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REMOVAL OF COLOUR AND TURBIDITY FROM TEXTILE EFFLUENTS BY CHEMICAL COAGULATION

Chemistry

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ABSTRACT

This study addresses the research of the removal of a textile dye from aqueous solutions by using coagulant –flocculants. Coagulation – flocculation is a widely used process to remove pollution due to suspended particles. In this research different coagulants like alum, lime, titanium sulphate, FeCl3, FeSO4 and MgCl2 were applied to select the suitable ones with optimum removal efficiency. Titanium sulphate in combination with lime and bentonite gave the best results. Lime and bentonite (as a coagulant aid) were employed to enhance the coagulation process. The removal of dyes from water in the order MB > MG > FS. The pH within 5 – 6 is optimum in getting maximum coagulation. Coagulation process is removed the suspended solids and colour pigments up to 90 – 98%.

KEYWORDS

Dye, Coagulation, Coagulant, Titanium sulphate, lime, Bentonite

INTRODUCTION

Textile wet processing is the major source of water consumption and wastewater generation. There are various treatment techniques to remove textile wastewater pollution. Coagulation is one of these techniques to remove pollution due to suspended particles. An experimental study was carried out on a dyeing wastewater to assess the removal efficiency and settling characteristics of suspended solids by coagulation process. Textile wastewater pollutants are generally wax, urea, ammonia, caustic soda, detergents, dyes and pigments that increase its toxicity, solids contents, biochemical and chemical oxygen demand. Coagulation cannot remove all the pollutants but it can be useful technique to initiate treatment in the first phase to reduce pollution level up to some extent. The pH value and total suspended solids of the wastewater was 3.5 and 16.98 mg/l respectively. Different coagulants like titanium sulphate, ferric chloride, ferrous sulphate, alum, like and their combinations were applied to select the suitable ones with optimum removal efficiency. Titanium sulphate in combination with lime and bentonite gave the best result.

Bentonite is natural clay containing mainly mineral montmorillonite as an important constituent. The quality of bentonite is determined by the content of montmorillonite. A good bentonite contains 80 to 90% montmorillonite, the rest is mainly quartz and illite. Bentonite can be processed to give sodium and calcium montmorillonite, activated clays and organo clays which display different special properties that can be exploited in a wide range of uses and applications.

Experiments and Results A comparative study was undertaken to assess the suitability using the coagulant for the removal of Methylene blue (MB), Malachite green (MG) and Fluorescein (FS) from water and wastewater using batch experiments[1]. Four solutions of 0.1, 1, 10 and 20 mg/l concentrations of each of the proposed dyes FS, MG and MB were prepared by dissolving commercial grade dyes in distilled water. Reagents that are able to provoke coagulation of natural colloids in water are coagulants like titanium sulphate. Which were tried individually and then 1:1 combination as a mixed coagulant. These were evaluated individually and then after blending (mixing) with 1, 5, 10, 15 and 20% bentonite. The compositions of different blends were investigated and optimized to enhance decolourization.

The interaction studies were carried out in batch tests. In 8 numbers of 250 ml capacity glass bottles, 0.5 g of coagulant was added to each of four sets, each having two bottles for different concentrations of a dye and 50 ml of the dye solution was added to each bottle. The bottle was shaken in a reciprocating shaker at 150 rpm for 5 hours at room temperature. Then the contents were centrifuged at 2000 rpm for 10 min and the supernatant liquid was filtered using 0.45 µm membrane filter. The filtrate was analysed for the dye concentration (APHA et al., 1998). To study the effects of coagulant dose 1, 5, 10, 15 and 20 g coagulant /l of dye solution and the effects of pH on sorption by varying its value were also studied.

Optimization of pH It was found that the optimum pH for better coagulation was 5-6 for textile wastewater. Mostly coagulation is dependent on wastewater on pH. For that pH was optimized prior to selection of optimum coagulant dose.

Dosage of coagulant aid Lime and bentonite were used as coagulant aid to enhance the coagulation process. The selected optimum dose of lime and bentonite was 1500 mg/l and 150 mg/l respectively (table 1).

Table 1. Optimum pH and coagulant dose

S. No.	TSS, mg/l	% Reduction in turbidity	Optimum pH	Optimum	Dose of	Coagulation (mg/l)
				Titanium Sulphate	Lime	Bentonite
1.	1700	98	5	1300	1500	150
2.	850	98	6	500	1500	150
3	1280	89	6	700	1500	150

Selection of suitable coagulant To select the suitable coagulants and their combinations were tried that provides higher removal efficiency. It was observed that the titanium sulphate without lime/bentonite were not able to coagulant the suspended particles in the effluents. Moreover, lime worked without coagulant aid. In case of titanium sulphate used with lime and bentonite. Heavy flocs were produced with good settling velocity (table 2).

Table 2. Removal efficiency of different types of coagulants

Loading Rate m3/m2 Day Detention Time		Removal Efficiency (%)	
	No Coagulant	Lime only	Titanium Sulphate+Lime + Bentonite
70(60)	13	65	84
55(80)	14	68	85
35(120)	18	75	92

CONCLUSIONS

Tests were carried out using a titanium sulphate solution. Titanium was found to be an effective coagulant for all four of the synthetic water type studies. The removal of dyes from water was in the order MB > MG > FS for most coagulants that can be explained on the basis of their structures. The pH within 5-6 is optimum in getting maximum coagulation. It was found the removal of suspended solids and colour pigments up to 90-98% and the reduction of associated wastewater BOD and COD up to 20-50%. Lime and bentonite (as a coagulant aid) were employed to enhance the coagulation process.

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