Investigation of color and COD removal from textile wastewaters byselected coagulation agent

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Abstract

The chemical coagulation methods have been using successfully for treatment of textile wastewaters which have high color, COD and TOC contents. The coagulants have adsorption capability and constitute hydroxide compounds with dissolved substances in colored wastewaters.The greatest advantage of the coagulation method is to decrease further COD values than the other methods. The disadvantages of this method are the high cost of the chemicals and high volume of slurry. If the sludge could not be disposed properlythe land around the treatment plant will adsorb the chemical content of the waste.The chemical coagulation method examinedfor removal of color and COD from textile dye containing wastewater.The cost of treatment was decreased by treatment of the slurry to provide reuse coagulantagent. The 88.7% of COD and 96.9% of color removal were occurred with the optimum pH of 11.5.

Key words: textile dyes, textile wastewater,coagulation,color removal,COD

1. Introduction

Industrial effluents are the major concern area because of their toxicity and threat to the living organisms [1]. The textile industry is the biggest user of water and has different complex chemicals during the various processes which resulted huge amounts of highly colored and polluted wastewaters[2]. Textile and dyeing plants use many artificial composite dyes and discharge large amounts of colored wastewaters with strong alkalinity, high chemical oxygen demand, and low biodegradability [3,4].The chemical structure of dyes contained in the effluents resists degradation because of their stability to oxidizing agents and toxic to the most microorganisms [4].Direct discharge of the highly polluted textile dye wastewaters is undesirable not only because of its color but also due to the production of highly carcinogenic chemicals to biota [5].Decolorization treatment operations include adsorption, ozonation and chemical precipitation also have been using for being fed to the subsequent treatment units or receiving environment [6]. Therefore all environmentalists are agree that textile wastewaters should be treated comply with the legal standards as well as the aesthetic standards before discharging to the water environments [1-6].Thus many processes such as physical,

chemical and biological treatment methods have been using while there are also the combination of a few methodshave been proposed and are currently employed to destroy toxic chemicalsdischarged along with textile wastewater [7,8,9] .

So far, there are many researches on treatment of textile wastewaters which have high COD and colored. The chemical coagulation methods have been using to remove color, COD and TOC from textile dye containing wastewaters. Adsorption, coagulation and membrane processes are effectivephysical and chemical techniques for color removal but they usemore energy and chemicals than biological processes and maycause secondary pollution problems in the form of sludge [10].Chemical treatment of wastewater pollutants wasinvestigated and developed long ago; however, its fullimplementation was delayed in favor of biologicaltreatment methods due to the elevated costs of chemicals [11]. Researches on chemical coagulation and flocculation methods have been observed as one of the most practiced technology.Coagulation is used for removal of the waste materials in suspended or colloidal form that do not settle out on standing or may settle by taking a very long time. In wastewater treatment, coagulation as pretreatment is regarded as the most successful pretreatment [12, 13]. The coagulants have adsorption capability and constitute hydroxide compounds with dissolved substances in colored wastewaters. The greatest advantage of the coagulation method is to decrease further COD and TOC values than the other methods[1-13].The disadvantages of the coagulation methods are the high cost of the chemicals and high volume of slurry. Due to the scarcity of space, extremely high land cost and the complexity of handling chemicals in some countries, a simple and efficient treatment process for the textile wastewater is essentially necessary. It should require minimum chemical consumption and space [14].

2. Materials and Method

The coagulation assays were performed with coagulant agent with 1 L beakers with jar test apparatus. The experiments were carried out with 500 sample wastewaters which contained C-I Black234dye (Burboyainc.). The several amount of coagulant between 200 and 2200 mg which is consist of Mg substituent was added and pH was adjusted to 11.5 with 1N NaOH and 10% $Ca(OH)_2$. The supernatants were prepared from mixture which was mixed for 1 min. at 100 rpm then 5 min. at 30 rpm and precipitate for 30 min. The absorbance measurements were carried out by using the spectrophotometer at 450 nm. The physicochemical parameters were carried out according to the Standard Methods (APHA, 1989)[15]. The incubation processes were performed at 148^0C for 2 hours by using thermo reactor (Aqua Lytics AL125).

3. Results and Discussions

In this study, treatability of the wastewater contains of 250mg / L C-I Black234 was investigated. The chemical coagulation experiments were performed with different amount of coagulant at different pH values. The optimum pH was determined between 10 to 12.5 with the coagulant dose of 600 mg /L. The results of the pH with different amount of the coagulant are shown at the Table 1. The COD and color removal efficiency also shown at the Figure 1 and 2. According to the results, together with increasing pH values from 10 to 11.5, the color and COD removal efficiency were increased. The optimum pH was selected as 11.5 because it was stable between 11.5 to 12.5. The color and COD removal efficiencies were 86.5% and 55.5% respectively at the optimumpH.After performing the optimization of pH, different amounts of coagulants (200-2200mg/L) were treated to the sample wastewaters containing dye.The results are given in Table 2. The color removal efficiency was increased from 35.8% to 99.7%as well as increasing the amounts of coagulants from 200 mg/L to 2200mg/L. The COD removal efficiency was increased from 30.4% to 93.0% as well as increasing the amount of the coagulant. The color (Figure 3) and COD removal (Figure 4) efficiency reached to %96.9 ve % 88,7 respectively with addition of 1400mg/L coagulant.After the two times subsequent increasing of coagulant dosage the yield only 2.8% and 4.3% for color and COD values respectively. Considering with the amount of the chemicals, the appropriateoptimum coagulant dosage was selected as 1400mg /L.

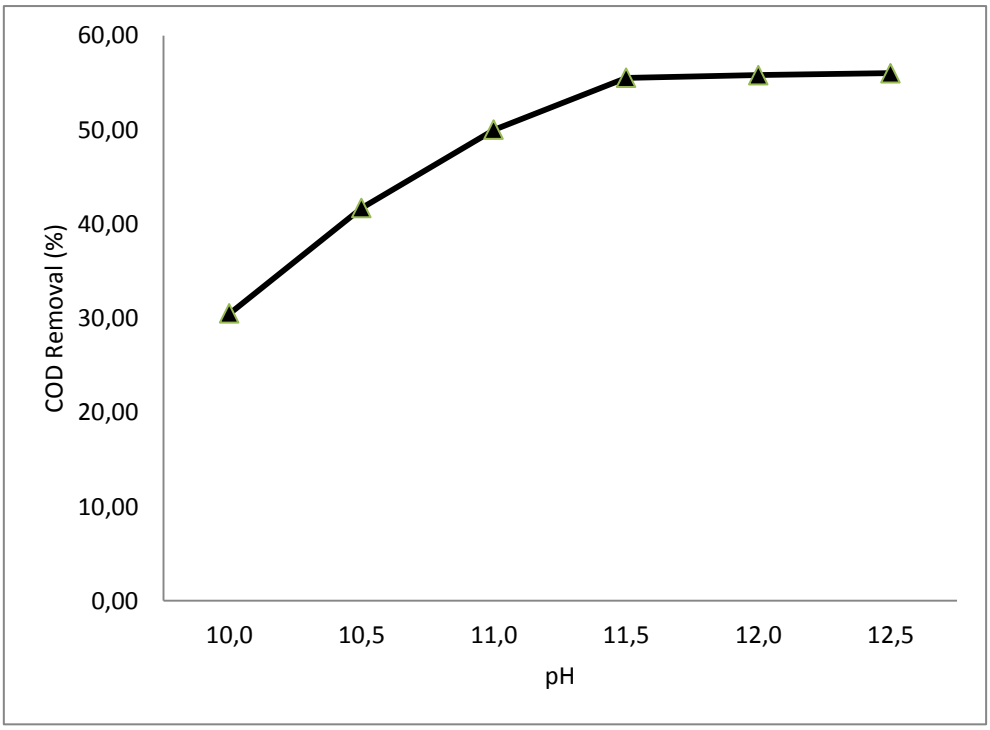

Figure 1. Effect of pH on COD Removal

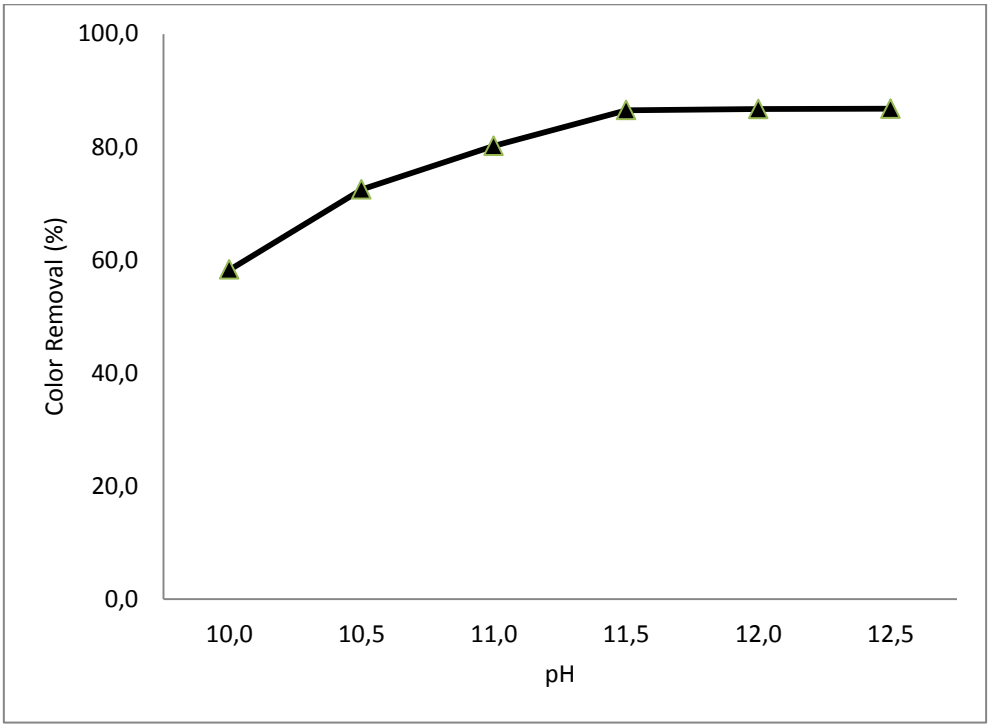

Figure 2. Effect of pH on color removal

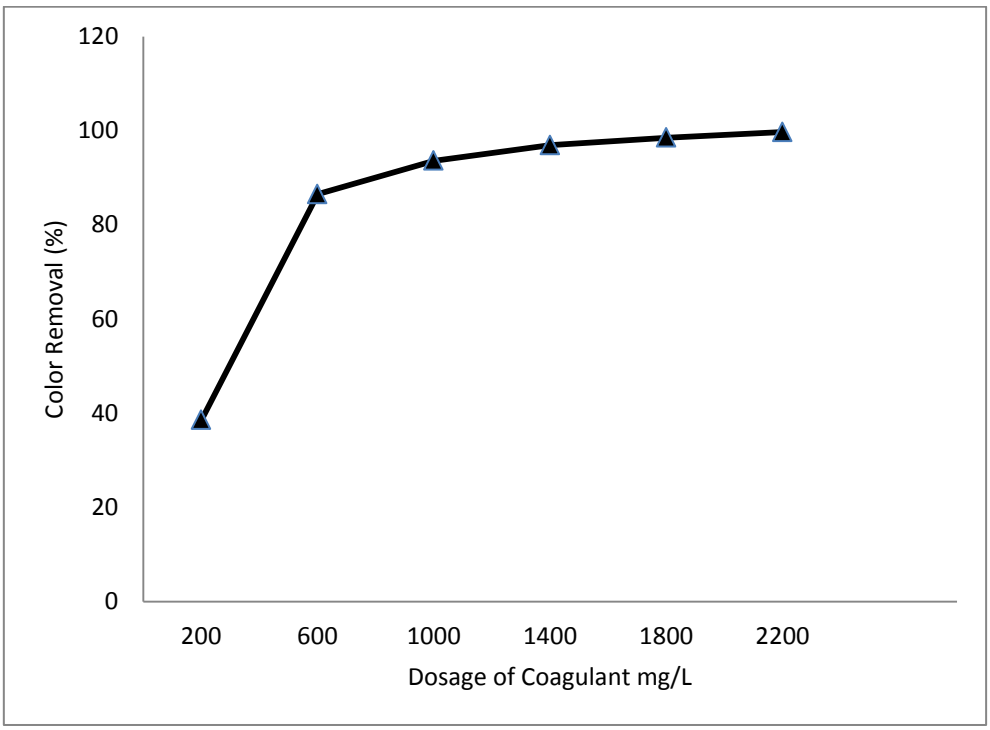

Figure 3. Color removal with increasing dosage of coagulant (mg/L).

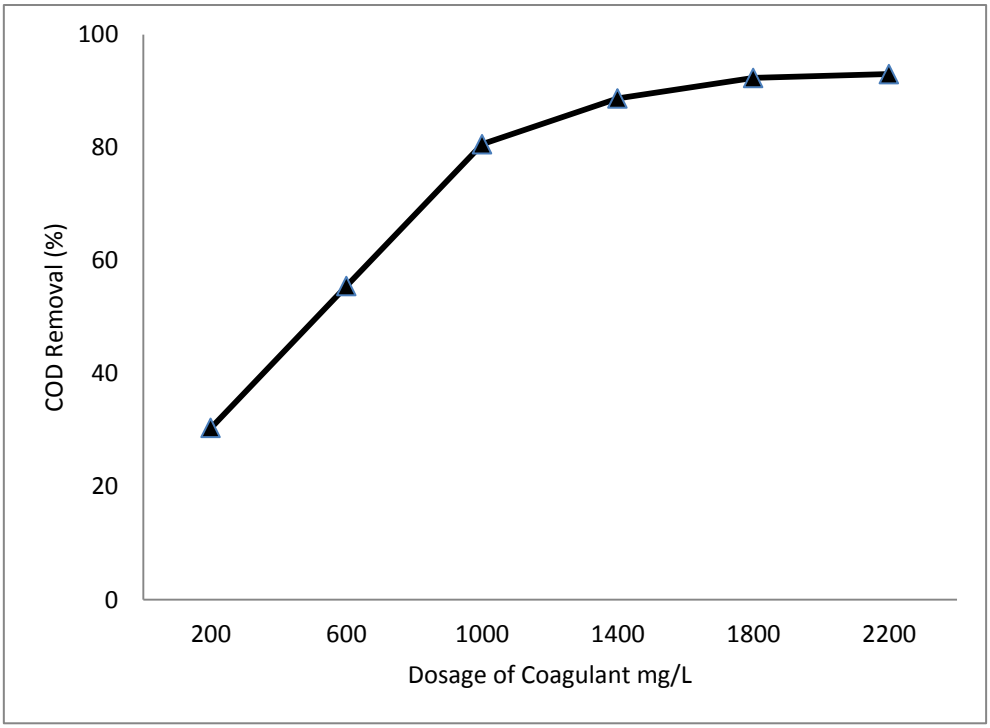

Figure 4. COD removal with increasing dosage of coagulant (mg/L).

4. Conclusion

COD and color removal by coagulation processes were studied in highly polluted wastewaters from textile dye wastewaters in this study.The optimum pH value of 11.5 was selected and the optimum coagulant amounts were determined as 1400mg / L. The yield at optimum dosage of coagulant forcolor and COD removalwere 96.9%and 88.7% respectively.The contents of wastewater from plants producing textile dyes have much quantity of chemicals and color than fabric producing factories. Furthermore removing color and COD have much more important than the textile wastewaters.According to the comparison between literature and this study our results have much higher efficiencies of color and COD removal. But it should be considered the cost and dosage of the coagulant which resulted slurry. It is suggested that reuse of the coagulant which is extracted from sludge could be economically beneficiary.

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