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A REVIEW ON ADVANCED OXIDATION METHOD FOR WASTE WATER TREATMENT

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ABSTRACT

Wastewater treatment for domestic and industrial effluent can be carried out by various physical, chemical and biological treatment methods. For removal of various organic and inorganic pollutants various advanced methods are used with good effect. Organic matter present in the wastewater reduces its dissolved oxygen content. This water if disposed to water reservoirs, can be harmful to aquatic life. Reduction of organic matter and other pollutants by using advanced oxidation method can be carried out by using various oxidizing agents including hydrogen peroxide and Fenton's reagent. Also advanced oxidation can be coupled with other methods for better treatment. The present review summarizes the research and studies carried out for wastewater treatment by using advanced oxidation methods.

I. INTRODUCTION

Industrial and domestic effluent is normally treated by physical, biological and chemical treatment methods. The wastewater is characterized by properties like chemical oxygen demand(COD), biological oxygen demand(BOD), dissolved oxygen, dissolved solids, pH, colour, hardness and turbidity. The ratio of COD to BOD helps in deciding the treatment method. If BOD values are high, then biological treatment method can be adopted. Removal of organic matter can be carried out by various physical, chemical and biological methods[1,2,3,4,5]. Removal of organic matter by using biological methods like activated sludge process, aeration, rotating biological contactors, anaerobic and aerobic reactors and trickling filters was observed to be effective alternative[5,6,7,8]. Adsorption technique was effective for removal of organic matter by using various low cost adsorbents[9,10,11,12]. Other major concern is heavy metals in effluent from industrial wastewater. Heavy metals were also removal successfully by adsorption by various investigators[13,14,15,16]. The advance methods like various membrane separation were also found to be promising[17,18,19,20]. The use of advance oxidation methods is also widely studied area. Various oxidizing agents can be used for treatment of wastewater. This method can be couple with other techniques for more effective treatment of wastewater. The present review summarizes the studies and research carried out for treatment of wastewater by using advance oxidation methods.

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II. RESEARCH ON ADVANCED OXIDATION METHOD FOR WASTEWATER TREATMENT

Kosogina et.al. investigated the chemical oxidation method for dye removal from wastewater[21].They carried out treatment of the textile effluent from factories of Ukraine polluted by the colouring agent. They were able to remove 98 percent colour by using the method. Fenton reagent was used for oxidation of colouring agent. Priyambodo et.al. investigated the treatment of wastewater by using semi batch Fenton reagent method(EF)[22]. They treated the samples with total organic content(TOC) and chemical oxygen demand(COD) of 16500 and 24000 mg/l respectively. Also photo electro-Fenton method was tried by them. They achieved 98-99 percent TOC removal during their investigation. The combination of electricity and UV irradiation was excellent process for wastewater treatment. Kumar et.al. used titanium dioxide photo catalysis for wastewater treatment[23]. They treated pulp and paper wastewater. Almost all the electron reach organic compounds are degraded by TiO_2 photo catalysis. Up to the TIO_2 dose of 0.75 g/l, the degradation increased. Further it became constant and then decreases. The degradation rate was very fast in first 1 hour and then it became slower. TiO_2 dose of 0.75 g/L and reaction time of 4 h were optimum conditions for treatment. An investigation was carried out by Torres-Sánchez et.al. on electrochemical treatment of dairy industry wastewater coupled with advanced oxidation technique[24].They treated ice scream manufacturing plant wastewater for their research. This wastewater is characterized by high biochemical oxygen demand (BOD_5), chemical oxygen demand (COD). They investigated the effect of the parameters like applied current density (j), reaction time, hydrogen peroxide (H_2O_2), iron (Fe^{2+}) and ozone dosage on the treatment efficiency. They observed the increase in the efficiency of the coagulation by about 25 percent on the use of Fenton reagent. Ozone system added to another 30% COD removal. Chittala et.al. reported the research on an advanced oxidation process for the reduction of sulphate in pharmaceutical effluent[25]. Chemo autotrophic activated carbon oxidation technology was used by them for the wastewater treatment. Chemo Autotrophic Activated Carbon Oxidation (CAACO) Reactor was the main building block of their treatment plant. They obtained 64 percent COD removal in the pilot plant. The BOD removal was 86 percent. During the treatment 52 percent sulphate was also removed. They concluded that the resin of the CAACO reactor was more efficient in reduction of sulphates than the conventional methods. Pavelescu et.al. investigated the treatment of partially treated sewage generated by a medium-sized city and partially treated industrial wastewater mostly petroleum refinery wastewater[26]. They used TiO_2 catalyst, for different exposure periods. They observed that with increase in TiO_2 catalyst from 0.25 mg/ ml to 1 mg /ml, an increase of UV280 removal for the sewage wastewater was slightly higher compared to the industrial sample. They made an important observation that fluorescence spectra indicated higher percent removal for the industrial sample, of about 90%, compared with the sewage one, of only 30%. Singh et.al. carried out review on performance of advanced photo catalytic detoxification of municipal wastewater under solar radiation[27]. According to them, the purification and disinfection of municipal wastewater can be carried out very effectively by this technique. It was also found that the photo-Fenton experiments were considerably faster than those with TiO_2. According to Al-Rekabi the advanced processes for wastewater treatment can be divided into three categories[28]. These categories are, tertiary treatments, physico chemical and combined biological physical treatments. On the basis of desired treatment goals , these can be classified based on the treatment objective and goal like, additional

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organic and suspended solids removal , removal of nitrogenous oxygen demand(NOD) , nutrient removal. They discussed the treatment methods with hydrogen peroxide and Fenton reagent. James et.al. carried out studies on micro pollutant removal by advanced oxidation of micro filtered secondary effluent for water reuse[29]. They used an advanced oxidation process (AOP) based on UV irradiation combined with hydrogen peroxide (UV/H_2O_2). It was observed that AOP achieved significant removal (>99%)of N-nitrosodimethylamine (NDMA) and endocrine disrupting compounds (EDCs) for all waters. Petrovic et.al. carried out elimination of pharmaceuticals by using advanced oxidation processes (AOPs) for wastewater and drinking water[30]. Pharmaceutically active compounds (PHACs) from urban, hospital and industrial wastewaters are cause of health concern. They summarized the research on two commonly used methods, applied advanced oxidation processes (AOPs), namely TiO_2 assisted photo catalysis and photo-Fenton process. An investigation was carried out on residual non-steroidal anti-inflammatory pharmaceuticals removal by advanced process by Feng and Feng[31]. They investigated removal of ketoprofen, naproxen and piroxicam. According to them application of typical advanced oxidation process would become technically and economically difficult or even impossible once the environmentally dangerous persistent organic pollutants are diluted in large volumes. The EAOPs, overcoming the usual reluctance to electrochemistry approach, could be applied as a plausible and reliable alternative promising method. Basics of heterogeneous photo catalysis, mainly on TiO_2 were described by Al-Rasheed[32]. According to him photo catalysis has large capability for the water treatment. Natural organic matter (humic substances) can also be decomposed by these methods.

III. CONCLUSION

Advanced oxidation methods are very effective alternative for treatment of wastewater. Various oxidizing agent like hydrogen peroxide, Fenton reagents and TiO_2 catalyst can be used for effective treatment of wastewater. The advanced oxidation methods were found to be very effective when used with other treatment methods. Electro Fenton and Photo Electro Fenton methods were used successfully for wastewater treatment. Advanced oxidation $UV-H_2O_2$ process for micro pollutant (MP) removal was also effective. It can be concluded that proper choice of treatment method and suitable combination of treatment methods can make the wastewater treatment more economical, effective and acceptable.

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