

Evaluate the Removal Efficiency of Dye Concentration and Cod from Textile Wastewater Treatments Using Combination of Organic and Inorganic Coagulants and Electro Fenton Process

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ABSTRACT: The requirements of dye concentration, COD removal has promoted the research in this study. Different types of coagulants used such as Abelmoschus seed, Poly aluminium chloride coagulant, Aluminium sulphate, Ferric chloride. The primary treatment results were obtained for removal efficiency from combination of Abelmoschus and PAC such as dye concentration removal efficiency 70%, and COD removal 65.01% respectively at optimum pH of 7. Secondary treatment like application of Electro Fenton process to treat textile wastewater has been studied and. The optimum dosage of coagulants, pH, Fe^{2+} /ozotech dosage, reaction time, power supply were 1.2 ml/L (combination of abelmoschus seed and PAC), 3, 12:2.0 ml/L, 60 min, 6 volts respectively. Under this condition removal efficiency of COD, Dye concentration were 77%, 84%, respectively.

KEYWORDS: Textile wastewater, Coagulation cum flocculation, optimum dosage, jar test, removal efficiency, Abelmoschus seed, PAC, aluminium sulphate, ferric chloride, electro fenton process,

I. INTRODUCTION

The textile industry is very water intensive. Water is used for cleaning the raw material and for many flushing steps during the whole production. Produced wastewater has to be cleaned from fat oil, color and other chemicals, which are used during the several production steps. The cleaning process is depending on the kind of wastewater (not every plant uses the same way of production) and also on. Also not all plants use the chemicals; especially companies with a special standard try to keep water cleaned in all steps of production. So the concepts, to treat the water can differ from each other.

II. MATERIALS AND METHODOLOGY

2.1. COAGULATION CUM FLOCCULATION

The coagulant such as organic and inorganic which are used in the study like abelmoschus seed, aluminum sulphate, polyaluminium chloride, ferric chloride for treatment of textile wastewater. The natural coagulants are received from

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the local market of Karaikudi, Tamilnadu. Preparation of organic coagulant Seed of abelmoschus are collected and then collected seed dried by sunlight for 48 hours. Then dried sample grained by using domestic blender, this grained particle was sieved through 600 micron meter sieve by using sieve shaker. This power particle mixed to the polyelectrolyte solution (1% solution of poly electrolyte and powered organic coagulant)

2.2. ELECTRO FENTON PROCESS

Lots of electrochemical mechanisms were involved to generate OH radicals and Fe²⁺ or reduce to Fe³⁺ to Fe²⁺ in the electro Fenton process, in this research batch type electro fenton reactor built to generate the fe²⁺ from fe³⁺, this test to be conducted under room temperature(25^oc), and capacity of open square glass cell is 2000ml . pH of the sample adjusted with sulfuric acid or sodium hydroxide. In each run 1000ml of wastewater (primarily treated textile wastewater) was placed in an electrolytic cell and desired amount of ions(fe²⁺) and ozotech solution were added before the electrical current was turned on. The current density was adjusted by a digital DC power supply device. A fixed electrical current density of 5volt was provided by a DC power supply. Both electrodes were in square shape and made from the plates with dimensions of 6cm*5cm *0.8cm .spacing between the electrode was 1cm. At the end of the run, the samples were allowed to stand for 60 mins and supernatant was taken for wastewater quality measurements. Dye concentration and COD were measured at 550nm wavelength using a UV –Vis spectrophotometer. The following equation (1), (2) and (3) shows the electro fenton process

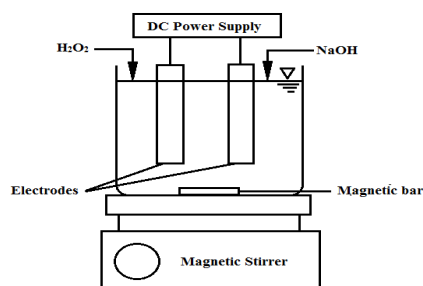
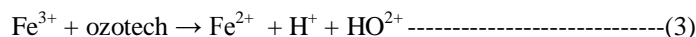
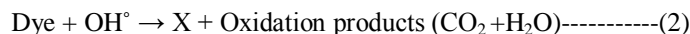
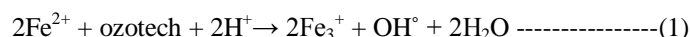


Figure 1. Schematic diagram of Electro Fenton process

2.3. EXPERIMENTAL SETUP

2.3.1. JAR TEST APPARATUS

The jar test is a common laboratory procedure used to determine the optimum operating conditions for water or wastewater coagulation-sedimentation treatment. This method allows adjustment of pH, variation in coagulant or coagulant aid dose. Time constraints followed in coagulation sedimentation studies are: Rapid mixing- 2 min (100 rpm), Slow mixing- 20 min (35 rpm) and Sedimentation- 45 min.

2.3.2. COAGULATION STUDY

For the study of coagulation jar test apparatus has been used. The dose considered for the organic and inorganic coagulants mixed proportion of 2:1 ratio.

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Fig 2. Abelmoschus plant

2.4. ELECTRO FENTON EXPERIMENTAL SETUP

The performance of Electro fenton process for treating synthetic wastewater was evaluated in lab scale. Reactor is a glass beaker having a size of 9.5cm diameter and 15cm height. Four identical electrodes like aluminum and copper plates, immersed in a solution in the rectangular beaker act as cathode and anode respectively. Figure 4 shows electro fenton process. The size of the plates 6cm*5cm*08cm.. 0.5 M Na₂SO₄ was used as the supporting electrolyte.



Figure 4. Electro Fenton process



2.5. REAGENTS

Chemicals were used in experiments are FeSO₄.7H₂O, NaOH. Ozotech (20%) solution and hepta hydrated ferrous sulfate (FeSO₄.7H₂O) of commercial grade.

III. RESULTS AND DISCUSSIONS

From the initial analysis of sample it was found that COD, BOD, dye concentration, TSS, DS, TDS, sulphate, chloride were exceeding their permissible limits.

3.1. EFFECTIVELY REMOVAL EFFICIENCY OF COAGULANT

In this study analyzing combination of different coagulants such as organic and inorganic at constant flow rate and different pH, and dosage.

3.2. EFFECT OF OPTIMUM DOSAGE OF COAGULANT

The optimum dosage of coagulants are determined by varying the dosage of 0.4, 0.8, 1.2, 1.6, 2.0 ml at constant pH of textile wastewater.

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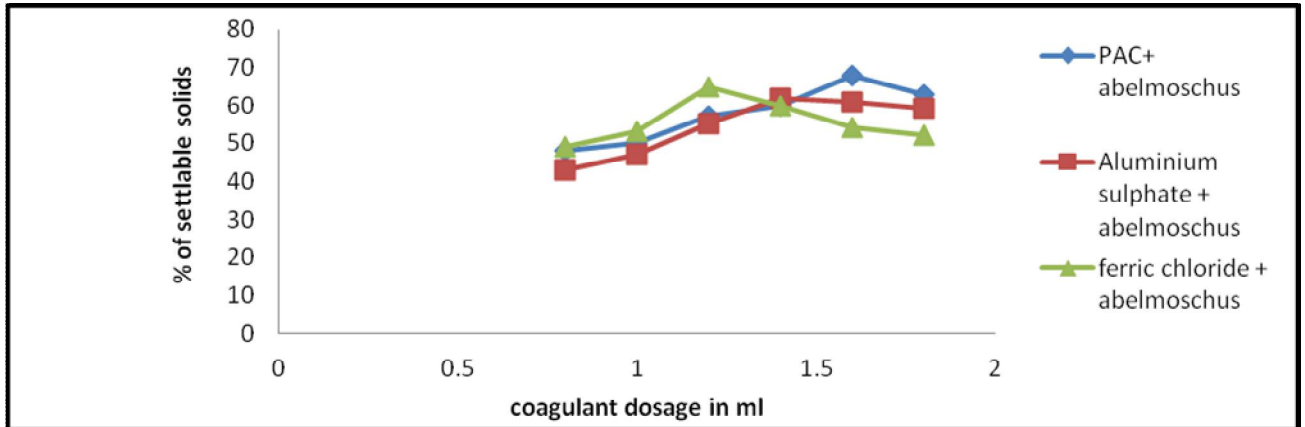


Figure5. Effect of Optimum dosage of coagulant

3.3. EFFECT OF OPTIMUM PH

Optimum pH is pH at which reduction of suspended solids, and dissolved solids take place. Optimum pH can be determined by varying the pH value as 2,3,4,7,8,9 respectively on combination of PAC + Abelmoschus coagulants.

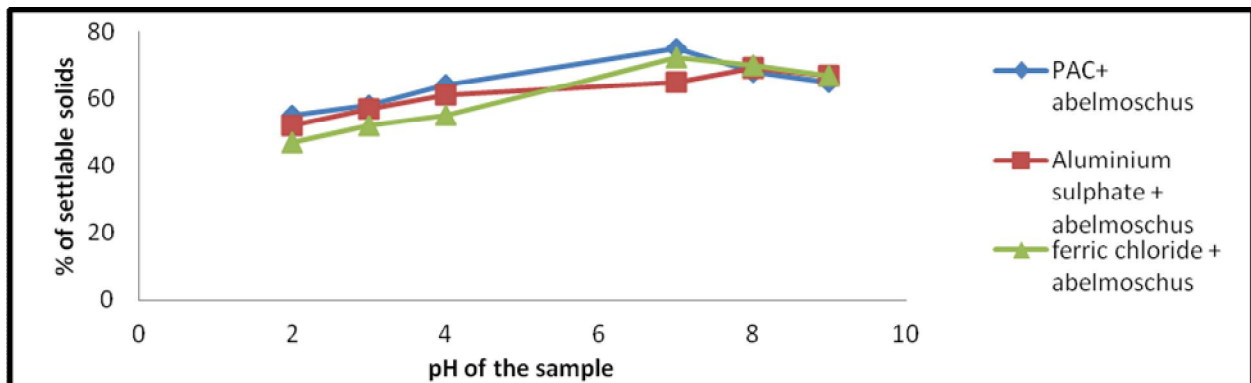


Figure 6. Effect of Optimum pH

Figure 6. shows that Graphical representation of Effect of pH on COD and dye concentration removal efficiency like The responses % COD removal, % dye removal, and Energy consumed for the EF of textile wastewater were calculated by conducting the experiments at suggested set of process parameters such as pH, dc power supply and chemical dosage. While the removal efficiency reached the maximum value at pH 3. In acidic conditions, the removal efficiency increased from 33% to 75% and 31% to 42% respective COD and dye concentration.

3.4. EFFECT OF PH ON COD AND DYE CONCENTRATION REMOVAL EFFICIENCY

It was well known that pH is one of the most important factors limiting the oxidation efficiency of Fenton process in the treatment of wastewaters due to its role in controlling the speciation of iron (Fe^{2+}/Fe^{3+}), Since the electro plate provides the transformation of Fe^{3+} to Fe^{2+} and extra generation of hydroxyl radicals.

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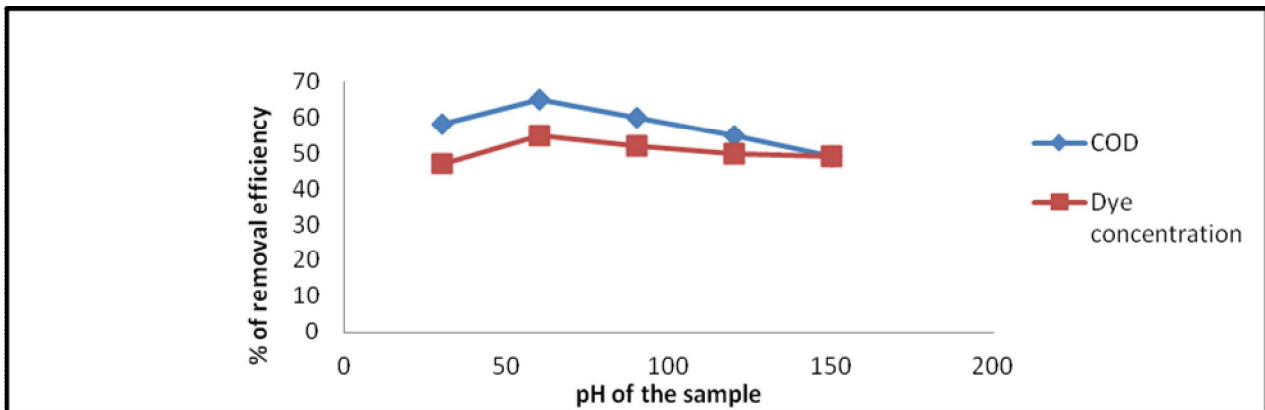


Figure 7. Effect of pH on COD and dye concentration removal efficiency

Figure 7 shows that Effect of DC current on COD and dye concentration Removal Efficiency analyzed From Fig 4.4 Investigate the influence of applied voltage on blue ME 4B removal efficiency, degradation at voltages ranging from 2 to 12 V was studied. Increases in the electrical current applied from 2 to 12 V caused the removal efficiency COD and dye to develop from 40 to 61% and 63% to 70.5%. Finally optimum DC currents for EF were determined as 6 volts removal of COD and dye 73%, 75% respectively. After that removal efficiency has decreased slightly from 73% to 61% and 73% to 70.5% respective volts of DC power supply on 8V to 12V.

3.5. EFFECT OF DC CURRENT AND POWER SUPPLY TIME DURATION ON COD AND DYE CONCENTRATION REMOVAL EFFICIENCY

DC current is the most significant parameter which determines the treatment cost and affects the treatment efficiency by controlling the resolution of iron from the sacrificial anode plate. The effects of applied DC current on COD and dye concentration were investigated in the DC current range from 3 to 15 volts at constant ozotech. COD and color removals via EF improved by rising DC current from 2 to 12 volts and reaction time between from 30 mins to 150mins.

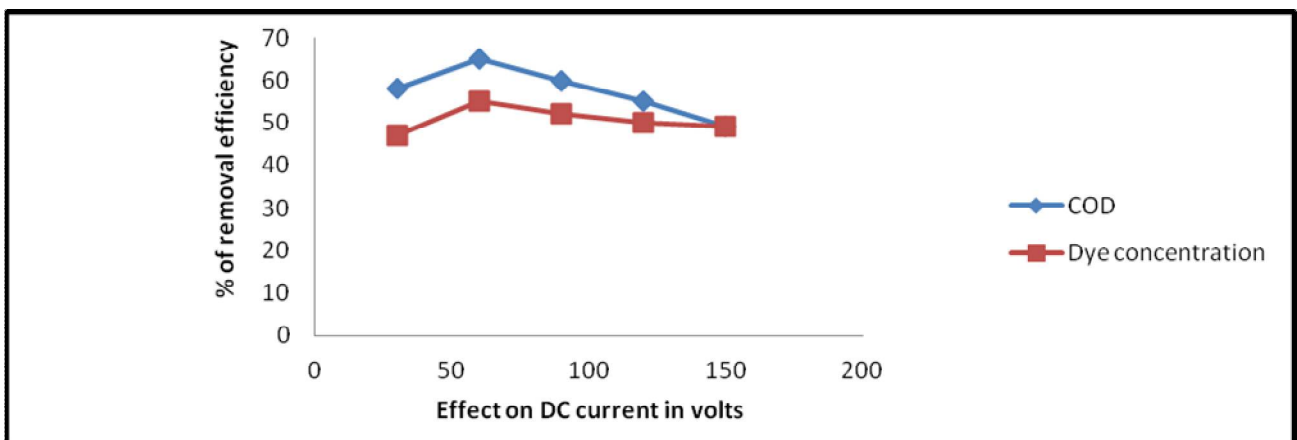


Figure 8. Effect of DC current and power supply time duration on COD and dye concentration removal efficiency

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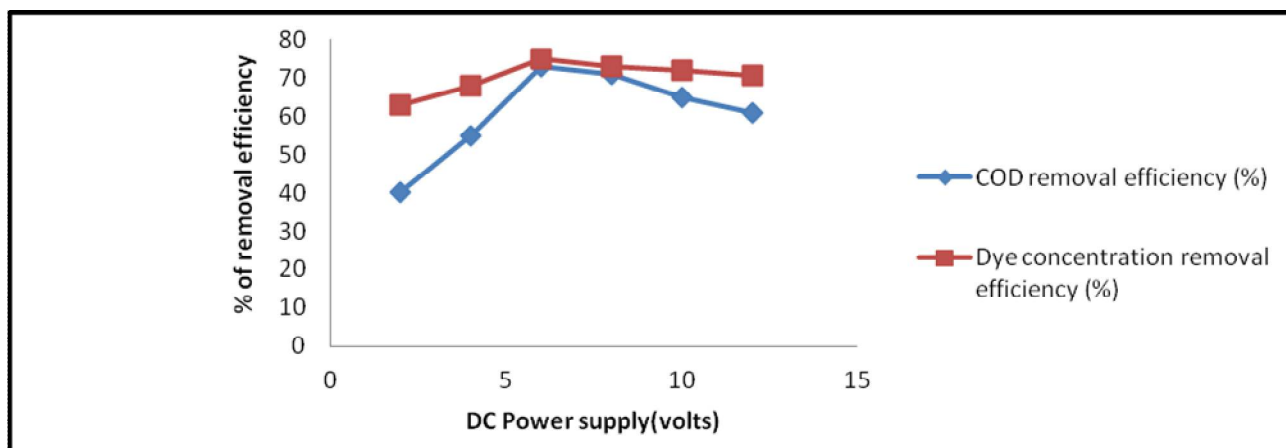


Figure 9 .Effect of DC current on COD and dye concentration removal efficiency

Graphical representation of Figure 8 & 9 shows Effect of Power supply time duration on COD and dye concentration Removal Efficiency was analyzed and To enlargement power supply to the electrode so that electrode liberates some ions to causes the extra pollutants to the aquatic medium i.e removal efficiency were analyzed from fig 4.5 49 % to 65 % and 47% to 55% . Finally optimum DC currents power supply for EF was determined as 60 mins represented above graph..

3.6. EFFECT OF $Fe_2SO_4 \cdot 7H_2O$ /OZOTECH ON COD AND DYE CONCENTRATION REMOVAL EFFICIENCY

The most important source of OH produced in Fenton process is ozotech. However, excess ozotech in the reaction solution has a scavenging effect on OH produced. In addition, residual (unreacted) ozotech in the effluent increases COD concentration of wastewater. As a result, the optimum Fe^{+2} /ozotech concentrations were found as 15:2 ml for EF processes.

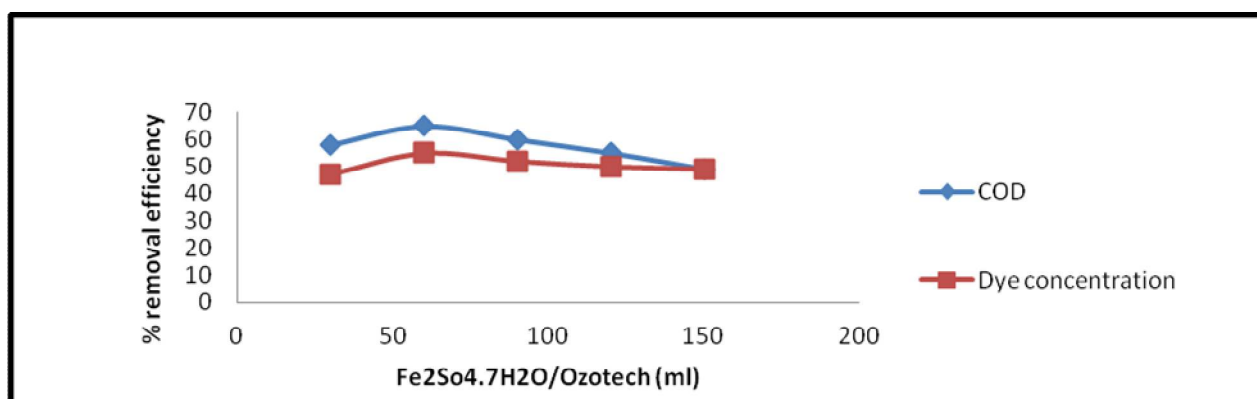


Figure.10. Effect of $Fe_2SO_4 \cdot 7H_2O$ /Ozotech on COD and dye concentration removal efficiency

Figure.10. Shows that Effect of $Fe_2SO_4 \cdot 7H_2O$ /Ozotech on COD and dye concentration removal efficiency indicated that increasing the OH radicals concentration from 0.5 to 3 ml/L .the removal efficiency of COD and dye concentration 45% to 67 % , 46% to 71% respectively. while increasing the concentration of ozotech from 0.5 to 2.0 ml/L increasing the removal efficiency 67% and 71% of COD and dye concentration , after that the removal efficiency starts to

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decrease slightly from 67% to 57% by adding of ozotech solution above 2.0ml/L. Finally optimum the optimum Fe^{+2} /ozotech concentrations were found as 15:2 ml.



Figure 10. Treated textile wastewater Table

IV. CONCLUSION

In this study, a detailed investigation of the electro-Fenton treatment of Turquoise blue H5G, which is an azo dye and has harmful effects on the environment and ecosystem, for water purification was performed. Polyaluminium chloride effectively removes concentration color and COD from textile wastewater. The effective pH range for PAC Treatment is at 7.0 and above. For both the reactive and dispersed dye waste, combination of abelmoschus & PAC was shown to be Superior to, others. The results of this study indicate that combination of abelmoschus & PAC may remove the dyes through charge neutralization and an adsorptive coagulating mechanism. The optimum initial pH of 3, DC current of 6V, of $Fe_2SO_4 \cdot 7H_2O$ /Ozotech dosage of 12:2 mL were determined to obtain higher RT BLUE H5G degradation and COD removal for both processes. Due to the extra generation of oxidizing agents in EF process, the oxidation rate and efficiency of EF process were increased and decreased.

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