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Review Article

ADVANCED OXIDATION PROCESSES FOR THE TREATMENT OF WASTE WATER OF TEXTILE INDUSTRY

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ABSTRACT
Due to increase in restrictive effluent quality by several water authorities, the traditional textile wastewater treatment processes have now become a challenge for researchers and engineers working in the field of environmental and textile industries. The methods which were used earlier for the treatment of wastewater such as biological treatment discharges are not tolerated because of their poor results as 50% of 85 colours had already been identified as non-biodegradable. Thus, the techniques used by different researchers known as advanced oxidation processes are reviewed in details in the present paper for the benefit of society by comparing the efficiencies of various types of AOPs in terms of their wastewater treatment.

***Keywords**: Waste Water Treatment; Textile Industry*

INTRODUCTION
Industrial effluent composed of many types of organic compounds. The compound so found may cause several kinds of problems at the time of treatment of waste water. This is because they show resistance to biodegradation as well as have toxic effects on microbial processes. Due to these problems alternative treatment technologies are required by the industries so that the refractory molecules can be transformed into biodegradable molecules. Of all the novel methods advanced oxidation processes (AOPs) are most commonly used by the engineers for the treatment of wastewater containing recalcitrant organic compounds. Therefore the waste water is a great challenge for textile industry due to its liquid form and presence of harmful chemicals (Venceslau et al., 1994).The pollutants of textile effluent comes from dyes used in the processing of raw material. The processes required for preparing textile materials need a range of chemicals. The chemicals as well as dyestuffs used are generally organic compounds. The final product do not contains the compounds hence they become totally wasted. Major part of the pollutants in the wastewaters composed of highly suspended solids, COD, heat, dye colours, acidity, and other solubilised materials (Dae-Hee et al., 1999). The textile industries and dyestuff manufacturing industries face big problems in the removal of colour present in the wastewaters .the total number of dyestuff are 87 and unfortunately 47% can be degraded (Pagga and Brown, 1986). It was observed that remaining colours found in waste water are generally due to the presence of insoluble dyes. The dyes present in wastewater have low biodegradability (Marmagne and Coste, 1996). Methods used earlier face difficulty in the oxidation of dyestuffs and complex structure of organic compounds at low concentration. Therefore advanced oxidation processes (AOP S) have been developed to resolve these problems. AOP'S processes basically composed of combination of ozone (O_3), hydrogen peroxide (H_2O_2) and UV irradiation. These kinds of methods have great efficiency for treatment of textile wastewater. The oxidants so used can effectively decolorized dyes but they could not remove the content of COD completely (Ahmet et al., 2003; Lidia et al., 2001; Stanislaw et al., 2001; Tzitzi et al., 1994).

Various Characteristics of Textile Wastewater
The waste water or effluent of textile industry basically composed of three components: - COD- Chemical oxygen demand, BOD- Biological oxygen demand, DS- Dissolved solids and SS- Suspended solids.

Table 1: Textile Industry Wastewater Characteristics

Parameters	Values
pH	7.0-9.0
BOD (mg/L)	80 – 6,000
COD (mg/L)	150 – 12,000
TSS (mg/L)	15 – 8,000
TDS (mg/L)	2,900 -3,100
Chloride (mg/L)	1000 – 1600
Total Kjeldahl Nitrogen (mg/L	70-80
Colour (Pt-Co)	50-2500

Advanced Oxidation Process (AOPS)

The earlier conventional oxidants cannot oxidize the compounds present in the waste water of textile industry. The basic function of AOPs is to generate and use hydroxyl free radical (HO) to destroy these compounds. Advanced oxidation processes produce and use OH• radicals and which attack the compound to be oxidised. The AOPs also offer a number of ways for OH• radicals. The generation of HO· can also be accelerated by simply combining these compounds like O_3 , H_2 O_2 , TiO_2 and UV radiation, electron-beam irradiation and ultrasound can also be used.A combination of H_2 O_2 /UV, O_3 / H_2 $o_{2,}$ O_3 /UV gernerally are used.

Applications of Different Types of AOPs in Waste Water Treatment

Use of O3/UV

Generally, as we know organic compounds (traditional ozonation) are unable to completely oxidize organic compounds into Carbondioxide and water. Even after oxidation certain intermediate products remain in the solution which may be toxic. UV radiation oxidizes the intermediate toxic compounds easily. For this, maximum radiation output of UV lamp in terms of efficiency must be 254 nm. The use of UV photons in O_3 /UV process is to activate ozone molecules, which stimulates the formation of hydroxyl radicals. Particularly, in UV illumination of TiO_2, initially conduction band electrons (ecb) and valence band holes (vbh) are yielded as shown in equation 1. Also the interaction of surface adsorbed molecular oxygen with band electrons gives superoxide radical anions which is given by equation 2, while the interaction of band holes with H_2O to produce HO• (hydroxyl radical) as given in equation 3 (Crittenden et al., 2005)

$TiO_2 + h\nu \rightarrow e_{cb} + h^+$ (1)

$e_{cb} + O_2 \rightarrow O_2^{-}\bullet$ (2)

$h^+ + H\ 2\ O \rightarrow H^+ + HO\bullet$ (3)

Use of Ultraviolet Lamp

The Ultraviolet lamp of wavelength of 254 nm with low-pressure is generally used. The ozone molecules should be absobed at 253.7 nm. A medium-pressure mercury lamp wrapped in a quartz sleeve is used as the light source which can generate the UV light at wavelength of 200-280 (Zhou and Smith, 2002). UV lamp has been applied by StanisLaw and Monika (1999) for the treatment of textile wastewater. Their process involves the use of two different UV radiations; 150W, Wavelength, 254-578 nm and 15W, wavelength, 254 nm, and time duration of 1 to 3 hrs to the synthetic textile wastewater. There was a significant reduction in microbial inhibitory action for optimum radiation time of 1 hour.

Hydrogen peroxide/UV light process

In this process Hydrogen peroxide/UV light is used which includes H_2 O_2 injection. This mixing is followed by a reactor that is equipped with UV light (200 to 280 nm). The O-O bond in hydrogen peroxide is break during this process which is done by the action of ultraviolet radiation the hydroxyl radical is generated in this process. (Buxton et al., 1988). hydrogen peroxide alone oxidized textile wastewater ineffectively. But when a combination of UV irradiation H_2 O_2 is used, the H_2 O_2 gets photolyzed and form two hydroxyl radicals (2OH•). The radicals so formed react with organic contaminants present in the wastewater (Crittenden et al., 1999). There is also reduction in microbial inhibitory growth from 47 to 26% (Stanislaw and Monika, 1999; Stanislaw; et al., 2001) when UV radiation/2ml H_2O_2 is applied to synthetic textile wastewater treatment. The duration of exposure was 1 hour.

Conclusion

The application of Advanced Oxidation Processes for the treatment of effluent of textile industry is very efficient especially in a combination of ozone, hydrogen peroxide and UV radiation. Different types of AOP techniques have been developed for the treatment of textile wastewater which also allows the choice of technique to be used.

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