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Effective Treatment Methods of COD and TDS from Dyeing Industry Effluent

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ABSTRACT

Though industries promote economy of the country, the pollution caused by them has to be controlled in order to save the environment from degradation. The present work has been aimed for the removal and reduction of chemical oxygen demand (COD) and total dissolved solids (TDS) of the dyeing industry effluent using oxidizing and coagulating agents, and adsorbent individually and in different combinations. About 0.25, 0.50, 0.75 and 1.00 g of oxidizing agent (sodium hypochlorite), coagulating agent (alum) and adsorbent (commercial activated carbon, CAC) were added separately and in combinations. The COD (92.3%) and TDS (80%) were removed using 0.25g of oxidizing agent within one hour, and with 1 g of coagulating agent the COD and TDS were removed 98.4 % and 90% respectively. For CAC it has been reported that the dosage of 0.75 g has resulted in 87.6 % and 80% of COD and TDS removal respectively. With the combination of sodium hypochlorite, CAC and alum, the percentage reduction of COD and TDS are 87% and 79% respectively. The statistical analysis revealed a positive correlation between reduction and the time.

INTRODUCTION

The major sources of water contamination are domestic, industrial, agricultural, thermal and radioactive waste (Gaur 1997). Surface water comes in direct contact with the atmosphere, seasonal streams, rivulets and surface drains. So there occurs exchange of dissolved and atmospheric gases while the wastes are added through water conveyances. The industries, which contribute much to water pollution are mainly pulp and paper industries, distilleries, oil refineries, pharmaceutical, textile, dyeing industry, dairy, acid pickling, power plant roller and flour mills etc. (Kudesia 1994). Effluents discharged from dyeing industries are highly coloured and toxic to aquatic life in receiving waters. Contamination of water resources with dyes is not desirable, as they are aesthetically displeasing. The dyes also prevent reoxygenation in receiving waters by cutting off sunlight penetration. In addition, most of the dyes used as colouring material are toxic to aquatic organisms. Existing technologies for dyes effluent treatment such as advanced oxidation process, electrochemical reduction, etc. may be efficient for the removal of dyes but their initial and operational costs are high.

The main problem found in the decontamination of textile wastewaters is the removal of colour, since at the present time there is no single process capable of adequate treatment, mainly due to the complex nature of these effluents (Cooper 1993).

Over 1,00,000 commercially available dyes exist and more than 7×10^5 tonnes of dye stuff are produced annually. As the dyes present in wastewaters decompose very slowly in normal environmental conditions, treatment methods to remove them have to be employed. As the dyes used in textiles are stable to light, oxidation and aerobic digestion, they pose problems since most conventional treatment methods are based on oxidation or aerobic digestion (Lee & Low 1987).

Various methods have been used for removing colour from the textile waste water like chemical coagulation, flocculation, biological treatment, membrane separation, oxidation by ozone, biosorption and adsorption. Adsorption is generally carried out by activated carbon, which is costlier. Many adsorbent materials have been evaluated for low cost operation are of higher efficiency. Alternative adsorbents investigated are wool, lignite, *Sphagnum* peat, fly-ash, boiler bottom ash, resin husk, inorganic salts, cashew nut hull carbon, etc. (Vasanthy 1996).

MATERIALS AND METHODS

The dyeing industry effluent was collected from a typical dyeing industry. The physico-chemical characteristics such as colour, odour, pH, temperature, TS, TDS, TSS, DO, BOD, COD, chloride and chromium were determined using analytical method (APHA 1989).

Batch type experiments: About 100 mL of the sample was taken in separate conical flasks. Accurately 0.25, 0.50, 0.75 and 1.00 g of oxidizing agent, coagulating agent and adsorbent were added separately and in combination. After addition of the chemicals the flasks were left for half an hour and filtered. The filtrate was subjected to TDS and COD analysis. For the present investigation sodium hypochlorite was used as an oxidizing agent, alum as a coagulating agent and commercial activated carbon (CAC) as an adsorbent.

Statistical analysis: The percentage reduction of COD and TDS obtained by various treatments were subjected to statistical analysis. The regression equation has been derived and the correlation co-efficient (r) has been calculated. The correlation coefficient substantiates the correlation between the dosage of the agents and the percentage removal of the COD and TDS (Palanisamy & Manoharan 1994).

RESULTS AND DISCUSSION

Physico-chemical characteristics of dyeing industry effluent: The physico-chemical parameters such as colour, odour, temperature, pH, TS, TDS, TSS, DO, BOD, COD, chlorides and chromium were determined and the values are tabulated in Table 1.

The effluent was black in colour with an objectionable odour. The pH of the effluent was 7.2, TDS 3860 mg/L. The total solids and total suspended solids of the effluent were found to be 3,960 and 100 mg/L respectively. The COD of the effluent was 6240 mg/L. The higher concentration of BOD and chlorides were found in the effluent (1220 mg/L and 2950 mg/L respectively).

Effect of oxidizing agent, coagulating agent and adsorbent on the removal of COD: The effluent on treatment with 0.25 g of oxidizing agent has shown highest reduction of COD (92.3%). With coagulating agent the maximum reduction of COD

Table 1: Physico-chemical characteristics of dyeing industry effluent.

S.No.	Parameters	Values (mg/L)
1.	Colour	Black
2.	Odour	Objectionable
3.	Temperature, °C	30.2
4.	pH	7.2
5.	Total Solids	3960
6.	Total Suspended Solids	100
7.	Total Dissolved Solids	3860
8.	Dissolved Oxygen	3.41
9.	BOD	1220
10.	COD	6240
11.	Chlorides	2950
12.	Chromium	Nil

was 98.46%, and with 0.75 g of CAC 87%. These doses of the chemicals were found to be optimum dosage (Fig. 1).

Effect of oxidizing agent, coagulating agent and adsorbent on the removal of TDS: About 80% reduction of TDS has been obtained with 0.25 g of sodium hypochlorite. With 1 g alum TDS reduction was 90%, and with 0.75 g of CAC 80% (Fig. 2). Hence, the optimum dose of 1 g of alum shows higher COD and TDS removal.

Similar work has been undertaken by Wadekar & Pandya (1999) for the removal of COD and TDS using fly ash. The authors have reported the maximum reduction of COD with 2% fly ash as the optimum dosage. Kaur & Paul (2001) have also tried saw dust ash for the removal of COD from aqueous dye solution such as Acid red 119, Acid Violet 49, Acid Blue 15, Acid violet 17 and Acid Violet 54. The authors have tried to fit the value using Freundlich and Langmuir isotherms. Similarly, Vasanthy et al. (2006) have efficiently tried the removal of colour, odour (95%) TDS

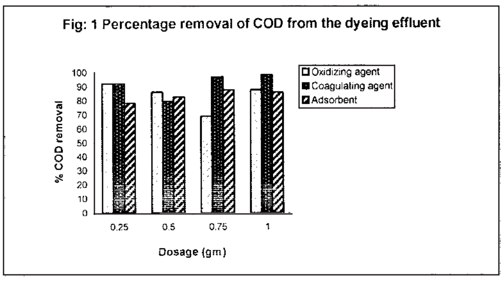


Fig. 1: Percent removal of COD from the dyeing effluent.

r = -0.28, y = 89.24x-0.2; r = 0.55, y = 83x+14.4; r = 0.88, y = 76.93x+11.07;

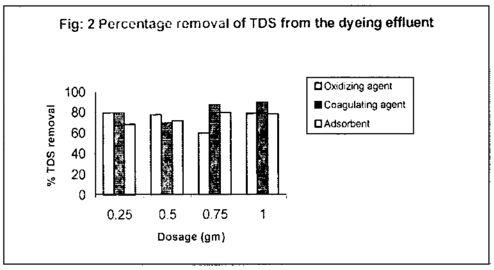


Fig. 2: Percent removal of TDS from the dyeing effluent.

r = -0.28, y = 79.5x–8.4; r –0.546, y = 65x+23.2 r =0.88, y = 66x+14

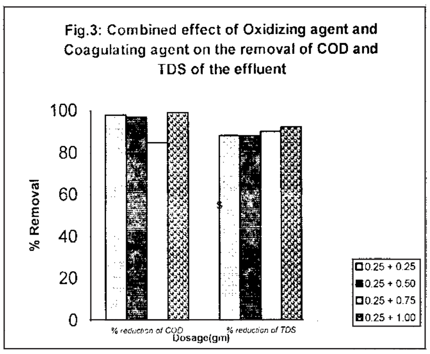
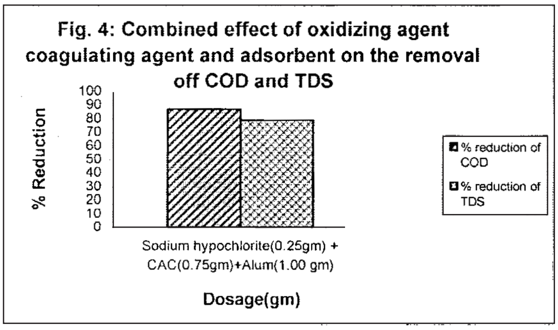


Fig. 3: Combined effect of oxidizing agent and coagulating agent on the removal of COD and TDS from the dyeing effluent.

r = 0.97, y = 87x+10; r =0.9326, y = 74.2x+15.2



r – 0.928, y – 96.3x | 1.85; r =0.928, y = 85.7x+3.7

Fig. 4: Combined effect of oxidizing agent, coagulating agent and adsorbent on the removal of COD and TDS.

(54.5%) and COD (63.7%) using calcium oxide and hydrogen peroxide from diluted spent wash. The authors have used the chemicals individually and in combination.

Combined effect of oxidizing and coagulating agent on the COD and TDS removal: Further, the combined effect of sodium hypochlorite and alum has resulted in 99% reduction in COD and 91% reduction in TDS. Similar results have been obtained when sodium hypochlorite is used with CAC (Fig. 3).

Thus, the optimum dosage of sodium hypochlorite was 0.25 g, alum 1 g, and CAC 0.75 g for 100 mL of the untreated dyeing industry effluent. Whereas, the combined effect of sodium hypochlorite, alum and CAC was resulted in 87% reduction of COD and 79% reduction of TDS, which needs further investigation for the optimum dose, when all the three chemicals are used together (Fig. 4).

Among the treatments performed, the highest reduction of COD (99.5%) and TDS (92%) has been obtained when the dyeing industry effluent was treated with 0.75 g of CAC and 1 gm of alum proving the efficiency of these agents. The correlation analysis proves a positive correlation between the combination of oxidizing and coagulating agents, and adsorbent.

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