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Trouble Shooting and Performance Enhancement in Activated Sludge Process for Treatment of Textile Wastewaters

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ABSTRACT

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 Biological Oxygen Demand (BOD) and Chemical Oxygen Demand(COD) value. This paper focuses on various troubles in performance of activated sludge process and performance enhancement by suggesting remedial measures to ensure the proper operation of activated sludge process(ASP).Also, it is noted that modification and alternative use of chemicals such as 45% solution of sodium bisulphate in burnout printing instead of this 15% of acetic acid and 30% sodium bisulphate is mixed to improve the overall efficiency in terms of Chemical Oxygen Demand(COD) and Biological Oxygen Demand(BOD).

Keywords - Activated sludge, Textile wastewater, Performance Enhancement, Trouble shooting

I. Introduction

In this textile mill bleached cloth is colored with dyes of various types, and printed with various design, depending on market demand. As a result, waste water produced in this section is difficult to treat, especially from the point of view of color removal and reduction of oxygen demand. 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 [1].

Cotton textile industry wastewater generated by the different production steps (i.e. sizing of fibers, scouring, desizing, bleaching, washing, mercerization, dyeing and finishing) has high pH and temperature. It also contains high concentrations of organic matter, non-biodegradable matter, toxic substances, detergents and soaps, oil and grease, sulfide, suspended and dissolved solids and alkalinity [2].

The activated sludge process is the most widely used secondary treatment process for treating both municipal and industrial wastewaters. The removal of the polluting dyes from effluents is an important problem, particularly for small scale textile industries where working conditions and economic status do not allow them to treat their wastewater before disposal and they have no choice other than discharging the effluents into the main stream of water resources. In aeration tank the water was aerated from the bottom with diffusers to maintain Dissolved Oxygen concentration above 4mg/l(For both the bacterial growth and the mixed liquor)[2].

The objectives of this study were: (1) To identify the problem in aeration tank of effluent treatment plant treating textile wastewater. (2) To suggest the remedial measures to ensure the proper operation of activated sludge process (ASP). (3) To improve the overall removal efficiency in terms of chemical oxygen demand (COD) and biochemical oxygen demand (BOD) from the ASP. (4) To identify the manufacturing process which produce more COD. (5) To suggest chemical which reduce the impact on treatment plant. (6) To control COD in effluent of different textile process.

Table 1: Characteristics of the textile industry effluent

Sr. no	**Parameters**	**Values**
1	pH	8–10
2	Temperature °C	38–40
3	TSS	180–200
4	TDS	3700–3900
5	COD	1400–1600
6	Trace elements (Fe, Zn, Cu, Ni, Mn)	15–20

Note: All values are expressed in mg/l, except pH and temperature [3]

A process description of woven cotton and polyester blended fabric manufacturing is discussed below as this is one of the major textile material commonly used all over the world.

Desizing is use to remove sizing material prior to weaving. Depending on the size that has been used, the cloth may be steeped in a dilute acid and then rinsed, or enzymes may be used to break down the size [4]. Bleaching improves whiteness by removing natural coloration and remaining trace impurities from the cotton; the degree of bleaching necessary is determined by the required whiteness and absorbency [5]. A further possibility is mercerizing during which the fabric is treated with caustic soda solution to cause swelling of the fibers. This results in improved luster, strength and dye affinity [6]. Dying is a process in which yarns and fabric acquire color. Textiles are dyed using a wide range of dyestuffs, techniques and machines. Printing is a process which colours and design are printed on fabric. The most common printing technique is screen-printing, roller printing and others. Pigments and dyestuffs are mainly used for printing. In finishing , yarn or fabric in order to impart the final touch and also the change properties of the fabric. It involves brushing or raising to make the surface hairy, physical treatment to improve the lustre, softness, to minimize the wash shrinkage and resins [4].

The activated sludge process consists of two units - the aeration tank (or basin) and the secondary clarifier (sedimentation tank). From the bottom of the secondary clarifier, settled and concentrated sludge is returned back to the aeration tank to maintain the mixed liquor suspended solids (MLSS) at desirable level. Excess sludge produced each day is wasted from the return sludge line and discharged, frequently, to a sludge thickener to keep the system operating at a controlled sludge age (mean cell retention time, MCRT or sludge retention time, SRT).

Problems associated with the activated sludge process:

1. Settling of biomass is difficult.
2. Concentration of biomass in aeration tank is less.
1. Foaming was observed on the surface of aeration tank.
1. Microorganisms are continuously carried over along with effluent from secondary clarifier.
2. During printing 45% solution of sodium bisulphate is used in burnout process which results in bacterial die off due to sodium bisulphate chemical, and COD was accounted around 1.5 lakh mg/l in 10 m3/d flow coming from brasso print process.

II. Experimental Details

2.1 Chemicals use

Chemicals of Burn out Printing

1. Acetic acid (CH_3COOH) – 15%
2. Sodium bisulphate (Na_2HSO_4) -30%
3. Water + gum – 55%

Biopolymer: Activated sludge flocs are thought to consist of microbial aggregates, filamentous organisms, organic and inorganic particles and exocellular polymers. These flocs are held together by means of exocellular polymers (biopolymers) and divalent cations to form a 3-dimensional matrix. Although the flocculation process is important, it is not well understood. It is known that bioflocculation is responsible for many of the changes in biofloc characteristics [7].

Table : 2 Coagulants use in effluent treatment palnt

Chemical	**Dosing**	**Before pH**	**After pH**
Lime	400-500kg/d	8	10.5
Ferrous sulphate	900-1000kg/d	10.5	6-7

2.2 Processes Adopted

Wastewater samples were collected from aeration tank-I, II, III and inlet as well as outlet of effluent treatment plant (ETP). Samples were collected in 2 liters white plastic beaker, which have been thoroughly washed with nitric acid and then rinsed many times with distilled water. All samples were preserved inside a refrigerator except samples for microbial analysis, which were analyzed within 24 hours. Sample analyzed according to Standard Methods (APHA, 1998). pH was measured by pH meter. Chemical oxygen demand (COD) was determined by reflux digestion method. DO was measured by the azide modification of Winkler method. Total solids were measured as the residue left after evaporation at 103 to 105˚C of the unfiltered sample. MLSS is determined by filtering the sample through a filter disk & the residue retain in the filter is dried to constant temperature at 103˚c. MLVSS is the residue of MLSS is ignited to constant weight at 550˚c. SVI is determined by estimation of settable solids by gravimetric method.

2.4 Result and Discussion

Initially, the design of a clarifier was having a size (4 meter diameter & 2 meter height). But adequate settling was not observed, hence to create quiescent conditions, unit was advised to installed 1m diameter, 1.25 m height and 5 mm thicken Mild steel plate. So that proper settling can occur.

Furthermore, to enhance good settling of mixed liquor suspended solids (MLSS), biopolymer (2ppm) was also decided to add in the aeration tank. During the dyeing and printing process various chemicals are used and due to it COD increases. In the brasso print, burnout process is carried out using sodium bisulphate chemical paste. This paste is applied on the cloth for printing and due to presence of cloth residue and sodium, COD increases up to 1.5 lakh and ultimately overall COD of effluent increase and to prevent this, waste water having 1.5 lakh COD is stored in storage tank and then form here gradually it is mix with effluent of various processes and then it is feed with into treatment plant and thus COD of effluent is maintain.

And it there are three aeration tank and one air pump. Firstly, the air was pumped in three aeration tank through one common pipe, starting from tank-3 to tank-3 and due to it the proper air pressure was not accounted in tank-1 resulted in DO deficiency and caused undesirable death of microorganisms and this result in increase of biomass and due to it they were carrying over into the clarifier. Now, a remedial measure of this, an extra pipe is from common pipe direct to tank-1, and due to it the efficiency of this tank increased.

Table : 2 COD removal efficiencies

Sr. No.	COD	
	INLET	OUTLET
1	1320	280
2	1280	374
3	1470	312
4	1569	110
5	1360	87
6	1447	75
7	1188	96

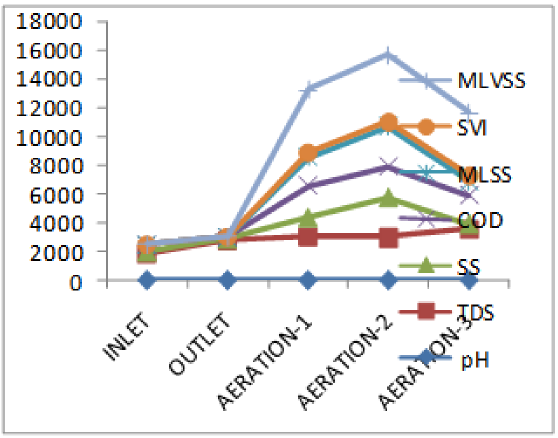

fig. 1 Result from the sample analysis

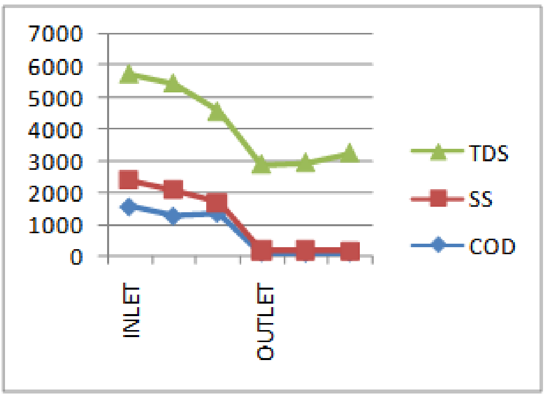

fig.2 COD, TDS and SS removal Efficiencies (Before Modification)

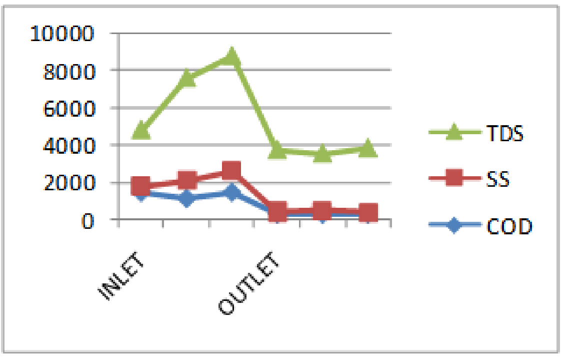

fig.3 COD, TDS and SS Removal Efficiency(after modification)

III. Conclusion

This result concluded by using biopolymer (2 ppm) in aeration tank, proper settling of microorganisms was obtained. By modification in secondary clarifier, desired velocity of effluent is obtained and carryover of biomass could also be prevented.

Before use of biopolymers, COD, TDS removal was recorded as 93% and 85% which has now reduced to

75% and 83% due to modification. Instead of using 45% of sodium bisulphate solution, 15% of acetic acid *and 30*% sodium bisulphate is mixed and it resulted in increase of bacteria in aeration tank. In dying process, due to use of formic acid, bacterial growth was not proper and this problem is solved by using acetic acid in place of it. Normally 2 ppm bio polymers were used in aeration tank which have now reduced to 0.1 ppm due to the above modification in process.

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