Advanced Oxidation by Hydrogen Peroxide 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 harms the aquatic life. Part one contains reduction of cod by using Hydrogen Peroxide and part two contains reduction of cod by using hydrodynamic cavitation.

Keywords: Hydrogen Peroxide, 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 storm water, and any sewer inflow or sewer infiltration". Therefore, wastewater is a by-product 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 waters of natural waters contaminated by domestic or industrial wastes.

D. *Hydrogen Peroxide reagent*

Calculated amount of sodium peroxide (Na_2O_2) is gradually added to an ice cold solution of 20% Sulphuric acid (H_2SO_4) in small lots with constant stirring.

$$Na_2O_2 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O_2$$

Upon cooling crystals of $Na_2SO_4 10H_2O$ separate out and the resulting solution contains 30% H_2O_2.

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 vapour pressure of the liquid and subsequent recovery above the vapour pressure. If the recovery pressure is not above the vapour 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	800	mg/l
2	TSS	6.4	mg/l
3	TDS	12.37	mg/l
4	COLORIMETER	25	--
5	pH	6.55	--

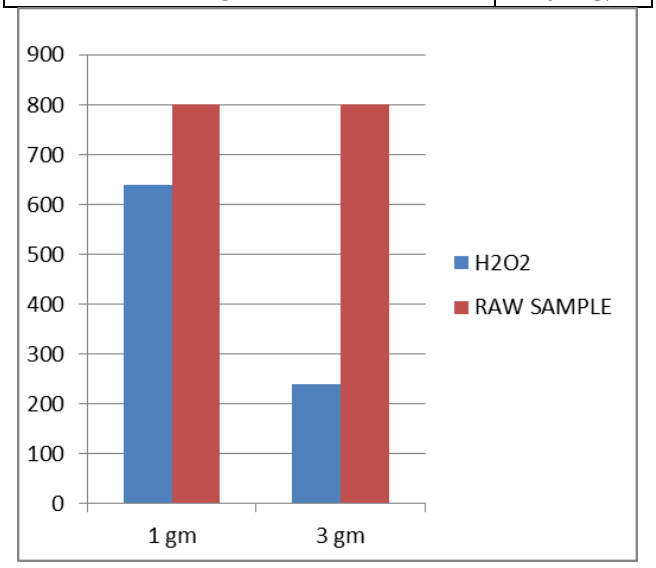
III. MATERIALS AND METHOD

A. *Chemical Oxidation by Hydrogen Peroxide Reagent*

- The process is carried out by adding hydrogen peroxide reagent in diluted sample
- The hydrogen peroxide 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 hydrogen peroxide in (1:800) diluted sample RAW SAMPLE= 800 mg/l SAMPLE CONTENT= 40ml

GM OF HYDROGEN PEROXIDE REAGENT IN (DILUTION RATE 1:800)	COD
1 ML	640 MG/L
3 ML	240 MG/L



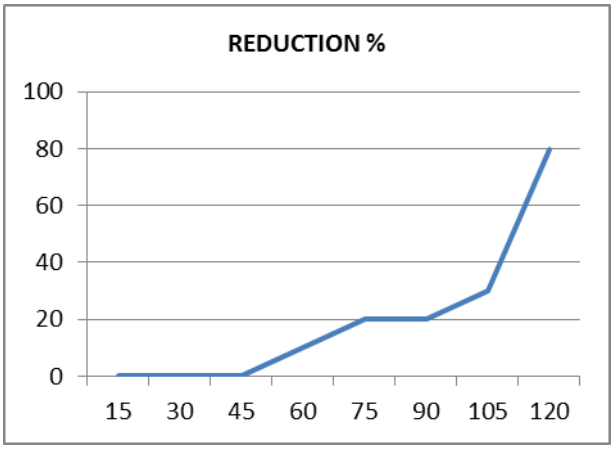
IV. HYDRODYNAMIC CAVITATION

The model consist of a 0.5 HP pump attached to the a 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: 800 mg/l

MINUTES	READING	COD(mg/l)
15	1.00	800
30	1.00	800
45	1.00	800
60	1.10	720
75	1.2	640
90	1.2	640
105	1.3	560
120	1.8	240

MINUTES	COD	COD REDUCTION %
15	800	0
30	800	0
45	800	0
60	720	10
75	640	20
90	640	20
105	560	30
120	160	80



V. CONCLUSION

Reduction % of COD by chemical oxidation by Hydrogen Peroxide is 70% and reduction % of COD by hydrodynamic cavitation is 80%. Reduction of cod by both chemical oxidation by hydrogen peroxide 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.