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Performance Evaluation of Effluent Treatment Plant for Textile Mill at Ramtek, MS, India

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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 at Ramtek, Nagpur (Maharashtra). An existing ETP is operating on biological treatment method (extended aeration activated sludge system) followed by tertiary treatment plant (R.O), with an average inflow of 30m^3/hr. Wastewater is analyzed for major parameters such as pH, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Dissolved Solid (TDS), Total Solid (TS), Total Suspended Solid (TSS) and Alkalinity. The effluent samples were collected from each units of ETP on a monthly basis for a certain period. A jar test was also conducted to determine the optimum dose of alum with respect to COD removal. After an experimentation, it was found at 400 to 500 mg/l dose of alum 42.48% COD reduction was achieved. The COD, BOD, TS and alkalinity after biological treatment reduces significantly, except TDS & TSS having very low reduction of 44% & 45% respectively. Overall treatment & analysis for treated effluent (from RO) describes, most of all the parameters were found within the permissible limit of Maharashtra Pollution Control Board. (MPCB)*

Keywords: *ETP, Chemical Parameters, % removal Efficiency, optimum dose, MPCB*

I. Introduction

The textile industry is one of the leading sectors in the Indian economy as it contributes nearly 14% to the total industrial production. The untreated textile wastewater cause rapid depletion of dissolved oxygen due to its high BOD value, if it is directly discharge into the surface water. The effluent with high levels of BOD and COD values are highly toxic for biological life. The high alkalinity and traces of chromium which is employed in dyes adversely affect the aquatic life and also interferes with the biological treatment process (Desai P. A. et al., 2011). Wastewater contaminated by dyes represents a relevant issue associated with several industries. Dyes, even at very low concentrations, reduce wastewater transparency and oxygen solubility and are often toxic and recalcitrant; moreover, these chemicals are toxic, carcinogenic or mutagenic for various organisms (P. U. Singare et al., 2014). Azo dyes are the most widely used dyes in industry & commonly used for cotton dyeing (S. Sen et al.,). Textile wastewater is one of the industrial wastewater which is very difficult to deal, the difficulty stems is due to large variability of characteristics in those wastewater (Sheng et al.,). India an average textile mill producing 60×10^4m of fabric per day is likely to discharge approximately 1.5 MLD of effluent (G.Gnanapragasam. et. al.). 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 (sumitkumar Patel etal.). The efficiency of individual units of an effluent treatment plants determines the overall performance of the plant and the final effluent quality (Khan et al.). Textile industry is a water intense industry consumes large quantities of water and thus produces large volume of wastewater during its manufacturing steps like dyeing, mercerizing, bleaching, and finish process.

II. Materials And Methods

2.1. Study area

The study was carried out for ETP of a textile mill at Ramtek near Nagpur city, having latitude & longitude of 21°18′56.95′N and 79°29′19.01′E respectively. The Total area occupied by the mill is 44.6 ha, out of which 0.104ha is allotted for Effluent Treatment Plant (ETP), 5 ha for Power Plant and remaining for textile unit, residential colony, stores etc. Water is supplied to the mill from Khindsi Lake and Canal near Ramtek. About 800-900m^3/d water is required for manufacturing process, and the total generation of waste water from the textile mill is about 700-800m^3/d. Recovered quantity of water after tertiary treatment varies between 400 and 670m^3/d.

2.2. Requirements

All the glassware, burette and pipettes were first cleaned with tap water thoroughly and finally with de-ionized distilled water. The chemicals and reagents were used for analysis were analytical reagent grade. The procedure for analysis or calculating the different parameters were conducted in the laboratory.

2.3. Industrial Effluent Sampling and Preservation

An existing ETP at Ramtek comprises of chemical treatment in which Poly aluminum Chloride (PAC) and lime was used as a coagulant followed by biological treatment which is operating on extended aeration activated sludge system along with a tertiary treatment plant where Reverse Osmosis (RO) unit is provided. The effluent samples were collected from each units of ETP (equalization, flocculation, PST [Primary Settling Tank], Aeration, SST [Secondary Settling Tank] and RO) on monthly basis for a period of Nov-13 to Apr-14. Samples were collected in a plastic bottle, before collecting it was thoroughly cleaned with hydrochloric acid and washed with tap water to render free of acid. The sample bottle was then labeled and its pH was also checked at site with pH paper. Until the analysis was over the effluent samples were preserved below 4°C.

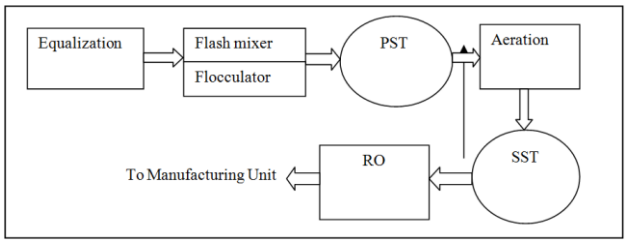


Fig 1. Flow Chart of ETP

2.4. Physico-chemical study

The collected samples were analyzed for pH, Total Dissolved Solids (T.D.S), Total Suspended Solids (T.S.S), Total Solids (T.S), Biological Oxygen Demand (B.O.D), Chemical Oxygen Demand (C.O.D) and Alkalinity

III. Result and Discussion

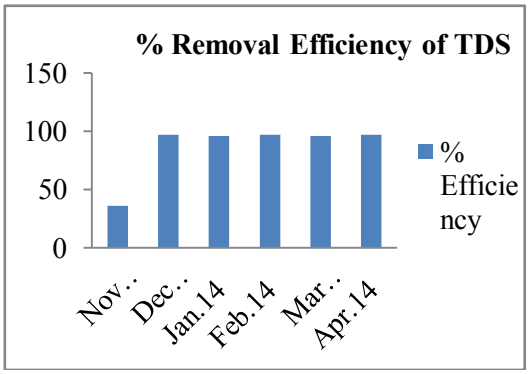
The experimental data on physico-chemical properties of effluent from different units of ETP is presented in the Table. No.1. In present study with an average flow of 30m^3/hr, pH value was found to be very high at equalization (13.1) due to use of sodium hydroxide in manufacturing which was brought to neutral at RO (7.0). By providing tertiary treatment the percentage removal efficiency in the TS, TDS, TSS and COD was 96%, 97%, 88% and 98% respectively, whereas for BOD and alkalinity it was found 99% reduction. The efficiency after biological treatment for COD, BOD and alkalinity was 88%, 98% and 93%, whereas for TDS and TSS it was found 44 & 45% respectively. After chemical treatment the percentage removal efficiency in TS was 19 to 30% which was due to colloidal solid present in effluent, TSS was 31 to 41%, and very less removal in TDS was observed having 17 to 33%, average TSS & TDS was found to be 38 & 24% respectively, whereas the reduction in COD was found to be insignificant having 36% reduction.

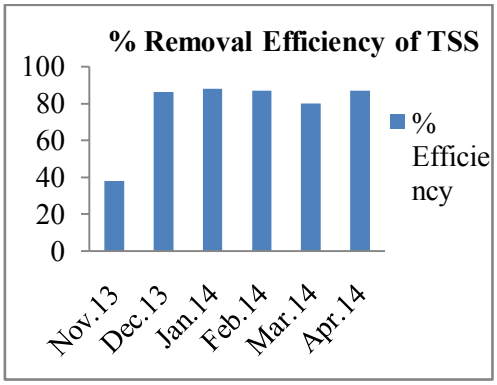
Table 1. Physico-Chemical Properties of Effluent Samples Collected from various Units of ETP

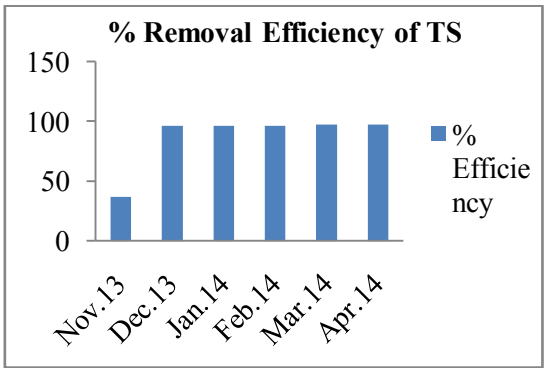
Physico-chemical properties	Units							
	Months	Equalization	Flocculation	PST	Aeration	SST	RO	% Removal
pH	Nov-13	13.0	--	--	7.8	7.8	--	--
	Dec-13	13.1	11.6	7.4	7.5	8.0	7.0	--
	Jan-14	12.8	6.7	7.3	8.7	8.6	7.6	--
	Feb-14	12.9	7.3	7.6	8.3	8.5	7.2	--
	Mar-14	13.1	10.5	7.8	9.1	9.3	7.7	--
	Apr-14	12.9	7.5	7.8	8.2	8.3	7.1	--
TS	Nov-13	15400	--	--	10200	9677	--	37 up to sst
	Dec-13	21340	16780	14920	19860	11580	680	96
	Jan-14	14240	13860	10480	9180	8480	560	96
	Feb-14	12180	10940	9840	8880	8240	420	96
	Mar-14	13680	13360	10980	9340	9420	300	97
	Apr-14	14660	13820	11040	9920	9680	400	97
TDS	Nov-13	15200	--	--	9800	9600	--	36 up to sst
	Dec-13	20620	15740	13700	10320	11520	580	97
	Jan-14	13560	13360	9740	8800	8260	440	96
	Feb-14	11560	10500	9520	8640	8080	340	97
	Mar-14	13080	12820	10600	9040	9160	420	96
	Apr-14	14020	13300	10600	9660	9500	320	97

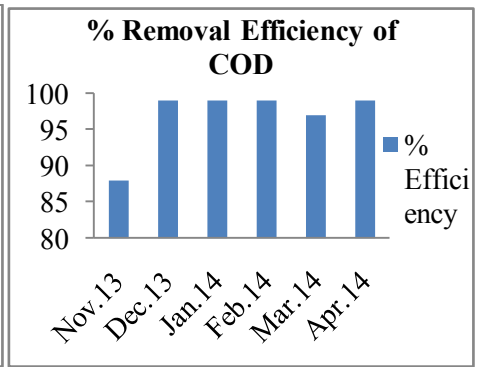
Physico-chemical properties	Units							
	Months	Equ	Floc	PST	Aera	SST	RO	% Removal
COD	Nov-13	4400	--	--	152	132	--	97 up to sst

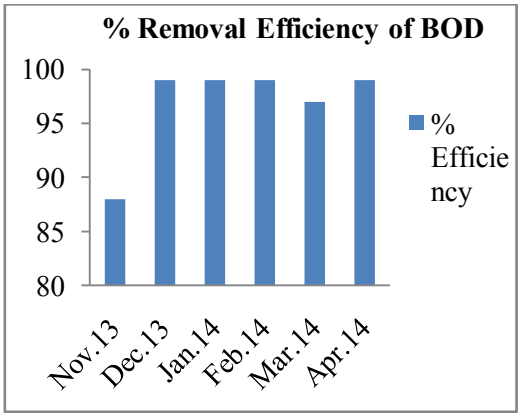
	Dec-13	3040	2540	2820	1240	60	40	98
	Jan-14	2120	1640	1076	714	280	28	98
	Feb-14	2000	1482	1440	1200	488	48	97
	Mar-14	3060	1960	1176	1200	560	48	98
	Apr-14	4460	2900	2720	1540	224	48	98
BOD	Nov-13	1160	--	--	65	15	--	98 up to sst
	Dec-13	920	1200	610	520	24	14	98
	Jan-14	1680	1480	980	80	56	4	99
	Feb-14	920	760	980	520	120	13	98
	Mar-14	880	680	540	200	120	2	99
	Apr-14	1100	960	700	560	224	11	99
Alkalinity	Nov-13	7800	--	--	865	900	--	98 up to sst
	Dec-13	14400	1100	1140	840	650	96	98
	Jan-14	11600	990	960	885	700	80	99
	Feb-14	14000	1130	1100	900	910	75	98
	Mar-14	2300	840	1390	2440	980	60	99
	Apr-14	14400	1360	1320	832	1072	84	99

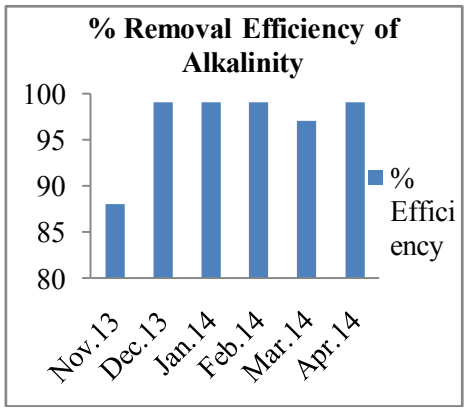












These graphs shows overall % removal efficiency of all the parameters for treated effluent

A jar test was conducted to determine optimum dose of alum with respect to COD removal. 10% alum solution was prepared & added at different dose to 500ml 0f 17 number of sample by increasing 0.5ml dose of alum solution in each sample. After an experiment it was found at 400-500 mg/l dose of alum 42.48% COD reduction was achieved. Also design for biological system was carried out with flow rate of $30m^3$/hr considering inlet BOD 700 mg/l in aeration tank as ETP comprises of 3 aeration tank of known capacity, by trial & error of F/M (Food to Micro-organism) and MLSS (Mixed Liquor Suspended Solid) and all the parameters {HRT

(Hydraulic Retention Time), volumetric loading , SOR (Surface overflow rate)} was calculated and was found within the design criteria of activated sludge process.

IV. Conclusion

After estimation it was found, only one aeration tank will be enough to meet the design criteria, hence the other two available tanks can be used for equalization which is necessary at the mill. Removal efficiency for physico-chemical properties in chemical treatment was less than 50% of their original values, due to improper flow & incorrect dosing of chemicals.

By providing RO plant characteristic of effluent was brought within the limit of MPCB. And thereby industry is practicing for water conservation by reuse & recycle of treated wastewater, in the manufacturing process for washing floors & equipments.

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