"Study of Wastewater Treatment by Using Oxidation Processes"

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Abstract **- The advanced oxidation process (AOP's) is more effective technology for removal of toxic and non easily removable waste present in wastewater. Oxidizing agent is more powerful for removal of waste present in wastewater. Now a days so many oxidation processes are used for removal of non easily removable waste present in wastewater, such most effective methods are Chlorine Dioxide (CLO_2), Hydrogen peroxide (H_2O_2), Ozone (O_3), Fenton reagent, Ultra-violet light (U/Light). In present paper highlighted the most effective methods used for treatment of Domestic as well as industrial wastewater. Oxidation process is used to destroy organic compounds in wastewater such oxidation methods are Chlorine Dioxide (CLO_2), Fenton reagent, Hydrogen peroxide (H_2O_2) and Ozone.**

Keywords: **Advanced oxidation process, Chlorine dioxide, Hydrogen peroxide and ozone and Fenton reagent.**

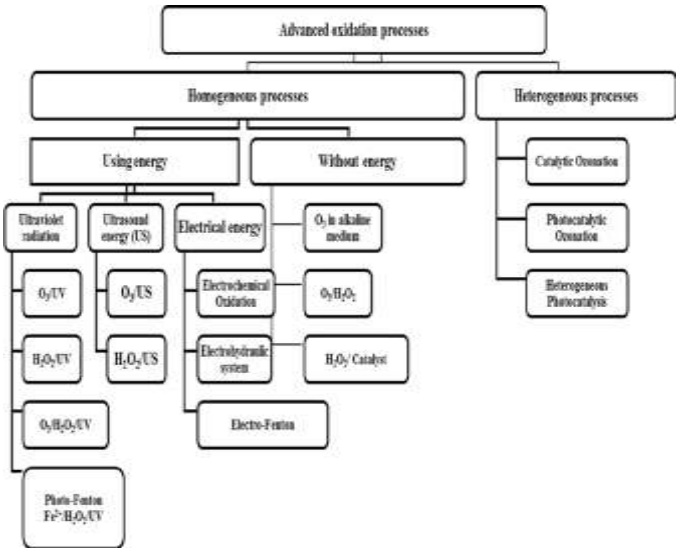
I. INTRODUCTION

In last 10 years the development of various techniques was came for the treatment of wastewater. Degradation of organic compounds can be removed by using biological treatment. The toxic compound cannot be remove from wastewater by using biological process, so advanced or best appropriate method is essential for the removing this kind of toxic compounds. The oxidation process is most powerful

Techniques are used for removal of toxic compounds into biodegradable substances. This treatment is more beneficial for the removal of waste from wastewater, such various oxidation techniques are Chlorine Dioxide (CLO_2), Hydrogen Peroxide (H_2O_2), Ozone (O_3) and Ultraviolet light (U/V light). The main aim of chemical oxidation process is mineralization of contaminants into carbon dioxide, water or inorganic, at least its transformation into harmless substances. The toxic compounds are not easily removed in biological treatment; such case chemical oxidation process gives better result as compared to biological process. In chemical oxidation process powerful reagents are used for the decomposition of contaminants in wastewater. Advanced oxidation processes (AOPs) are used to oxidize complex organic components found in wastewater that are difficult to degrade biologically into simpler final products. When chemical oxidation is utilized for the treatment of wastewater, it may not be necessary to complete oxidation of compounds or group of compounds. In some cases, partial oxidation is sufficient for the conversion of toxic compounds into biodegradable substances. The degradation of toxic compound in wastewater treatment can be removed in three steps i.e. primary degradation, intermediate degradation and final degradation.

Advanced oxidation processes typically involve the generation and use of the hydroxyl radical (OH') as a strong oxidant to destroy compounds that cannot be oxidized by conventional oxidants such as oxygen, Ozone and chlorine. The main objective of advanced oxidation process is development and implementation of new standards for wastewater treatment. The suitable application of advanced oxidation process is to use more powerful agent such as H_2O_2 (Hydrogen peroxide) and O_3 (Ozone), their application should not replaced. The following figure shows the various technologies for wastewater treatment.

Figure.1 classification of advanced oxidation processes.



In oxidation process so many oxidants are used for decomposition of organic waste in wastewater, oxidation

power of various reagents is different. The following table shows the various oxidation potential of oxidant used in wastewater treatment.

Table no.1- Oxidation potential of various oxidizing agents

Sr. no	Oxidizing agent	Oxidation potential (V)
1.	Hydroxyl Radicals	2.80
2.	Ozone	2.08
3.	Hydrogen peroxide	1.78
4.	Hypochlorite	1.49
5.	Chlorine dioxide	1.27

II. ADVANCED OXIDATION PROCESSES

1. Fenton process –

The Fenton reagent, a product of hydrogen peroxide and Fe (II) salt, is discovered by Henry J.H. Fenton. He described the oxidation power of hydrogen peroxide on certain organic molecules in which OH^- radicals are produced from hydrogen peroxide under the addition of Fe (II) as a catalyst. This system is considered as the most promising treatment among AOPs for remediation of highly contaminated waters. The Fenton reagent is able to destroy organic compounds in wastewater, such as phenols and herbicide.

2. Ozonation –

The advanced oxidation process (AOP's) is alternative method for decolorizing and reducing recalcitrant load from industrial wastewater. The oxidation potential of ozone is 2.08 V. The advanced oxidation processes are based on generation of hydroxyl radical in water, which are highly reactive and non selective oxidant that can oxidize organic compounds. Ozone is highly reactive oxidizing agent, its more application in industrial and domestic application related to oxidation. Ozone is formed from dioxide by the action of ultraviolet light and also atmospheric electrical discharges, and is present in very low concentrations throughout the Earth atmosphere. Ozona ion has potential in decolorizing for the following reason: 1.Nil the sludge after treatment with Ozonation.2.Risk minimizes 3.Many operations covered in one step 4. No skilled person required 5. Minimum land required. For economic point of view combining of various advanced oxidation processes (AOP's) reduced the reaction time and cost.

3. Hydrogen peroxide

Advanced oxidation processes are used for degradation of organic waste and decolorization of water. The oxidation potential of hydrogen peroxide is 1.78 V. By using Hydrogen peroxide as an oxidant in wastewater treatment refractory organic substances are decomposed, also effectively reduced COD, offensive odor are greatly reduced

4. Chlorine dioxide –

Chlorine dioxide which was first used in drinking water treatment as an oxidant increasingly of interest in domestic and industrial wastewater treatment(Eckenfelder and Bowers, 1994). The oxidation potential of chlorine dioxide is 1.27 V. Chlorine dioxide is more effective oxidant for removal of bacteria and viruses in wastewater. Besides, its biocides properties are not influenced by pH and it is a more powerful oxidant than chlorine (Reynolds and Richards, 1996). However, ClO_2 is only slightly superior to chlorine as a bactericide but it is a much superior virocide. Compared to ozone which is the strongest oxidant of the common disinfecting agents, ClO_2 has the advantages of easier generation in point of use and a longer life of the preservation (White, 1992). Chlorine dioxide is more stable at 3000PPM, so for more accurate result should prepare at 5000 PPM. The chlorine dioxide has 250% more oxidizing property as compared to chlorine, hydrogen peroxide and ozone. Chlorine dioxide remains stable and does not ionize in solution between pH 2 and 10. The chlorine dioxide is typical operating conditions and yields for this method of generation are shown below:

(1) $Cl_2 + H_2O \rightarrow HOCl + HCl$

(2) $2NaClO_2 + HOCl + HCl \rightarrow 2ClO_2 + H_2O + 2NaCl$

Net: $2ClO_2 + 2NaCl \rightarrow 2NaClO_2 + Cl_2$.

III. ADVANTAGES AND DISADVANTAGES OF ADVANCED OXIDATION PROCESSES (AOP'S)

Advantages of AOP's –

1. Constant process experiment.
2. No disposal of solids waste (compared with AC sorption or membrane filtration).
3. Some heavy metals can also be removed in forms of precipitated M (OH) x

Disadvantages of AOP'S:

1. High operation cost due to chemicals and energy input.
2. Skilled expert are required for the design and operation.
3. More searches are required on technology.

IV. CONCLUSION

From the study of above four methods, chlorine dioxide as an oxidant gives better quality result of water as compared to other methods for domestic wastewater treatment; also it has longer time of disinfection and oxidation property and also more solubility in water. Chlorine dioxide has adjusted the pH value during entire treatment of wastewater.

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