A SPECULATIVE SCRUTINY ON PULP AND PAPER INDUSTRY WASTEWATER BY SOLAR PHOTO FENTON PROCESS

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ABSTRACT:

The nature of wastewater that is discharged into the earth is to be bettered because of the scarceness of water. Paper and Pulp industry part right now positions fourth for its water use and it is likewise probably the greatest maker of wastewater. Paper and Pulp industry Wastewater is considered as an extreme natural hazard when it is untreated or severely treated before release into accepting waters on account of the nearness of harmful substances. Contaminants inherent to paper and pulp wastewater include effluent solids, sediments, absorbable organic halides (AOX), chlorinated organic compounds, chemical oxygen demand (COD), biological oxygen demand (BOD), contaminants, thermal loads, microorganisms such as coliform groups and toxic chemicals. A conventional technique for taking care of paper and pulp wastewater incorporates physical, concoction, or potentially natural procedures, or in certain occurrences, a blend of these tasks is utilized. Current wastewater treatment technologies are deemed ineffective in the utter removal of pollutants, particularly organic matter. In many instances, these organic compounds are resistant to conventional treatment methods, therefore creating the requirement for modern engineering sciences. This report delineates the effect of solar photo-Fenton process on pulp and paper wastewater. Besides the investigation is carried out to find out the removal efficiency of color and COD. The experimentation is conducted in a lab scale solar photo- Fenton reactor of capacity 1litre which is disclosed to the sunlight with the reaction time of 180 and 120 minutes. In solar photo-Fenton process dose of 50:1 ratio of Fe^{2+}+H_2O_2 at 75 minutes is obtained as optimum. This analysis is being proposed to resolve the challenges in removing a wide range of contaminants and for better uses of economic resource

I. INTRODUCTION

Paper is a thin material that has been around for about 2000 years. It is produced by pressing together moist fibres of cellulose pulp derived from wood, rags or grasses, and drying them into flexible sheets. It is a versatile material with many uses, including writing, printing, packaging, cleaning, and for a number of industrial and construction processes. To meet the daily requirements of paper, more than 450 million tons of paper is produced by world paper industry .At the end of 2020, it is expected that the demand of paper usage will reach to 500 million ton per annum. Among world India ranks 20^{th} in paper producing country. Pulp and paper sector currently ranks fourth for its water usage. To produces tons of paper, $15m^3$ to $50m^3$ of water is required for the modern mills. In India around 900million m^3 of water is consumed and 700million m^3 of wastewater is annually discharged by paper and pulp industry. Quantity of water consumption in paper and pulp industry varies according to the quality and kind of paper to be manufactured. On overall global industrial wastewater production, 42% of wastewater production is from paper and pulp industry. From paper industries nearly 2% of worlds trade and 3.5% of the world industrial pollution occurs.

The wastewater generated from the paper and pulp industry is mainly due to washing of wooden chips, baggase, rice or wheat before pulping, chemically cooked pulp, pulp during bleaching and also from pulp cleaning equipments. The major constituents of wastewater are suspended solids including bark particles, fiber pigments and dirt, dissolved colloidal organics like hemicellulose, sugars, lignin compounds, alcohols, turpenting, sizing agents, adhesives like starch and sulphatesetc, color bodies primarily lignin compounds and dyes. Dissolved inorganics such as NaoH, Na_2so_4 and bleach chemicals,thermal loads, microorganisms such as coliform group and some toxic chemicals. In paper and pulp industry the primary, secondary and tertiary treatments are carried out to remove solids, particulate matter, biodegradable organic matter and also the microorganisms which present in it.The conventional methods used in paper and pulp industry to treat wastewater are physicochemical methods and biological methods.

The physico chemical method which includes sedimentation , coagulation, precipitation, adsorption, chemical oxidation, and membrane filtration. The production of large volumes of metal hydroxide, high green house gas emission and disposal problems are the major environmental impact of this method. In biological method there is two approaches involved either aerobic or anaerobic. In aerobic approach, it requires high energy supply typically 880Kwh to 1000Kwh per ton for the COD removal. To operate anaerobic approach relatively high temperature i.e) greater than 30^0 c is required. The biogas produced in this process is difficult to store and needs to be treated because of contaminants deposited in it such as H_2s, which are the major drawbacks of this method.

In order to meet the increasingly stringent discharge limits, mills are forced to adopt unconventional and technologically advanced treatment systems to reduce refractory organic compounds. Hence, treatment with some advanced oxidation processes (AOP's) is needed. Hence, the aim of this research is to investigate the efficiency and feasibility of solar photo fenton process for the pre treatment of pulp and paper wastewater.

II. COLLECTION OF SAMPLE

The waste water was collected from pulp and paper mill at Erode and it was stored at 4°C. At beginning, initial characteristics of pulp wastewater are observed and reported in the table 1.

Sl.NO	PARAMETERS	UNITS	VALUE
1	pH	-	8.4
2	Total Dissolved solids (TDS)	mg/L	4900
3	Total Suspended solids (TSS)	mg/L	1850
4	Total Chemical Oxygen demand (TCOD)	mg/L	3050
5	Soluble Chemical Oxygen demand (SCOD)	mg/L	2200
6	Total Solids (TS)	mg/L	1600
7	Chlorides	mg/L	79.2
8	Alkalinity	mg/L	449.86
10	BOD_5	mg/L	65.19

Table 1: Initial Characteristics of Waste Water

III. SOLAR PHOTO FENTON TREATMENT

Solar photo Fenton treatment was performed using 500 ml of waste water in a glass tray reactor of Size - 21.5 cm x 21.5 cm x 15 cm. The photo-Fenton reactions were taken away in a tray reactor with the working volume of 1L. The whole system was exposed under strong solar irradiation, from 11.00 AM to 03.00 PM from March to May. When the system was endangered to the sun; it was read at the start of the experiment. The sample was taken from the reactor from every 10 minutes to analyse COD. The color was monitored in the absorbance range of 475nm. To avoid floc formation overhead stirrer is used.

IV. RESULT AND DISCUSSION

A. Effect of dosage of concentration fe^{2+}+ H_2O_2 on cod removal

From the fig: 1, it is clear that the increasing amount of Fe^{2+}+ H_2O_2 leads to greater COD and color removal. Between the ratios of 5:1,10:1,20:1,30:1,40:1,50:1,60:1, the COD removal is nearly equal. The dosage of 50:1 ratio of Fe^{2+}+H_2O_2 was taken as optimum at 75minutes. Increase in Fe^{2+}+H_2O_2 concentration lowered the degradation rate. Therefore, it was not worth taking large amount of H_2O_2 dosage for increasing degradation.

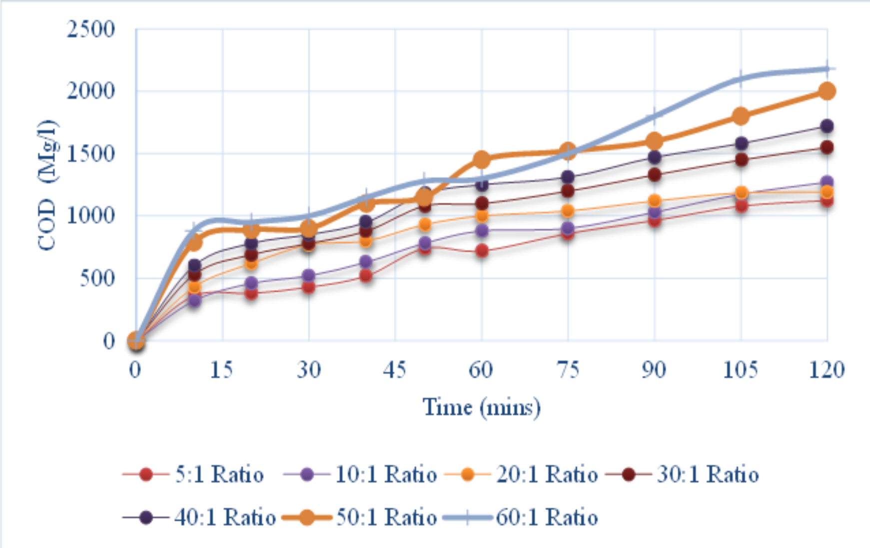

Figure: 1 Effect of Dosage of Concentration Fe^{2+}+ H_2O_2 on COD removal

B. Effect of dosage of concentration fe^{2+}+ H_2O_2 on removal efficiency

COD reduction increases from 40% to 60%. COD reduction increases linearly with reaction time up to 75 minutes; afterwards the rise is nearly flat. Thus, dose of 50:1 ratio at irradiation time of 75 min is significant for COD reduction, which is clearly noted in fig: 2.

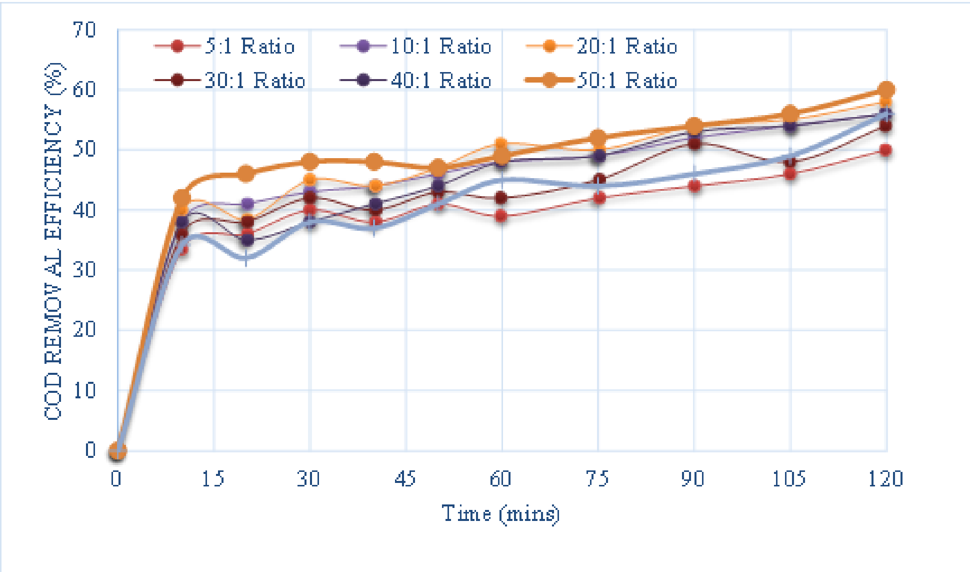

Figure: 2 Effect of Dosage of Concentration Fe^{2+}+ H_2O_2 on Removal Efficiency

C. Effect of biodegradability

The biodegradability is spoted From the fig: 3, the optimum reaction time is observed at 75 minutes in dosage of 50:1 ratio.

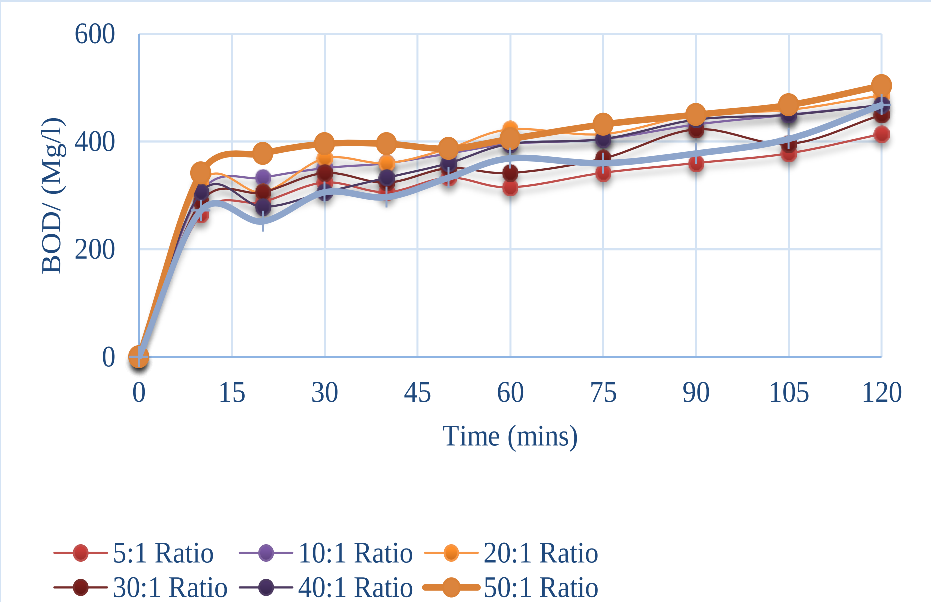

Figure: 3 Effect of Biodegradability

D. Effect of temperature and cod removal efficiency

The experiment was conducted at different temperature 30^{0}c, 40^{0}c and 50^{0}c at different ratio of dosage. From the fig: 4 and 5 it's clear that, at optimum its removal efficiency reached to 58% and the COD release rise between 40^{0}c and 50^{0}c.

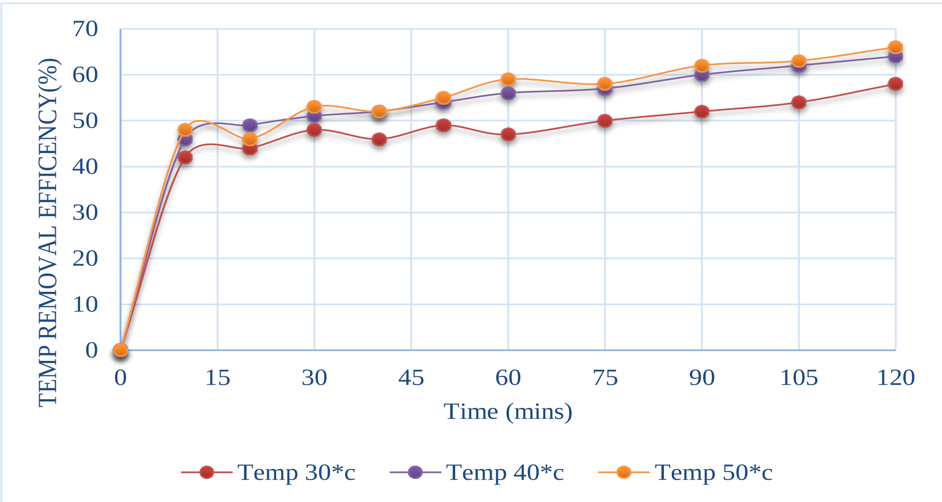

Figure: 4 Effect of Temperature

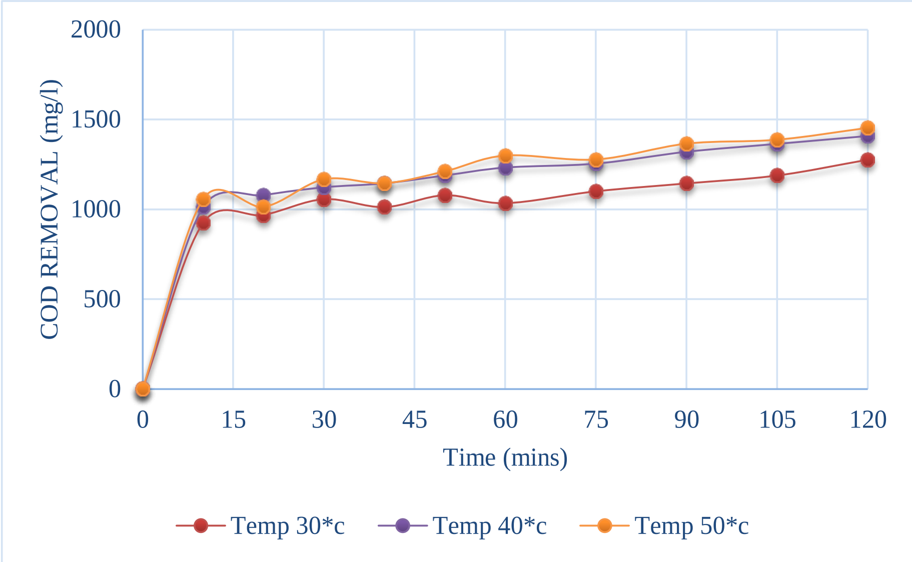

Figure: 5 Effect of Temperature on COD Removal Efficiency

E. Effect of lignin

The rate of degradation increases with increase in concentration. From the fig: 6, the percentage of lignin removed from the wastewater is obtained high as 70%.

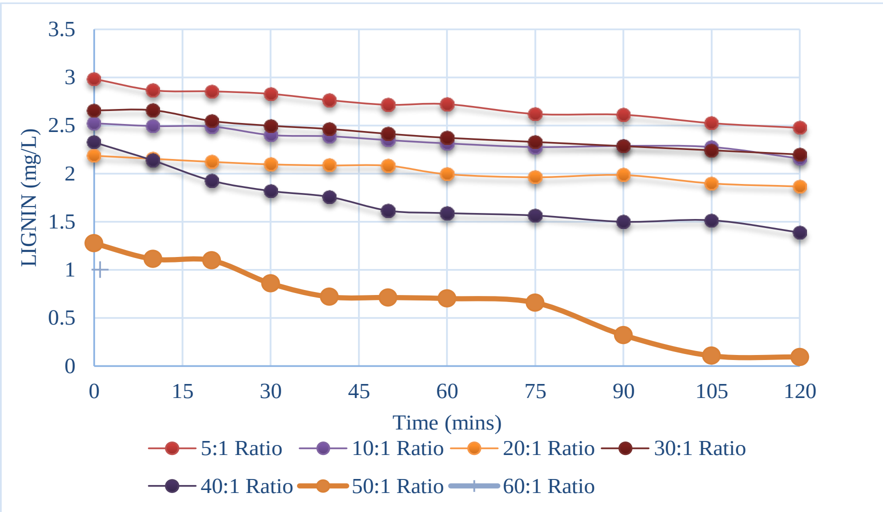

Figure: 6 Effect of Lignin

F. Effect of pH

The experiment was conducted at different pH values ranging from 2 to 6.The COD release enhanced with increase in doseFe^{2+}+ H_2O_2 varying with dosage ratio ranges as 5:1, 10:1, 20:1, 30:1, 40:1, 50:1and 60:1.The optimum removal of COD was obtained at pH=3 in the ratio of 50:1, at the reaction time of 75 minutes at 40^0c. From the fig: 7 and 8, it is detected that the percentage of COD reduction as 51%.

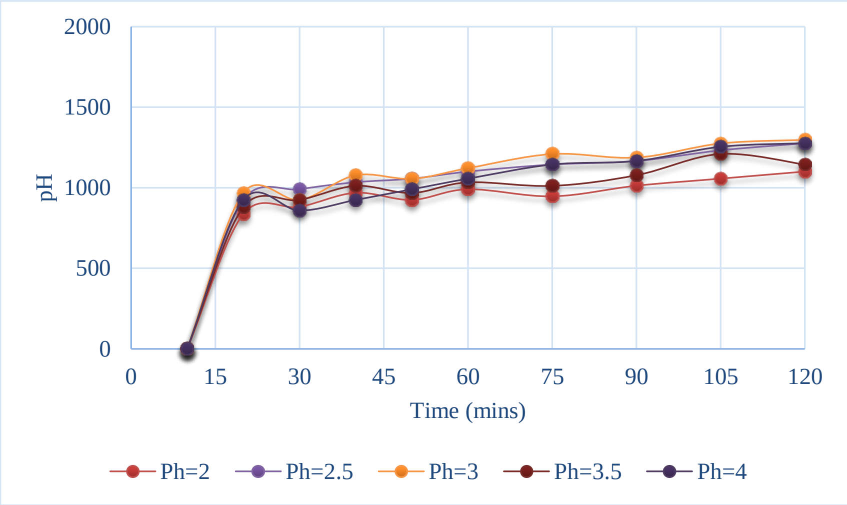

Figure: 7 Effect of pH for COD Removal

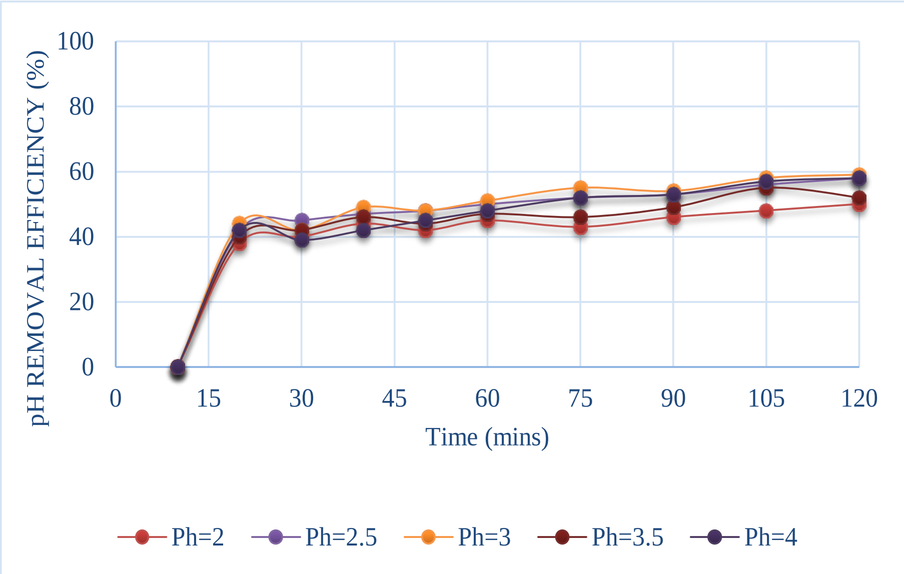

Figure: 8 Efficiency of pH

V. CONCLUSION

In this research work, the efficiency of solar photo Fenton treatment on pulp and paper wastewater is investigated. In solar photo-Fenton process dose of 50:1 ratio of Fe^{2+}+H_2O_2 at 75 minutes is obtained as optimum. COD reduction increases from 40% to 60%. COD reduction increases linearly with reaction time up to 75 minutes; afterwards the rise is nearly flat. Thus, dose of 50:1 ratio at irradiation time of 75 min is significant for COD reduction. Also, The optimum removal of COD was obtained at pH=3 in the ratio of 50:1, at the reaction time of 75 minutes at 40^0c. The percentage of lignin removed from the wastewater is obtained high as 70%. This study shows the performance of solar photo fenton process and efficient removal of the non-biodegradable substance. Also this analysis is being proposed to resolve the challenges in removing a wide range of contaminants and for better uses of economic resources.

VI. REFERENCES

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