International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

Treatment of Paper Industrial Effluent by Electro Chemical Process

Aswathy Johnson[1], Asst. Prof. Lubina CH[2]

[1]*Department of Civil Engineering, MCET College, Kerala, India*
[2]*Department of Environmental Engineering, MCET College, Kerala, India*

Abstract - *The paper industry is the largest industry in India. Among world it ranks 20th paper producing country. These industries disturbing the ecological balance of the environment by discharging a wide variety of wastewater. The effluent generally contains a number of contaminants including acids, bases, total dissolved solids, and heavy metals. The pulp and paper industry is one of the heaviest users of water within the Indian industrial economy, requiring 54 cubic meters on average of water per metric ton of finished product. With water used in nearly each step of the manufacturing processes, pulp and paper mills produce large volumes of wastewater and residual sludge waste, presenting a number of issues in relation to wastewater treatment, discharge and sludge disposal. However, increasingly advanced treatment technologies, including innovative strategies geared towards water reuse and resource recovery. Wide range of wastewater treatments are currently known to people. With the recent technology development in electrochemical field, new techniques has been introduced in industries, named as electrocoagulation and electro-Fenton. The present study aims to examine the electro-Fenton/electro- coagulation (EF/EC) process for the treatment of wastewater generated from pulp and paper mills. Electrochemical methods are known to be effectively employed for the treatment of toxic organic substances with low biodegradability. In order to improve the efficiency of electrochemical methods, hybrid systems where different oxidation processes are simultaneously managed within the same electro-chemical cell are frequently used. Fenton oxidation is distinguished from other oxidation methods thanks to its high efficiency, short oxidation time, simple use, applicability for the treatment of a wide variety of substances, requirement of relatively less special equipment and sludge formation. Known as a system where the chemicals used in the Fenton oxidation are produced in a electrochemical cell and the coagulation takes place within the same reactor, the hybrid process of electro-Fenton/electro-coagulation yields fairly good results in the treatment of wastewater with high pollution load.*

Key Words: *pulp and paper mill, .AOP, electro-Fenton, electro- coagulation, Electro chemical process.*

1. INTRODUCTION

Industries are vital for the development of any country. Industries have a huge effect on the environment as it uses huge volume of water and chemicals in their processing. The large consumption of water results in the generation of huge amount which needs to be treated before discharging in to aqueous ecosystem[1]. The effluent generally contains a number of contaminants including acids, bases, total dissolved solids, and heavy metals[2]. The pulp and paper industry is one of the heaviest users of water within the Indian industrial economy, requiring 54 cubic meters on average of water per metric ton of finished product. With water used in nearly each step of the manufacturing processes, pulp and paper mills produce large volumes of wastewater and residual sludge waste, presenting a number of issues in relation to wastewater treatment, discharge and sludge disposal[3]. However, increasingly advanced treatment technologies, including innovative strategies geared towards water reuse and resource recovery. Wide range of wastewater treatments are currently known to people. With the recent technology development in electrochemical field, new techniques has been introduced in industries, named as electrocoagulation and electro-fenton.

1.1 ELECTROCOAGULATION PROCESS

Treatments of waste water by electrocoagulation have been practiced for several years. Electrocoagulation is the process of destabilizing the suspended, emulsified or dissolved contaminants in an aqueous medium by introducing an electric current into the medium. The electric current provides the electromotive force to drive the chemical reactions. When the reaction are driven or forced the elements or compounds will approach the most stable state. Generally this state of stability produces a solid that is either less colloidal and less emulsified (or soluble) than the compound at equilibrium values. As this occurs the contaminants form hydrophobic entities that precipitate and can be easily be removed by a number of secondary separation techniques. Electrocoagulation (EC), the passing of electric current through water, has proven very effective in the removal of contaminants from water.

1.2 ELECTRO-FENTON PROCESS

In recent year large amount of water and wastewater generated from various industries and produce organic matters and contaminated the water, this organic compound in water poses serious problems to public health as well as environment. The advanced oxidation process (AOPs) is one

of the advanced treatment method for wastewater remediation. In advanced oxidation process, electro-fenton process (EFP) is one of the best methods for the wastewater treatment. Electro–Fenton process is a promising technology for waste water treatment process and it is more economical, efficient and environmental friendly for treatment and removal of organic matter compared to conventional technologies. This technology based on the continuous electro generation of H2O2 at a suitable cathode by the reduction of dissolved oxygen.

2. METHODOLOGY

The methodology involves checking the parameters and treating the industrial wastewater by using electrochemical process. The method of collection of water samples is of great importance and should be done carefully. Otherwise serious errors are likely to occur in the results due to contamination during sampling. Bottles with stoppers which are thoroughly cleaned and sterilized should be used. The parameters were selected based on the influence of waste and other chemicals. The parameters included BOD, pH, Dissolved Oxygen, COD, TDS, turbidity, hardness, colour.

3. RESULT AND DISCUSSION

The aim of the study is the comparison of electrocoagulation and electro-fenton process in treating industrial wastewater and its comparison with irrigation standards. Each process is done by using different experimental set up such as by changing voltage and inter electrode distance. We checked the important parameters of treated sample and obtained results are presented below. The following table shows the comparison between electrocoagulation and electro-fenton with the irrigation standards. From the table it is clear that electro-fenton is most suitable method for treating industrial waste water. The electro-fenton using 20 V and 2 cm distance is yielding good results.

3.1 SAMPLE CHARACTERISTIC

The initial sample values of pH, colour, turbidity, COD, BOD, DO, hardness, conducting electrocoagulation and electro- fenton process is shown below.

Table -1: Sample Characteristics

Parameters	Initial sample
Ph	8.3
Turbidity (mg/l)	200
Hardness (ppm)	18220
DO(mg/l)	1.8
Acidity (mg/l)	0
Alkalinity (mg/l)	370
Total dissolved solids(mg/l)	130
BOD (mg/l)	1672
COD(mg/l)	5200
Colour	Dark Brown

3.2 RESULTS OBTAINED AFTER ELECTRO-COAGULATION PROCESS

The obtained values of pH, colour, turbidity, COD, BOD, DO, hardness, solids after conducting electrocoagulation process is shown below.

Table -2: Results obtained after electrocoagulation process

Parameters	Electrocoagulation				Irrigation standard
	4 cm		2 cm		
	10 V	20 V	10 V	20V	
pH	8.1	8.1	7.9	7.8	5.5-9
Turbidity mg/l)	97	75	89	73	55
Hardness	1972	1890	1903	1800	1100-1300
DO(mg/l)	1.9	2.1	2.1	2.3	2.5-5
Acidity	0	0	0	0	50
Alkalinity	305	265	260	210	250
TDS	22.7	14.1	15.7	13	200
BOD (mg/l)	370	325	280	238	100
COD(mg/l)	872	834	810	790	300
Colour	Slightly yellow				-

3.3 RESULTS OBTAINED AFTER ELECTRO-FENTON PROCESS

The obtained values of pH, colour, turbidity, COD, BOD, DO, hardness, solids after conducting electro-fenton process is shown below.

Table -3: Results obtained after electro-fenton process

Parameters	Electro-fenton				Irrigation standard
	4 cm		2 cm		
	10 V	20 V	10 V	20 V	
Ph	7.9	7.1	7.8	6.9	5.5-9
Turbidity (mg/l)	75	52	73	50	55
Hardness	1930	1862	1622	1276	1100-1300
DO(mg/l)	2.1	2.8	2.3	3	2.5-5
Acidity (mg/l)	0	0	0	0	50
Alkalinity	300	240	260	180	250
Total dissolve	20.3	11.2	12.3	10	200
BOD (mg/l)	320	200	190	100	100
COD(mg/l)	890	370	540	290	300
Colour	Colou rless				-

3.4 REMOVAL EFFICIENCY OF ELECTRO COAGULATION AND ELECTRO-FENTON PROCESS

Table -4: Comparison of removal efficiency

Parameter (%)	Electro Coagulation (%)	Electro fenton (%)
BOD	85.76	94.01
COD	84.80	94.42
TDS	90.0	92.30
Hardness	90.12	92.99
Turbidity	63.5	75
Alkalinity	43.24	51.35

The comparison efficiency of electro Coagulation and electro-Fenton process . EC process can minimize most of the disadvantages of conventional process. Percentage removal of BOD, COD for EF process 94.18, 95.48 and for EC process

86,87.69 respectively. Removal efficiency of TDS, Hardness for EF process 96.8, 94.18 and for EC process 94.41, 90.48 respectively. Percentage removal of Turbidity, Alkalinity for EF process 75,51.35 and for EC process 63.5,43.24 respectively. Removal efficiency is higher for EF process as compared to EC process. Costs of both processes are nearly equal.EF process is a promising technology for applications in waste water treatment.

4. CONCLUSIONS

Various conventional methods for waste water treatment are present from ancient times, but most of them are complex and lengthy in nature.EF and EC process can minimize most of the disadvantages of conventional processes. Percentage removal of BOD, COD for EF process 94.18, 95.48 and for EC process 86, 87.69 respectively. Removal efficiency of TDS, Hardness for EF process 96.8, 94.18 and for EC process 94.41, 90.48 respectively. Percentage removal of Turbidity, Alkalinity for EF process 75,51.35 and for EC process 63.5,43.24 respectively. Removal efficiency is higher for EF process as compared to EC process. Costs of both processes are nearly equaled process is a promising technology for applications in waste water treatment.

The present study aims to examine the electro-Fenton/electro-coagulation (EF/EC) process for the treatment of wastewater generated from pulp and paper mills. Electrochemical methods are known to be effectively employed for the treatment of toxic organic substances with low biodegradability. In order to improve the efficiency of electrochemical methods, hybrid systems where different oxidation processes are simultaneously managed within the same electro-chemical cell are frequently used. Fenton oxidation is distinguished from other oxidation methods thanks to its high efficiency, short oxidation time, simple use, applicability for the treatment of a wide variety of substances, requirement of relatively less special equipment and sludge formation. Known as a system where the chemicals used in the Fenton oxidation are produced in a electrochemical cell and the coagulation takes place within the same reactor, the hybrid process of electro-Fenton/electro-coagulation yields fairly good results in the treatment of wastewater with high pollution load. This project is used to scope of further study.

REFERENCES

[1] Deepak Sharma,"Treatment of Pulp and Paper Effluent by Electro coagulation" International Journal of ChemTech Research Vol.6,

[2] Pushpalatha, M B Krishna,"Electro- Fenton Process for

Waste Water Treatment A Review" International Journal of Advance Research, Ideas and Innovations in Technology Vol.3, 439-451.

[3] UmranTezcan, SeherTopal,"Treatment of tissue paper waste water; application of Electro-fenton method" International Journal of Environmental Science and Development Vol.62.

[4] Selvabharathi G, S. Adishkumar,"Treatment of Pulp and Paper Wastewater by Electro Fenton Process" Asian Journal of Research in Social Sciences and Humanities Vol. 6, October.

[5] Walid K.Lafi, "Electro-coagulation Treatment of Wastewater from PaperIndustry" International journal of engineering sciences & research technology, Vol 5

[6] C B Shivayogimath,"Applications of Electrocoagulation in Treatment of Industrial Wastewater" International Journal of Engineering Sciences & Research Technology Vol 6.

[7] B Ramesh Babu, Prashant Bhagawati,"Studies on Electrochemical Treatment of Pulp and Paper Mill Waste Water" International Journal Of Energy& Environment Vol 6 October.