Jr. of Industrial Pollution Control 31(1)(2015) pp 73-76
© EM International
Printed in India. All rights reserved
www.envirobiotechjournals.com

INNOVATIVE METHOD FOR DECOLOURATION OF TEXTILE INDUSTRY EFFLUENT

RUPALI SHRIVASTAVA

Department of Chemistry, Rajdhani Engineering College, Jaipur, Rajasthan, India.

(Received 5 October, 2014; accepted 20 Novermber, 2014)

Key words: Photoreduction, Titanium oxide, Textile effluent

ABSTRACT

Textile industries are major source of effluents due to their operations. Released colored organic compounds in effluent contaminate the water and are source of non-aesthetic pollution and eutrophication. In the present paper an innovative method is reported for the decolouration of dyes in textile effluent using photoreduction in presence of solar radiation. Commercial samples of different azo and cremazole textile dyes commonly used in textile industries of Sanaganer region in Rajasthan were used for method development. Photocatalytic activity of titanium dioxide, zinc oxide and manganese oxide was studied in presence of sunlight on commercial dye samples namely Violet, Congo Red, Blue S_1 and Orange 3R. The results show that decoloration efficiency of TiO_2 is many fold higher than ZnO and MnO. The process shows a significance enhancement when it is carried out at optimum concentration of reducing agent and appropriate time for solar irradiation. 89% Colour removal from effluent was reached at 96 Hrs operating time.

INTRODUCTION

Textile dyes and other industrial dye stuffs constitute one of the largest group of organic compound that represent an increasing environmental danger. About 1-20 % of the total world production of dyes is lost during the dying process and is released in the textile effluent. Textile industry effluents are mostly discharged into the environment after minimal pretreatment with a high amount of pollutants. The release of these coloured waste waters in the environment is a considerable source of non esthetic pollution and eutrophication and can originate dangerous by products through oxidation, hydrolysis and other chemical reactions taking place in the waste water phase. Azo dyes which constitute the largest and most important class of commercial dyes used in textile industries have a serious environmental impact, because their precursors and degradation products are highly carcinogenic.

The main challenge for the textile industry today is modify production methods, so they are more ecologically friendly at a competitive price, by using safer dyes and chemicals and by reducing cost of effluent treatment/ disposal. Many different and complicated molecular structures of dyes make dye

***Corresponding author's email:** rupaliargal@rediffmail.com

wastewater difficult to be treated by conventional biological and physicochemical process. Therefore, innovative treatment technologies need to be investigated.

The decolouratisation of dye waste water using photoreduction technique involving metal oxides and solar radiation is the subject of this research paper. Titanium Oxides, Manganese Oxide, Zinc Oxide were used in comparison to conventional methods for removing organic species in the environment because the process gradually breaks down the contaminant molecule, no residue of the original material remains and therefore no sludge requiring disposal to landfill is produced. The catalyst itself is unchanged during the process. Additionally microamounts of reagent are sufficient to carry out the process. Due to these advantages the process result in considerable saving in the water production cost and keeping the environment clean.

EXPERIMENTAL

For the present study of assessment of water quality, Sanganer industrial area, Jaipur, Rajasthan state was selected (longitude $95^0$24 E; latitude $27^0$18 N). This area is principally involved in manufacturing and trade of textile products principally cotton for more than 50 years. The area lack proper drainage system and as a result of this, all the industrial waste water effluents are drained into the Amanisha canal which effects the near by irrigation agricultural products and the quality of ground water. Water samples from these areas were collected and designated S1-S_4. Samples were collected from the source point outlet of finishing unit at Sanganer industrial estate (S_1), 100 m away from source point(S_2), 200m away from source point (S_3/) and 400m away from source point (S_5). Standard procedure (spot sampling) were followed during sampling. All the samples of the effluent were collected in sterile, dry and properly stopper polypropylene bottles. Study of treatment of textile effluent by application of photoreduction was carried out using UV-Visible double beam spectrophotometer. TiO_2 $P_2$5 70% , MnO and ZnO were taken of AR grade. Dyes as direct dyes Violet and Congo Red and cremazoles- Orange 3R and Blue S1 were used as dying agent at random basis from local Sanganer textile industry. Dye solutions were prepared by dissolving 10mg dye powder in 100ml of distilled water. λmax of individual dyes were determined in the range of wavelength from 300 nm to 750 nm, the results are shown in Table 1.

Table 1. λmax of individual dyes

Dye	λ max.
Violet dye	545 nm
Congo red	495nm
Blue S^1	570nm
Orange 3R	490nm

RESULTS AND DISCUSSION

One mL of each of the photocatalyst (TiO_2, ZnO, MnO) were separately introduced in 25mL of standard dye sample and were kept for photoreduction at room temperature in visible radiation. The graphs 1-4 , represent the colour degradation of commercial dyes namely violet, congo red, blue S_1 and orange 3R with respect to time with all the three types of photocatalyst titanium oxide, zinc oxide and manganese oxide.

It was found that 96 hrs duration is appropriate time for decolouration. The result also show that TiO_2 is more efficient for maximum decolouration .

Based on the above study different concentrations of TiO_2 were used for the treatment of textile industry effluents samples S_1-S_4. For this 25 mL of 10 times diluted samples were mixed with 0.2 mL, 0.4 mL, 0.6 mL, 0.8 mL, 1.0 mL and 1.2 mL of 0.02M TiO_2 solution. Samples were kept in sunlight for photoreduction for 96 hrs. Results of photoreduction using different concentration of TiO_2 photocatalyst with all the four industrial samples can be seen in graph 5-8.

Results show that 88% decrease in colour intensity was observed in 96 hours and at 1.0mL of 0.02M concentration of titanium oxide. Thus titanium oxide can be successfully applied for colour removal of textile effluent by photoreduction in presence of visible light at room temperature. By application of this method textile industry effluent can be made less harmful.

CONCLUSION

In this research paper a method has been developed for remediation of five different samples collected from source to sink of textile industry effluent using photoreduction. Photocatalytic activity of TiO_2, ZnO, MnO was studied on four different commercial dye samples namely Violet, Congo red, Blue S1 and Orange 3R for method development. Results show that remediation was maximum with TiO_2. Further studies were carried out using various concentration of TiO_2 and it was found that 1.0mL TiO_2 in 25 mL effluent sample

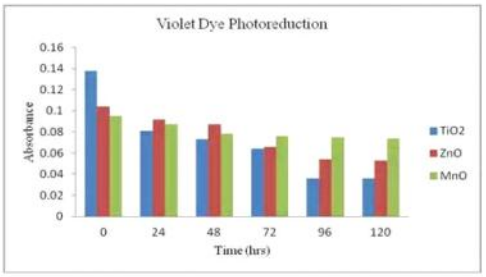

Fig. 1 Violet Dye Photoreduction

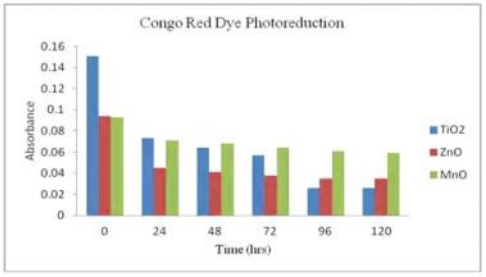

Fig. 2 Congo Red Dye Photoreduction

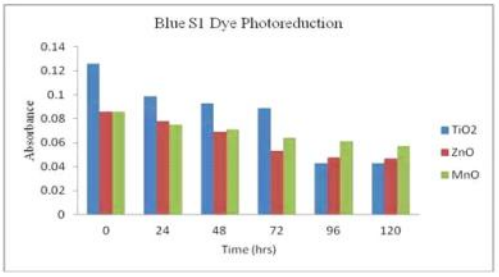

Fig. 3 Blue S1 Dye Photoreduction

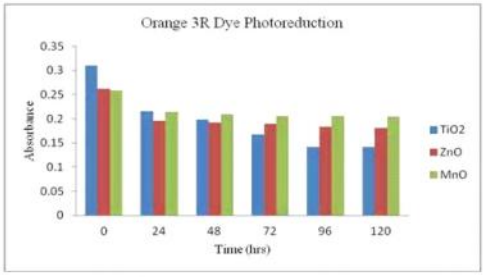

Fig. 4 Orange 3R Dye Photoreduction

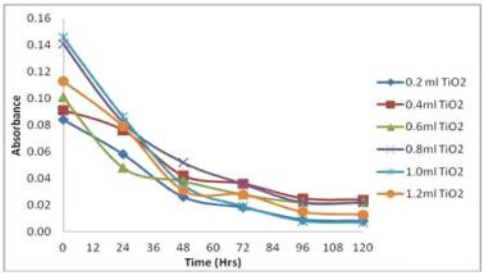

Fig. 5 S_1 Photoreduction using Titanium Oxide

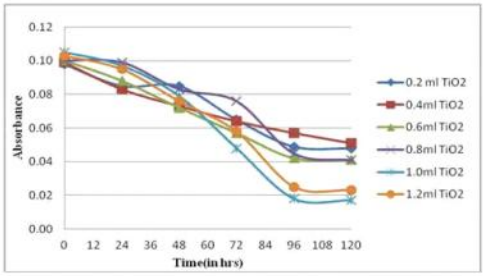

Fig. 6 S_2 Photoreduction using Titanium Oxide

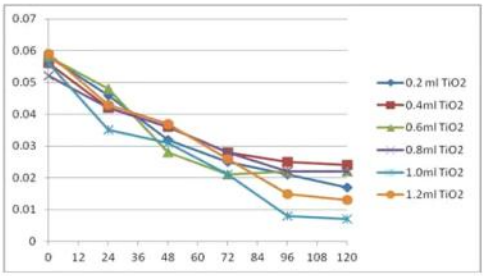

Fig. 7 S_3 Photoreduction using Titanium Oxide

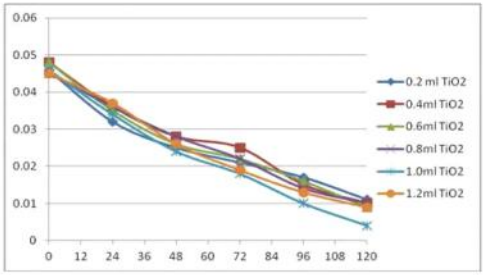

Fig. 8 S_4 Photoreduction using Titanium Oxide

and 96 hours was most effective for photoreduction. The developed method show that TiO_2 have great potential in photoreduction of dyes in effluents and was applied commercially in treatment of textile effluent.

REFERENCES

Bekbolet, M. and Ozkosemen, G. 1996. A preliminary investigation on the photocatalytic degradation of a model humic acid. *Journal of Water Science and Technology*. 33 : 189-194.

Linsebigler, A.L. and Lu, G. Yates, 1995. Photocatalysis on surfaces: Principles, mechanisms, and selected results. *Journal of Chemical Reviews*. 95 : 735-758.

Minero, C., Maurino, V. and Pelizzetti, E. 1997. Photocatalytic transformations of hydrocarbons at the sea water/air interface under solar radiation. *Journal of Marine Chemistry*. 58 : 361-372.

Ohno, T., Sarukawa, K., Tokieda, K. and Matsumura, M. 2001. Morphology of a TiO_2 photocatalyst (Degussa, P-25) consisting of anatase and rutile crystalline phases. *Journal of Catalysis*. 20 : 82-86.

Ollis, D.F., Pelizzetti, E. and Serpone, N. 1991. Photocatalyzed destruction of water contaminants. *Journal of Environmental Science and Technology*. 25: 1522-1529.

Walhman, A. 2000. The theory of dying(and the secrete of life). *Journal Soc. Dyers Color*. 116 : 140-143.

Yosuff, R.O. and Sonibare, J.A. 2004. Characterization of textile industries' effluents in Kaduka, Nigeria and pollution implications. *The international Journal of Environmental science and Engg*. 12 : 212-221.