Chemical Oxidation by Fenton's Reagent and Hydrodynamic Cavitation

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Abstract— Reduction of chemical oxygen demand is important as it reduces the dissolved oxygen present in water bodies thus reducing the health of the water body and harm the aquatic life. Part one contains reduction of cod by using fenton's reagent and part two contains reduction of cod by using hydrodynamic cavitation.

Keywords: Fenton Process, Hydroxyl Radicals, Hydrodynamic Cavitation

I. INTRODUCTION

A. *Wastewater*

Wastewater is "used water from any combination of domestic, industrial, commercial or agricultural activities, surface runoff or stormwater, and any sewer inflow or sewer infiltration". Therefore, wastewater is a byproduct of domestic, industrial, commercial or agricultural activities. The characteristics of wastewater vary depending on the source.

B. *Dissolved Oxygen*

Dissolved oxygen refers to the level of free, non-compound oxygen present in water or other liquids. It is an important parameter in assessing water quality because of its influence on the organisms living within a body of water. In limnology (the study of lakes), dissolved oxygen is an essential factor second only to water itself. A dissolved oxygen level that is too high or too low can harm aquatic life and affect water quality.

C. *Chemical Oxygen Demand*

Chemical oxygen demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as Ammonia and nitrite. COD measurements are commonly made on samples of waste watersor of natural waters contaminated by domestic or industrial wastes.

D. *Fenton's Reagent*

Fenton's reagent is a solution of hydrogen peroxide (H2O2) with ferrous iron (typically iron(II) sulfate, FeSO4) as a catalyst that is used to oxidize contaminants or waste waters. Fenton's reagent can be used to destroy organic compounds such as trichloroethylene (TCE) and tetrachloroethylene (perchloroethylene, PCE).

E. *Hydrodynamic Cavitation*

Hydrodynamic cavitation describes the process of vaporisation, bubble generation and bubble implosion which occurs in a flowing liquid as a result of a decrease and subsequent increase in local pressure. Cavitation will only occur if the local pressure declines to some point below the saturated vapor pressure of the liquid and subsequent recovery above the vapor pressure. If the recovery pressure is not above the vapor pressure then flashing is said to have occurred. In pipe systems, cavitation typically occurs either as the result of an increase in the kinetic energy (through an area constriction) or an increase in the pipe elevation.

II. CHARACTERISTICS OF WASTE WATER

SR NO.	CHARACTERISTICS	READING	UNIT
1	COD	960	mg/l
2	TSS	6.4	mg/l
3	TDS	38.6	mg/l
4	COLORIMETER	25	--
5	pH	8.2	--

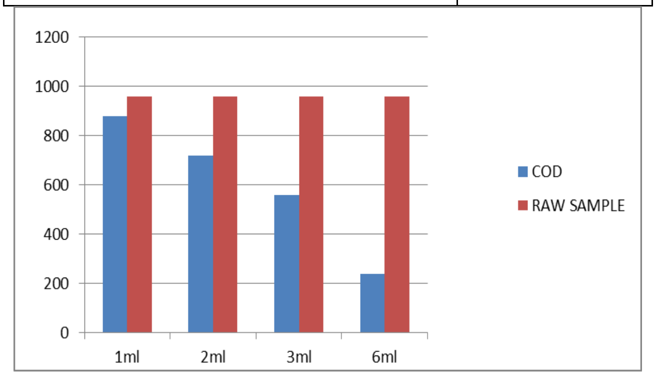
III. MATERIALS AND METHOD

A. *Chemical Oxidation by Fenton's Reagent*

- The process is carried out by adding fenton's reagent in diluted sample
- Preparation of fenton's reagent : Dissolve 69.50 g of (FeSO47H¬2O) in 500 ml of distilled water containing 5ml of concentrated H2SO4
- The fenton's reagent was added in different quantities and COD was obtained.
- This process is used to reduce the COD thus adding the sample till COD is below 250 mg/l

The following table shows the reduction of cod on addition on fenton's reagent in (1:80) 40 ml diluted sample RAW SAMPLE= 960 mg/l

ML OF FENTON'S REAGENT IN (1:80) 40 ML DILLUTED SAMPLE	COD
1 ML	880 MG/L
2 ML	720 MG/L
3 ML	540 MG/L
6 ML	240 MG/L

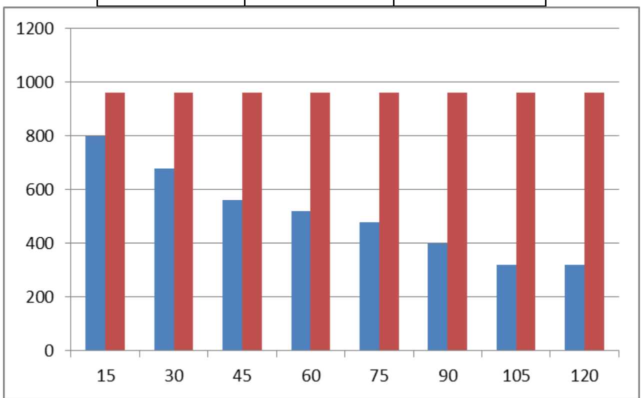


Hydrodynamic Cavitation

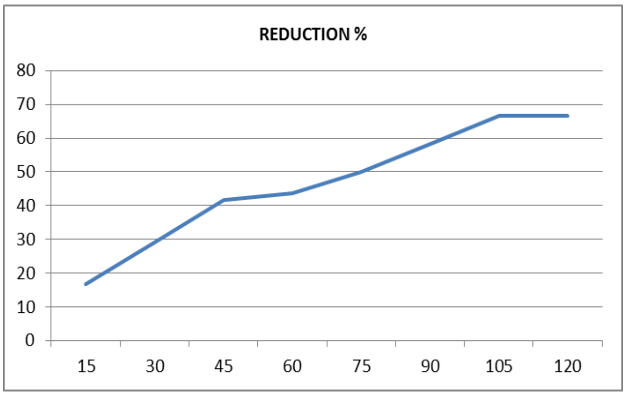
The model consist of a 0.5 HP pump attached to the drum of 50 litres capacity through Pipes.

For hydrodynamic cavitation, experiments were performed in reactor of capacity 50 litres in which effluent was lifted and circulate by the pump of capacity 0.5 HP for different intervals of time without use of any chemical. Sample was kept for quiescent condition for 2 hours for the settlement of the precipitate. All experiments were carried out in batch mode. Several set of experiments were carried out to check the optimum range of time.The samples were taken at every 15 minute intervals starting from 15 to 120 minutes. At every 15 minute interval sample is collect and COD is obtained. MAIN SAMPLE : 960 mg/l

MINUTES	READING	COD(mg/l)
15	1.00	800
30	1.15	680
45	1.30	560
60	1.35	520
75	1.40	480
90	1.50	400
105	1.60	320
120	1.60	320



MINUTES	COD	COD REDUCTION %
15	800	16.67
30	680	29.16
45	560	41.67
60	540	43.75
75	480	50.00
90	400	58.33
105	320	66.67
120	320	66.67



IV. CONCLUSION

Reduction % of COD by chemical oxidation by fenton's reagent is 75% and reduction % of COD by hydrodynamic cavitation is 66.67%. Reduction of cod by both chemical oxidation by fenton's reagent and hydrodynamic cavitation is efficient but not recommendable as the dilution factor is very high. Other methods which require less or no dilution requirements should be used instead.

REFERENCES

[1] Jian Chen et al., Ph.D. Thesis, Advanced Oxidation Technologies: Photocatalytic treatment of wastewater; Universitair docent bij het subdepartement milieutechnologie, Holland, 1997.

[2] Rook, J.J., formation of haloforms during chlorination of natural water, water treatment exam., Vol. 23, pp. 234, 1974, as cited in reference (1).

[3] Peyton, G.R., significance and treatment of volatile organic compounds in water supplies, (Eds.) N, M. Ram, R. F. Chrisman, K. P. Cantor, 1990, Lewis publishers. Chapter 14, oxidative treatment methods for removal of organic compounds from drinking water supplies, pp. 313-362, as cited in reference (1).

[4] Pentrate, B. and Shultheis, S., Non-Thermal plasma techniques for pollution control, ed. NATO ASI Series G, Vol. 34A and B, Springer, Berlin, 1993.

[5] Evans, D., Rosocha, L.A., Anderson, G.K., Coogan, J.J. and Kushner, M.J, J. Appl. Phys., Vol. 74, pp. 5378, 1993, as cited in reference (1).

[6] Sharma, A. K., Locke, B.R., Arce, P. and Finney, W.C. A preliminary study of pulsed streamer corona discharge for the degradation of phenol in aqueous solutions, Hazardous waste/Hazardous materials, Vol. 10, pp. 209-219, 1993.

[7] Bartolo, B.D., Spectroscopy of the excited state, Vol. 12 of NATO Advanced study institutes series, Plenum press, New York, 1976.

[8] Yamamato, T., Ramanthan, K., Lawless, P.A., Ensor, D.S., Newsome, J.R., Parks, N. and Ramsey, G.H., Control of organic pollutants by an AC energized Ninth International Water Technology Conference, IWTC9 2005, Sharm El-Sheikh, Egypt 128 ferroelectric pellet reactor and a pulsed Corona reactor, Trans. IEEE industry applications, Vol. 28, pp. 528-533, 1992.

[9] S. K. Dhali and I. Sardja, Dielectric-barrier discharge for processing SO2, J. Appl. Physics, Vol. 69, pp. 9391, 1991.
[10] McEwan, M.J. and Philips, L.F., Chemistry of the atmosphere, Ddware Arnold Ltd., London, 1975, as cited in reference (1).