Fenton Process Combined With Coagulation for the Treatment of Textile Wastewater

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***Abstract*- Fenton oxidation (H2O2 /Fe+2) method is considered to be one of the most effective, simple and economical method. In this study the efficiency of fenton process combined with coagulation for treatment of textile wastewater was examined. Different Parameters such as pH, Turbidity, conductivity, BOD, COD etc. were examined. Dosages of fenton reagents was determine using jar test experiments. Coagulation was given. Final parameters were examined after the treatment process.**

Index Terms- Textile wastewater, Fenton Process, Coagulation, Feso4, H2O2.

I. INTRODUCTION

Textile industry consumes large quantities. The various operations involved in cotton textile industry are warping, winding, sizing weaving, dying, padding, steamer, CDR zone, CDR washing, printing, finishing. All this processes generate considerable volume of effluents and forms major source of wastewater containing organic and inorganic substances. Industrial wastewater contains toxic and non-biodegradable compounds that affect effectiveness of conventional treatment techniques. Pollutants in the wastewater coming from raw materials processing, process by-products, process chemicals and final production. Organic, inorganic, color producing dyes, toxic compounds like cyanide and heavy metals, if discharged without any treatment are harmful to aquatic life in water bodyThus, Advanced Oxidation Process (AOP) with Fenton reagent (Fe2+/ H2O2)helps to degrade organic compounds presented in polluted water In AOP, hydroxyl radical (OH.) are generated in solution and are responsible for oxidation of organic compounds. Hydrogen Peroxide is a multipurpose oxidant for many systems. It can be applied with or without catalyst. Catalyst normally used is ferrous sulphate and other normally used are iron salts, Al+3, Cu+2.

Fenton Treatment

In 1894, chemists first discovered organic Fenton in (H2O2) and Fe2+ can be mixed solution consisting of the rapid oxidation, and to such a system known as the standard Fenton reagent can be that many of the known organic compounds such as carboxylic acid, alcohols, esters of inorganic o xidation, o xidized effect is very obvious . Fenton reagent was mixed by H2O2, Fe2+ gets a strong oxidant; in particular, apply to certain difficult to control, or biological to xic industrial wastewater.

The Fenton‟s treatment has been widely applied in the treatment of non-biodegradable wastewater in field of AOP. the efficiency of Fenton‟s depends on properties of wastewater, pH values,Fe+2 :H2O2 conc., & reaction time(Aeration). Moreover, iron (Fe+2) is highly abundant & non toxic element & hydrogen peroxide (H2O2) is easy to handle environmentally. this treatment have proved worthy in this treatment have proved worthy in this field ,achieving good results in destruction of pollutants. the objectives of this study was to investigate the performance of Fenton ‟s reagents & couple applicat ion of coagulation plus Fenton.

It has been demonstrated that Fenton's reagent is able to destroy toxic compounds in wastewater such as phenols and herbicides. Production of OH radicals by Fenton's reagent occur by means of addition of H2O2 to Fe2+ salts.

$$H_2O_2 + Fe^{2+} \rightarrow OH\bullet + OH^- + Fe^{3+} \quad (1)$$

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required. This reactant is an attractive oxidative system for waste water treatment due to the fact that iron is very abundant and non toxic element and hydrogen peroxide is easy to handle and environmentally safe. The oxidation using Fenton's reagent has proven a promising and attractive treatment method for the effective decolonization and degradation of dyes [3]. The Fenton system uses ferrous ions to react with hydrogen peroxide, producing hydroxyl radicals with powerful oxidizing abilities to degrade certain toxic contaminants [4]. Hydroxyl radicals may react with ferrous ions to form ferric ions or react with organics:

$OH + Fe^{2+} \rightarrow OH^{-} + Fe^{3+}$ (2)

$OH + organics \rightarrow products$ (3)

Hydroxyl radicals can also react with hydrogen peroxide to produce other radicals, and may also combine with each other to produce hydrogen peroxide, which are shown below

$OH + H_2O_2 \rightarrow H_2O + HO_2$ (4)

$OH + OH \rightarrow H_2O_2$ (5)

Ferrous ions and radicals are produced during the reactions. The reactions are shown in Equations.

$H_2O_2 + Fe^{3+} \leftrightarrow H^{+} + FeOOH^{2+}$ (6)

$FeOOH_2^{+} \rightarrow HO_2 + Fe^{2+}$ (7)

$HO_2 + Fe^{2+} \rightarrow HO_2- + Fe^{3+}$ (8)

$HO_2 + Fe^{3+} \rightarrow O_2 + Fe^{2+} + H+$ (9)

Coagulation

In waste water treatment operations, the processes of coagulation and flocculation are employed to separate suspended solids from water. Although the terms coagulation and flocculation are often used interchangeably, or the single term flocculation is used to describe both; they are, in fact, two distinct processes. Coagulation is the destabilization of colloids by neutralizing the forces that keep them apart. Cationic coagulants provide positive electric charges to reduce the negative charge (zeta potential) of the colloids. As a result, the particles collide to form larger particles (flocs). Rapid mixing is required to disperse the coagulant throughout the liquid. Coagulation process is necessary in wastewater treatment as it can help to sediment the flocs formed during chemical treatment of the wastewater.

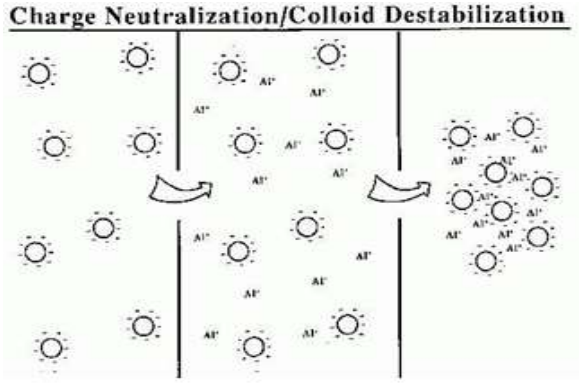

Figure-1: Charge Neutralization and Colloid Destabilization Mechanisms

II. MATERIAL AND METHODOLOGY

The purpose of this study is to evaluate the effect of oxidation by Fenton process and improving the wastewater treatment by coagulation. The main parameters were focus on was the biological oxygen demand (BOD), chemical oxygen demand (COD) and turbidity removal. The textile wastewater which was collected from a textile company near kim, Surat and analyze initially to determine the initial turbidity, conductivity, pH, COD and also BOD content. It is important to analyze the initial conditions of the wastewater to manipulate the experiments and achieving the objectives of the experiments. The main materials used in this experiment later were ferrous sulfate (FeSO4), hydrogen peroxide (H2O2). For Fenton Process, ferrous sulfate and hydrogen peroxide were used meanwhile for Coagulation process. Ferrous sulfate and hydrogen peroxide were available at our college Lab. Experimental methods are all done using the Jar test.

Combined coagulation-Fenton's process

Fenton process

Fenton process it is one of the advanced oxidation process. It is the result of reaction between hydrogen peroxide (H2O2) and ferrous sulphate (FeSO4) producing hydroxyl radical (OH.) the hydroxyl radical is a strong oxidant capable of oxidizing various organic compounds.

Jar Test

Chemical coagulation were conducted with the help of jar test. Various dosages 2gm+10ml, 2.5gm+12ml, 1.6gm+16ml, 3gm+22ml, 5gm+25ml, 7gm+30ml

were used for Fe 2+ and H2O2. the coagulation experiment proceeded with rapid mixing of wastewater sample at 130 rpm for 2 min, slow mixing at 30 rpm for 20 min, then settling for 1 hour. after settling , filtration was done . Filtration process is done with the help of filter paper. Then, After jar test COD and BOD of wastwater samples were measured according to procedures described in APHA standard methods .From that final reading of COD , BOD ,Turbidity ,pH , Conductivity etc. were calculated.

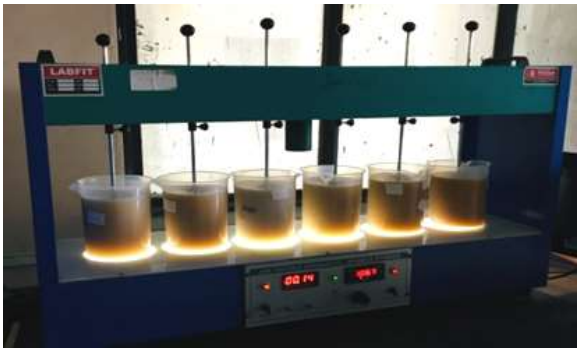

Figure- 2 : Fenton process with coagulation

Figure- 3: Coagulation process

III. RESULT AND DISCUSSION

3.1 Characteristics of Textile waste water

Waste water or raw effluent was collected from textile industry. The initial readings of sample was immediately taken and after that the sample was acidified at pH 2 & it is kept for the preservation into freezer.

Table-1:The Characteristics of textile waste water

Sr. no.	Parameters	Initial Values
1.	pH	6.65
2.	COD(mg/l)	800
3.	BOD(mg/l)	250
4.	Turbidity(NTU)	250
5.	Conductivity(µs/cm)	0.70

Table-2:Result of Turbidity after Fenton process

Sr. no.	Dosage of ($FeSo_4$+H_2O_2) (gm+ml)	Turbidity		
		Initial	Final	Reduction (%)
1.	2+10	250	118	52.8
2.	2.5+12		42	83.2
3.	1.6+16		214	14.4
4.	3+22		30	88
5.	5+25		24	90.4
6.	7+30		17	93.2

Table-3: Effects on Conductivity after Fenton process

Sr. no.	Dosage of($FeSo_4$+H_2O_2) (gm+ml)	Conductivity (µs/cm)	
		Initial	Final
1.	2+10	0.70	0.36
2.	2.5+12		0.35
3.	1.6+16		0.43
4.	3+22		0.40
5.	5+25		0.38
6.	7+30		0.41

Table-5: Removal of COD & BOD after fenton treatment

Sr. no.	Dosage of($FeSo_4$ +H_2O_2) (gm+ml)	BOD			COD		
		Initial	Final	Reduction (%)	Initial	Final	Reduction (%)
1.	2+10	250	58	76.8	800	216	73
2.	2.5+12		60	76		208	74
3.	1.6+16		60	76		224	72
4.	3+22		66	73.6		200	75
5.	5+25		48	80.8		184	77
6.	7+30		50	80		160	80

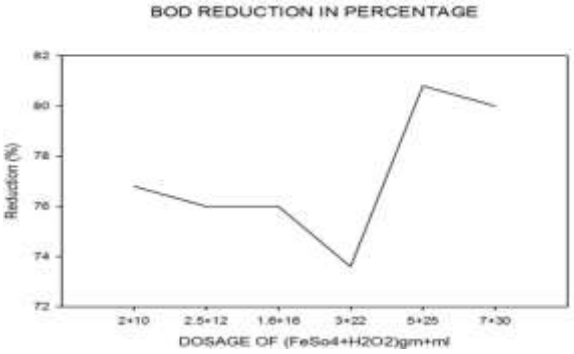

Figure-4: Removal Efficiency of BOD

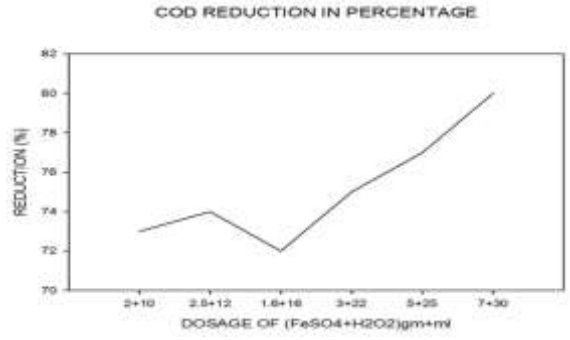

Figure-5: Removal Efficiency of COD

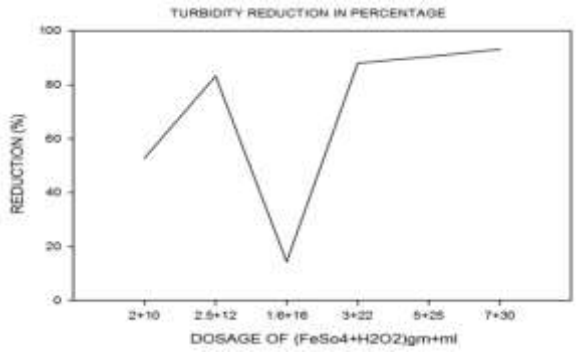

Figure-6: Removal Efficiency of Turbidity

IV. CONCLUSION

It is evident from result & discussion that good reduction is achieved. The application of Fenton's reagent in textile wastewater treatment technology is an efficient method for the decomposition of pollutants present in it and can be used successfully as a preliminary stage preceding its biological treatment. Fenton process gives removal efficiency keeping optimum dose of FeSO4 = 5gm and dose of H2O2 = 25 ml for BOD 80.8% and for COD 80% keeping optimum dose of FeSO4 = 7 gm and dose of H2O2 = 30 ml and for Turbidity 93.2% dose of FeSO4 = 7 gm and dose of H2O2 = 30 ml. It is necessary to check the reaction with respect to the large amount of various type of wastewater and find proper relation which enables the quick optimization of the process with respect to the changing input parameters of the wastewater subjected to treatment.

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