Reduction of COD and BOD of synthetic water by Using Advance Oxidation Process (UV/H₂O₂)

Beenu Boudh¹, Prof. Nitin Kumar Verma²

¹M. Tech Scholar, Department of Chemical Engineering, Madhav Institute of Technology and Science, Gwalior, INDIA
²Assistant Professor, Department of Chemical Engineering, Madhav Institute of Technology and Science, Gwalior, INDIA

ABSTRACT

In present study, reduction of phenol by advanced oxidation process such as UV/H₂O₂. Many factors influence the oxidation process such as the pH value, contact time and the amount of hydrogen peroxide. The maximum chemical oxygen demand (COD) and biological oxygen demand (BOD) range from 80~533 mg/l and 15~50mg/l were achieved after treatment at phenol concentration 20, 30, 40 and 50 mg/l with 2, 4, 6 and 7 ml of H₂O₂ dosage and contact time 10, 20, 30, 40, and 50 min. The Maximum reduction in COD and BOD were 79.1% and 68%, respectively was achieved by UV/H₂O₂ process.

Keywords— Advance Oxidation Process, UV/ H₂O₂, phenol, H₂O₂, COD and BOD

I. INTRODUCTION

For all living beings, the environment is important. Each and everybody is affected by environmental issues like global warming, depletion of the ozone layer, dwindling forest, energy resources, loss of global biodiversity, etc. Environment study deals with the analysis of the degradation process in water, air, land, soil and organisms which leads to pollution.

Advanced oxidation processes (AOPs), involving various phase systems, are under active investigations. These processes make use of visible light or ultraviolet, different catalysts (TiO₂) and oxidants (oxygen, hydrogen peroxide and ozone) are used to prepare highly reactive radicals (HO·) for the degradation of aqueous pollutants into innocuous mixture [1]. Various pollutants, and dyestuff used in industries such as textile, paper or even food products poses a threat to the environment. During their processing, some are discharged in textile effluents, causing problems to the aquatic environment (absorption and reflection of sunlight, toxicity) [2], [3], [4]. Advanced oxidation processes, although making use of different reacting systems. These attributes to same chemical aspects, i.e. production of OH radicals. They are also characterized by a limited selectivity of being attack which is a useful attribute for an oxidant used in wastewater treatment and for solving decomposition problems. The AOP effect is also increased by the fact that they offer different possible ways for OH radicals’ production, thus allowing a better compliance with the specific treatment required [5]. Most of the studies have focused on decolorization, degradation mechanisms, and mineralization reactions in dye- ozone reactions, and few have reported the relationship between ozone-substrate and the stoichiometry of the degradation reaction during ozonation process. Advanced oxidation processes (AOPs) are alternative methods for decolorizing and reducing recalcitrant wastewater loads from textile companies. AOPs are based on the generation of hydroxyl radicals in water, which are highly reactive and non-selective oxidants that can oxidize organic compounds. Accordingly, the ozone-based systems are feasible for decolorizing azo dyes [6]. The advantages of this process are, among others, that no additional disposal problems are involved after treatment because the organic contaminants in the water are almost completely destroyed while removing the color. On the other hand, the use of ultraviolet (UV) light to degrade and destroy organic pollutants within textile wastewater could be a source of toxic dioxin and dioxin-like compound [7] In 1987 the Advance oxidation process was established by Glage and co-worker. After reviewing several research papers, I have concluded that advanced oxidation process is basically not a very new treatment method. Advanced Oxidation Process is general chemical processes which are used for treatment of water and wastewater by oxidation of hydroxyl radical (OH) in sufficient quantity for the
treatment of water. These hydroxyls radical react very rapidly with most organic compound because this hydroxyl radical is powerful and non selective chemical oxidant [8, 9]. The Advance oxidation process may achieve the overall efficiency of compound in some cases. The Advance Oxidation Process may be used as pre/ post treatment for the biological system [10]. After pre treatment of the biological contaminate residue left can be removed from the post treatment process [11]. This technique is used for the treatment of effluent and other waste material released from the industry. Photo catalysis is one of the techniques for the water and wastewater treatment which are called the “Advance oxidation process”. The advance oxidation processes mainly work with the UV lamp or solar radiation [12].

Biological Oxygen Demand (BOD) is a measure of the oxygen used by microorganisms to decompose this waste. Chemical Oxygen Demand (COD) is the amount of oxygen consumed by the organic compounds and inorganic matter which were oxidized in water [13].

The word “phenol” which is the part of water pollution and in which include the phenol, C₆H₅OH, and all derivative and it is released from the industry. Phenol is a weak acid, which is rapidly soluble in water and it is also called the carbolic acid, is an aromatic organic compound [14].

II. MATERIAL AND METHOD

- **Material:**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Material used</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Phenol</td>
<td>99.9 % purity</td>
</tr>
<tr>
<td>02</td>
<td>UV Bulb</td>
<td>9 Watt</td>
</tr>
<tr>
<td>03</td>
<td>H₂O₂</td>
<td>1.132 Specific gravity</td>
</tr>
<tr>
<td>04</td>
<td>Double distilled water</td>
<td>Chem. Lab India, Gwalior</td>
</tr>
<tr>
<td>05</td>
<td>Dosing pump</td>
<td>165-230 Volt/50Hz</td>
</tr>
<tr>
<td>06</td>
<td>Digital balance</td>
<td>AC-1-ph-Wire Static Meter</td>
</tr>
</tbody>
</table>

- **Preparation of solution:**

  In our experimental study with advance oxidation process (UV/H₂O₂). The solutions were prepared by dissolving the phenol in distilled water with appropriate volume of phenol. It was used 3 liter distilled water, previously homogenized and conditioned to room temperature. Then it was added the phenol compound 60 mg during the first 10 min of the beginning of the reaction and the volume of H₂O₂ 6 ml were added after 10 min.

- **Experimental setup and method:**

  All experiments were performed in the batch reactor with UV/ H₂O₂ process at ambient temperature. In this study experimental setup used is shown in fig.1. In an annular glass photo reactor, photoreactions were carried out. The reactor was cylindrical, made of quartz glass which was available for the transfer of reaction. A low pressure UV lamp with monochromatic radiation at 254 nm and a nominal power of 9 W which was immersed in the glass reactor was used. The Outside wall of the reactor was covered with aluminum foil which improves the filtration efficiency of reaction mixture. The reaction mixture was filled into the reaction chamber. The reaction mixture located between the UV lamp and the reactor walls. The feed solution of phenol mixed by needed volume of H₂O₂ is continuously re-circulated through the reactor by using a dosing pump. The samples were withdrawn at different time intervals for estimations of phenol.

III. RESULT AND DISCUSSION

From our experiment we collect the sample of water after reduction of phenol for determining the COD and BOD range after treatment.

**Effect on COD of phenol reduction:**

From the fig.2 the COD of sample continuously decrease with irradiation time at different levels of phenol concentration by UV/H₂O₂ process. The total reduction of COD was achieved during the process at 20 to 50 mg/l phenol concentration ranging from 80–533 mg/l. The result of this study, the organic and the inorganic presence in water is low because the COD is continuously decreasing.
Effect on BOD of phenol reduction:
From the fig.3 the BOD of sample continuously decreases with irradiation time at different levels of phenol concentration by UV/H₂O₂ process. The maximum reduction of BOD was achieved during the process at 20 mg/l phenol concentration ranging from 50~15 mg/l. The result of the study that oxygen demands is also decreased with continuously decreasing the BOD in water.

IV. CONCLUSION
We conclude from the study that the BOD and COD of water continuously decrease with irradiation time and different level of phenol concentration by UV/H₂O₂ process. In the present work, we can see that that is decrease in BOD with time at different concentration of phenol from which we can also conclude that oxygen demand in water also decreases. The COD reduction concluded the organic and inorganic demand in water is also reduced.

REFERENCES
[8] Marina Trapido “Ozone based Advance Oxidation Process” Department of chemical engineering, Tallinn University of Technology, Ehitajate tee, 5, 19086
[10] Alessandra Cesaro, Vincenzo Naddeo and Vincenzo Belgiono “Waste water treatment by combination of Advaned Oxidation process and conventional Biological system” J. Bioremed Bideg 2013, 4, 8-10000208