. As a result, textile units in the MIDC industrial estate is being included in the city limits and the municipal corporation began levying octroi duty and other taxes on these units. The additional taxation, together with the inflation, reflected in the rising costs of the goods produced and their prices became unremunerative in the competitive market (Textile Development Foundation (TDF) 2001).

Environmental problems of the textile industry are mainly caused by discharges of wastewater. The textile sector has a high water demand. Its major effect on the environment is on primary water consumption (80–100 m3 /ton of completed textile) and waste water discharge (115–175 kg of COD/ton of finished textile, a big range of organic chemicals, low biodegradability, colour, salinity). Therefore, reuse of the effluents represents an economic and ecological challenge for the overall sector (Li Rosi et al., 2007). The textile processing employs a variety of chemicals, depending on the quality of the raw material and product (Aslam et al., 2004). The effluent resulting from these processes change significantly in composition, due to differences in processes, used fabrics and machinery (Bisschops and Spanjers, 2003). In the textile effluent highly contaminated pollutants are SS, COD, heat, colour, acidity, and other soluble substances (Venceslau et al., 1999; World Bank, 2007). The characteristics of textile effluents differ and depend on the type of textile manufactured and the chemicals used. The textile effluents contain metals like Cr, As, Cu and Zn, which are capable of damaging the environment (Eswaramoorthi*et al.*, 2008).

Three processes are used for the treatment of textile wastewater: biological, physical and chemical methods. The reasons for less efficiencies were inadequate treatment due to incorrect dosing of chemicals necessary in the treatment process and inactivity and even death of required micro-organisms due to insufficient oxygen or lack of nutrients, overcapacity to the treatment plant, lack of ability for operation and maintenance for ETP and also the operating conditions are different from designed values. (Desai and Kore, 2011)

2. MATERIAL AND METHODS

2.1. *Study area*

The textile industry is situated at Chincholi MIDC (Lg. 17.6599 and Lt. 75.9064) Solapur district of Maharashtra, India. Having treatment capacity of 520 CMD, it is observed that the unit is running with the effluent capacity of 507 CMD. The effluent after treatment is sent to CETP for further treatment.

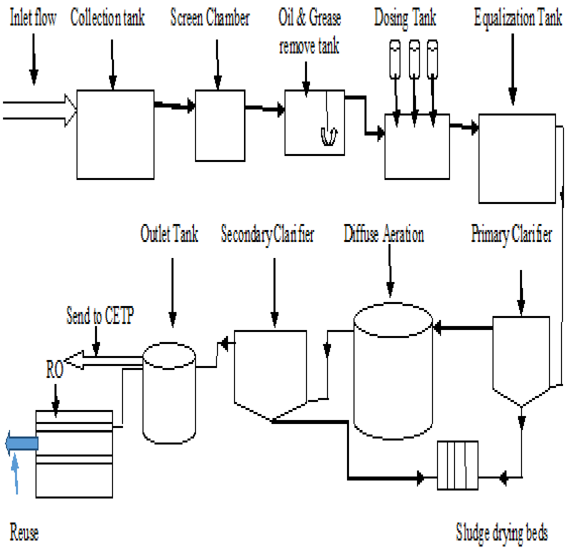

Figure 1- Flow Diagram of Textile Effluent Treatment Plant.

2.2. *Sample Collection and Analytical Method*

Sampling was carried out seasonally over a period of three years for physico-chemical parameters and metal analysis. Samples were collected from the two sampling locations i.e. from the influent and effluent of the ETP. Before collection of samples, cans were rinsed with the samples being collected. Grab type sampling technique was used to collect the samples. Untreated (Inlet) and treated (Outlet) effluent samples were analyzed for physico-chemical parameters and metals. The parameters like total dissolve solids (TDS), total suspended solids (TSS), chemical oxygen demand (COD), biological oxygen demand (BOD) and Lead, Chromium, Cadmium and Nickel were determined according to the standard methods (APHA 1998, CPCB).

$$\text{Efficiency (\%)} = \frac{\text{Inlet effluent} - \text{Outlet effluent}}{\text{Inlet effluent}} \times 100$$

3. RESULT AND DISCUSSION

The capacity of treatment unit is 720 m3/Day and influent discharged through pipeline is 507 m3/Day to CETP. The physico-chemical parameters and metals analyzed and textile effluent treatment plant treatment efficiency (%) were presented in the following table no.1. The efficiency of textile ETP was calculated by considering COD, BOD, TSS, TDS, Chloride and metals like Lead, Cadmium, Chromium and Nickel etc. The quality of effluent wastewater is generally decided by its pH value. The pH value of the treated effluent in the present study was found to be within these limits. Based on the results, it was observed that the percentage treatment efficiency of ETP was in the range of 13-24.5% with an average treatment efficiency of 18.97% (Table 1).

The COD reduction efficiency of 83.1 % observed in the present study was higher and lower was 51.6%. Also it was observed that the COD reduction efficiency is increasing in 2017 because of up-gradation of technology in ETP. Similar results for reduction of COD observed 30–37% reduction achieved using alum treatment (Song et al. 2003); and 63.5% reduction achieved by giving ferric chloride treatment (Naumczyk and Rusiniak 2005). However, the COD reduction efficiency of the present study was 81% reduction efficiency attained by using alum and ferric chloride treatment (Islam et al. 2011); 77% reduction by Fenton oxidation using H_2O_2 and $FeSO_4$ (Mandal et al. 2010); 92% reduction using sandstone filtration followed by $FeCl_3$ treatment (Chowdhury et al. 2013).

The maximum BOD reduction efficiency of 88.3% and minimum was 55.4% observed in the present study. Similarly the 76% reduction achieved using anaerobic lagoon, aerobic lagoon, aeration tank, reverse osmosis and sludge drying bed treatment technique (Kavitha et al. 2012), and 98.3% BOD reduction achieved by coagulation, flocculation using ferrous sulphate followed by polyelectrolyte treatment, aeration, biological treatment, reverse osmosis and multiple effective evaporator treatment technique (Nayana et al. 2015).

Table 1: Shows seasonal treatment efficiency (%) of textile industry ETP.

Sr. No.	**Parameters**	**2015**			**2016**			**2017**		
		Summer	Rainy	Winter	Summer	Rainy	Winter	Summer	Rainy	Winter
1.	pH	24.5	16.2	17.3	19.8	20	21.7	21.7	13	16.6
2.	COD	60.8	51.6	52.3	57.6	56.3	79.5	78.7	83.1	79.9
3.	BOD	62.9	55.4	59.4	64.1	59.7	86.8	80.8	88.3	87.2
4.	TDS	-7.2	3.1	2.5	-4.9	-7.9	-5	7.3	12.5	4.2
5.	TSS	86.9	83.2	88.7	85.8	85.7	89.2	86.1	86.1	92.4
6.	Chloride	11.8	7	3.3	9.3	8.3	8.1	11.1	10.6	6.6
7.	Chromium	30.3	35	32	34.8	30.3	28.1	35.4	32	28.2
8.	Cadmium	100	100	100	100	100	100	100	100	100
9.	Lead	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
10.	Nickel	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

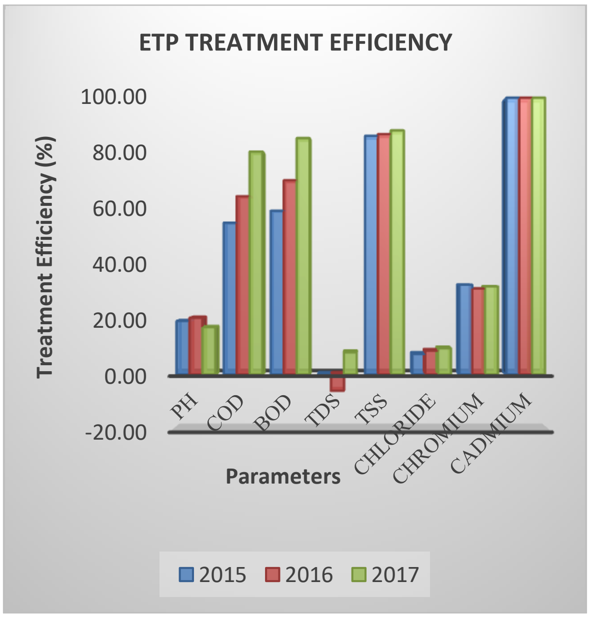

Figure 2 Shows three years average treatment efficiency of textile ETP.

It was observed that the TSS and TDS maximum reduction efficiency is 92.4%, 12.5% and minimum was 83.2% and -7.9% respectively. Comparatively TSS and TDS reduction by 94 and 39.7%, respectively, was achieved using an activated sludge process (Srikanth Vuppala et al. 2012); TSS and TDS respective reduction by 97.8 and 45.3% achieved using the SDB method (Kavitha et al. 2012); 96.0% reduction in TDS using multiple effect falling film and forced circulation evaporator method (Salakki et al. 2014). The Chloride maximum & minimum removal efficiency was 11.8% and 3.3% observed. The removal efficiency of cadmium was observed range in between 28.1% to 35% and the 100% efficiency of chromium was observed. In the analysis of textile effluent the lead and nickel was not observed.

Table 2: Shows mean and standard deviation of treatment efficiency (%) year wise of textile industry ETP.

Sr. No	**Parameters & Metals**	**2015**	**2016**	**2017**
1	pH	19.33 ± 3.68	20.50 ± 0.8	17.10 ± 3.57
2	COD	54.90 ± 4.18	64.47 ± 10.64	80.57 ± 1.86
3	BOD	59.23 ± 3.06	70.20 ± 11.87	85.43 ± 3.31
4	TDS	-0.53 ± 4.72	-5.93 ± 1.39	8.00 ± 3.42
5	TSS	86.27 ± 2.29	86.90 ± 1.63	88.20 ± 2.97
6	Chloride	7.37 ± 3.48	8.57 ± 0.52	9.43 ± 2.01
7	Chromium	32.43 ± 1.94	31.07 ± 2.79	31.87 ± 2.94
8	Cadmium	100.00 ± 0.00	100.00 ± 0.00	100.00 ± 0.00

The three years efficiency data is presented in statistical mean and standard deviation in above table 2. The mean is increasing order with respective parameters of COD, BOD, TDS, TSS and Chloride in three years because of up-gradation in textile ETP and adapted advance technology for increasing treatment efficiency. While the mean of chromium and cadmium was not much increasing or decreasing order.

4. CONCLUSION

The performance evaluation of textile industry was found that BOD, COD and TSS reduced significantly whereas TDS reduction was very less. In metals the cadmium removal efficiency was good as compare chromium was poor efficiency. The overall performance of textile industry removal efficiency of effluent treatment plant is satisfactory.

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