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Performance Evaluation of Effluent Treatment Plant for Textile Industry in Kolhapur of Maharashtra

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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 kagal-Hatkanangale MIDC area, Kolhapur (Maharashtra). An effluent treatment plant is operating on biological treatment method (Fluidized Aerobic Bio-Reactor) with an average wastewater inflow of 2MLD 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) and Total Dissolved Solids (TDS). The effluent samples were collected on a daily basis for a period of one month. The raw wastewater pH was highly alkaline it was then bringing down to neutral which was helpful for biological treatment. The BOD, COD of the treated effluent reduced significantly, where as very small reduction was observed in dissolved solids. Most of all the parameters were within the permissible limits of Maharashtra Pollution Control Board, India.

Keywords: Effluent Treatment Plant, Textile Industry, identification, rectification.

1.0 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 (Palamthodi *et al*., 2011).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 present textile industry is having weaving capacity of 10 million meter per annum. During the production process, effluent generated in the plant is drain to ETP. The samples collected daily and analyzed for Physico-chemical and biological parameter except BOD as it takes three days for analysis for the period of one month during the training period. On average, approximately 200 liters of water are required to produce l kg of textiles. The risk factors are primarily associated with the wet processes- scouring, desizing, mercerizing, bleaching, dyeing and finishing. Desizing, scouring and bleaching processes produce large quantities of wastewater (Yusuff *et al*., 2004). The large volumes of wastewater generated also contain a wide variety of chemicals used throughout processing. These can cause damage if not properly treated before being discharged into the environment (C Parvathi *et al*., 2009).

Fig 1: Google image of Raymond zambaiti Ltd, Kolhapur

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, surfactants, $NaSiO_3$, 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: Yusuff and Sonibare (2004)

The flow sheet of ETP is shown in fig no. 2. The flow sheet to achieve the standard required as per consent letter of Maharashtra Pollution Control Board comprises of the following units: 1] Screen Chamber 2] Equalization tank 3] Flash mixer 4] Flocculation Tank 5] Tube Settler-I 6] Fluidized Aerobic Bio-Reactor (FAB-I) 7] FAB-II 8] Tube Settler-II 9] Chlorine Contact Tank 10] Sludge Thickener 11] Centrifuge.

The wastewater generated from the plant is collectively passed through the screen chamber to remove the floating matter present in the wastewater. The quality and quantity of the wastewater is maintained in the equilisation tank where air blower is provided for the supply of oxygen. The wastewater then comes to the flash mixer in which lime and ferrous sulphate are the coagulants added to the wastewater with detention time of 30 seconds. The floc gets formed due to the slow mixing and resultant settling of floc in the first tube settler reduces total suspended solids and BOD load on the secondary treatment. The water is then allowed in the FAB-I where micro-organisms are attached to the media while media is suspended in the wastewater. The growth occurred on the media. The oxidation of organic matter is done with the help of micro-organisms. The sludge formed due to biological process gets settled in the tube settler II. The wastewater treated by secondary treatment is then allowed in chlorine contact tank to kill pathogens using the hypochlorite as a disinfectant. The treated wastewater is then sending to the common effluent treatment plant for further treatment. The sludge settled in the tube settlers is then sending to the sludge thickener then it is concentrated in centrifuge using poly electrolyte dosing. The concentrated sludge is send to the hazardous waste disposal site at rajangoan, pune.

The samples collected on daily basis and brought to the laboratory for analysis of various environmental parameters. The BOD and COD were analyzed using Standard Methods for The Examination of Water and Wastewater (APHA, 1998). COD was determined by the dichromate digestion method while BOD was determined by the dilution method. TDS is analyzed by portable digital TDS meter manufactured by EI Electronics. TDS meter was checked and calibrated according to the manufacturer's specifications. TDS was calibrated using the potassium chloride solution provided by the manufacturer.

2.0 Experimental procedure

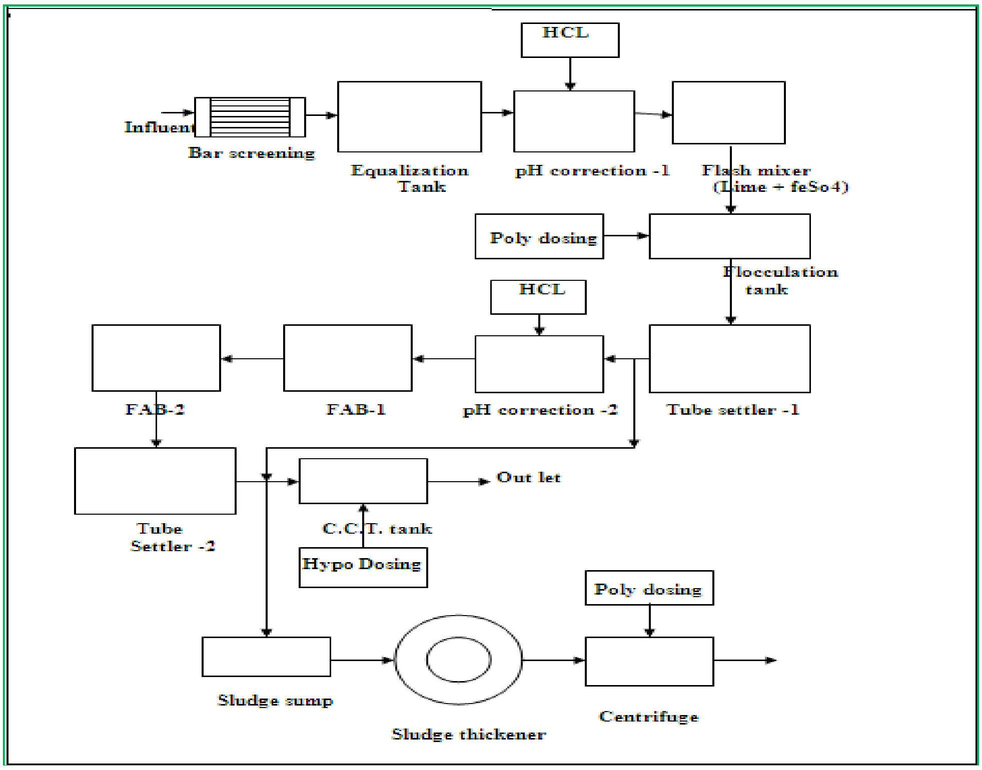

Fig. 2: Flow chart of ETP of Raymond zambaiti Ltd, Kolhapur

3.0 Results and Discussion:

Table 1 shows the major processes involved in textile manufacturing and the nature of waste-water generated. For evaluating the performance of ETP, the accurate idea of the composition of effluents is very important. This is so because industrial effluents contain various pollutants that may alter the quality of the receiving water and the environment at large (Ogunlaja *et al.*, 2009). The results of daily analysis of pH, COD, BOD and TDS etc are represented in Table 2.

Table 2: Daily analysis of inlet and outlet parameters

Date	Treated quantity	Inlet parameters				Outlet parameters			
		pH	COD	BOD	TDS	pH	COD	BOD	TDS
15/6	1214	12.94	1422	298	2000	7.52	224	36	1900
16/6	1500	13.18	1436	-	2100	7.94	208	-	2000
17/6	1224	12.20	1234	-	1900	7.36	200	-	1800
18/6	1463	13.14	1152	278	1800	7.74	188	46	1700
19/6	1438	12.14	1218	-	1900	7.48	192	-	1800
20/6	370	12.10	1088	-	1700	7.62	188	-	1600
21/6	1010	12.92	1296	242	1800	7.94	196	36	1700
22/6	1188	12.18	1214	-	1900	7.30	180	-	1800
23/6	1850	13.14	1320	-	2000	7.62	202	-	1900
24/6	1057	13.18	1472	322	2100	7.68	184	42	1800
25/6	1203	12.84	1280	-	2000	7.92	194	-	2000
26/6	1341	13.88	1288	-	2000	7.95	190	-	1900
27/6	231	12.14	1120	-	2000	7.88	182	-	1700
28/6	1039	12.18	1320	310	2100	7.68	188	52	1800
29/6	1248	12.34	1228	-	2000	7.48	192	-	1700
30/6	1146	12.84	1286	-	2000	7.42	204	-	1800
31/6	1347	13.88	1328	-	2100	7.9	210	-	1700
02/7	937	13.14	1296	-	1900	7.68	180	-	1800
03/7	1806	13.10	1232	320	1800	7.33	192	72	1600
04/7	132	12.18	1140	-	1900	7.58	182	-	1800
05/7	879	13.34	1320	-	1800	7.94	200	-	1800
06/7	1006	13.22	1328	358	1900	7.68	188	72	1800
07/7	819	12.64	1280	-	2000	7.95	216	-	1900
08/7	1162	12.84	1424	-	2100	7.9	236	-	1800
09/7	1061	12.18	1104	282	2000	7.68	180	56	1700
10/7	1026	12.94	1248	-	2000	7.6	210	-	1800
11/7	287	11.98	1120	-	1900	7.34	188	-	1700
12/7	939	12.08	1280	294	1900	7.98	192	80	1800
13/7	1105	12.50	1136	-	2000	7.94	184	-	1900
14/7	1169	12.88	1210	-	2100	7.98	220	-	1800
15/7	964	12.22	1200	284	2000	7.92	182	36	1900

The color of the effluent was brownish black. In-complete use and the washing operations give the textile wastewater a considerable amount of dyes (Palamthodi *et al*., 2011). It has been documented that residual color is usually due to insoluble dyes which have low biodegradability as reactive blue 21, direct blue 80 and vat violet with COD/BOD ratio of 59.0, 17.7 and 10.8 respectively (Adel Al-Kdasi *et al*., 2004). The coagulation and flocculation helps to remove color of the effluent (Wong, 2007). The pH of the raw effluent is very high as the incoming wastewater is highly alkaline in nature. The bleaching agents used in the process are reasons for high alkaline wastewater. The pH correction is done with the help of HCL and brings down to neutral which is favorable pH for biological treatment. TDS are composed mainly of carbonates, bicarbonates, chlorides, phosphates and nitrates, calcium, magnesium, potassium and manganese, organic matter salts and other particles. No appreciable change was observed in values of dissolved solids in treated effluent. TDS detected could be attributed to the high color from the various dyestuffs being used in the textile mills (Mohabansi *et al*., 2011).

The COD and BOD of raw effluent varied from 1104 to 1475 mg/l and 242 to 358 mg/l respectively. The higher values of COD and BOD in raw effluent attributed to the presence of chemical substances and breakdown of raw material used for preparation of fiber respectively. The COD and BOD of treated effluents were reduced significantly to a greater extent due to the biological treatment process for which the effluent is passed through FAB I and II. The FAB consists of a tank filled with specially developed media. These media are made of special material of suitable density that can be fluidized using an aeration device through diffusers. A bio-film develops on the media, which move along the effluent in the reactor. The movement within the reactor is generated by providing aeration with help of diffusers placed at the bottom of the reactor. This thin film on the media enables the bacteria to act upon the bio-degradable matter in the effluent and reduce BOD/COD content in presence of oxygen from the air used for fluidization (sanllersystems.com).

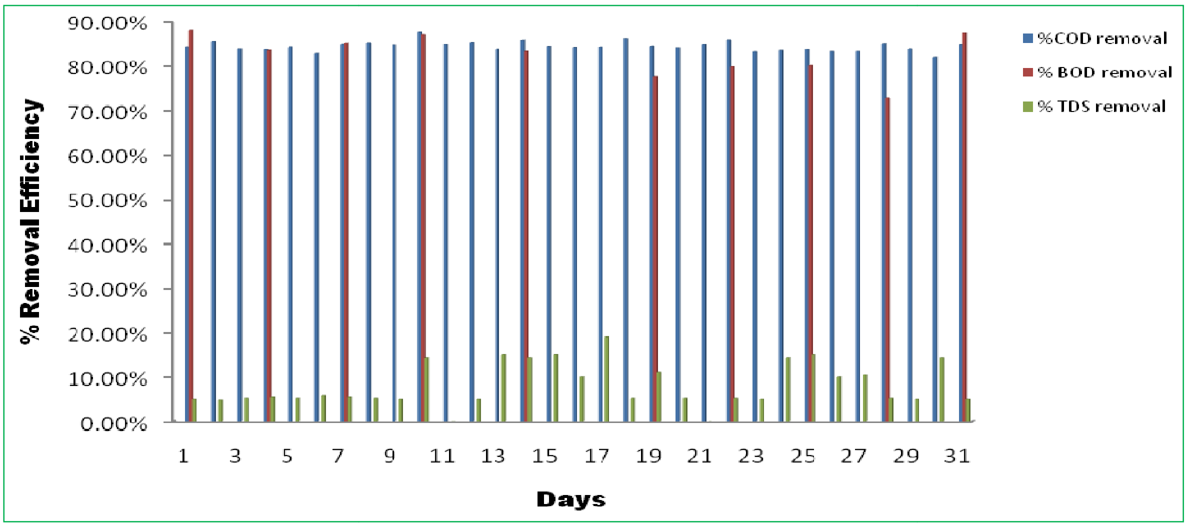

Fig 2: Variation in percent removal of COD, BOD and TDS

Most of the studied parameters are well within the permissible limit prescribed by MPCB because the industry has installed adequate treatment system to treat the raw effluent. The treated effluent is applicable for land application so it is used for green belt development in the industrial premises and 30% of the total effluent treated is reused for this purpose. The disposal of excess of treated effluent to common effluent treatment plant is best and effective and environmentally acceptable option for better downstream conditions.

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