INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE AND TECHNOLOGY
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www.vmsindia.org

Photocatalytic Decolorization Of Industrial Waste Water Using Zinc Oxide Nano-Photocatalyst

P. K. Rahangdale
Bhawabhuti College, Amgaon- 441902, India
Email: pralhadrahangdale@gmail.com; Contact: +91 9881010726

Abstract
This research article represents photodegradation of dye pollutants present in the effluent (wastewater) collected from Morarjee Textile Industry, Butibori, Nagpur under visible irradiation using Zinc Oxide as a nanophotocatalyst. Photodegradation studies were performed employing spectrophometric measurements at λmax equal to 480 nm. The photodegradation rate was found to increase linearly with irradiation time. Maximum (88%) decolorization of colored wastewater sample was achieved after irradiation for 2 hours at 35^{0}C as minimal optimum temperature. The optimum catalytic dose was determined to be 50mg/l. Thus the self prepared nanophotocatalytic material under investigation reported in the present research paper has potential applications in the field of environmental/industrial pollution control.

Keywords: Photocatalytic degradation, Zinc oxide, Visible irradiation, Wastewater treatment, Industrial pollution control.

Introduction

Water contamination amputation of organic dyes in the effluents of textile plants is of immense environmental concern due to the potentially toxic effects of even relatively small amount of dye pollutants and other colored compounds[1]. Semiconductors are used to degrade hazardous organic pollutants present in water to less harmful materials[2]. Environmental pollution control studies which are being carried out across the globe indicate the prominent focus on the newer/easier methods for decolorization of textile wastewater. The importance of these types of researches is being increasing in the recent years and has become a subject of major public health concern/scientific interest. Grzechulska and Morawski[3] were of the opinion that the removal of color causing materials from wastewater is often more important than the removal of other organic chemicals. Decolorization of effluent from textile dyeing and finishing industries has been achieved much important because of aesthetic and environmental concerns[4]. A few important photocatalytic applications of Zinc Oxide have been quoted in the literature, which include photodegradation of various pollutants[5 -11], killing of bacteria [12] and killing of tumor cell in cancer treatments[13]. The overall benefit of investigations in the field of inventions towards newer/easier methods for decolorization of textile industrial wastewater lies in the concept of saving/recycling of a huge amount of water, because textile industries are regarded as consumer of huge amount of chemicals as well as water[14]. The treated water may be recycled in the same factory or may be reused in various other fields including agriculture. Abbas J. Attia, Salih H. Kadhim and Falah H. Hussein have studied photocatalytic decolorization of textile wastewater of Hilla Textile Factory (Iraq), using TiO_2 as photocatalyst under UV irradiation[15]. It has been considered to be very excellent means for saving huge amount of water, especially, in the countries which are suffering from water dearth. The present work reports an investigation on photocatalytic decolorization of textile wastewater of Morarjee textile factory, using self prepared ZnO as nanophotocatalyst by irradiation with visible light at varying temperature condition.

Experimental

Initially Zinc Oxide, the nanophotocatalyst, was prepared in laboratory using co-precipitation method followed by its characterization[16]. The photocatalytic degradation study was carried out for self collected textile wastewater. In degradation experiments 5 mg of zinc oxide was suspended in 100 ml of the textile wastewater containing various dyes and placed it in a photoreaction cell. Homogeneity of reaction mixture was maintained by stirring with magnetic stirrer. The photocell was equipped with temperature control system as well as variable source of radiations for desired frequency.

Periodically 2 ml of irradiated samples were withdrawn with the help of micro syringe and centrifuged to separate the solid catalyst and the absorbance of the supernatant liquid was

measured at λmax equal to 480 nm using UV-Visible Spectrophotometer (CE 2371). The absorbance during experiments was compared with a calibration curve. The calibration plot was obtained from known absorbance percentage of colored textile wastewater sample before treatment.

Results and Discussions

Experimental results proved that the textile wastewater generated after dyeing process was effectively decolorized as a result of photocatalytic degradation of various dyes which were present in it by use of self prepared nanophotocatalytic material, that is, zinc oxide. Under optimal conditions, the extent of decolorization was achieved to be 88 % at 35^{0}C. Figure 1 shows that photodegradation of textile industrial wastewater is directly proportional with the time of irradiation.

Conclusion

Zinc Oxide could be potentially used as a powerful nanophotocatalytic material for degradation of dyes present in textile industrial wastewater, where the extent of decolorization was achieved to be 88 % at optimal conditions. 50mg/l nanophotocatalyst dose, 35^{0}C temperature and 2 hours of irradiation/photoreaction time were established as optimal parameters. Thus the self prepared nanophotocatalytic material reported in this research article can be successfully used for industrial/environmental pollution control.

Acknowledgements

Author likes to record deep sense of his gratitude to the Principal and the Director, PG & Research Department of Chemistry, Hislop College Nagpur and the Principal, Shri Shivaji Science College, Nagpur, for allowing the use of their Chemistry Research Laboratories. Author is highly thankful to Mr. Rahul Kurzekar, a research student, for his valuable help during this investigation.

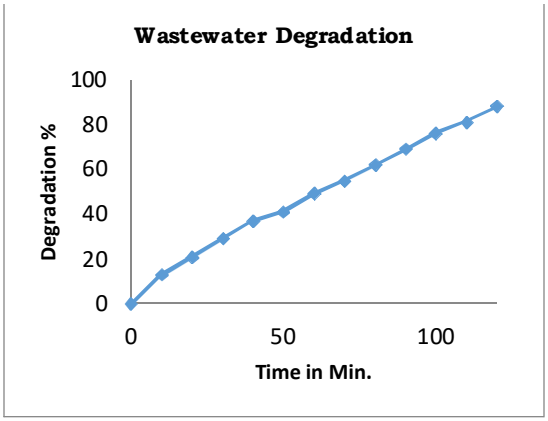

Figure 1. Photocatalytic degradation of textile industrial wastewater on zinc oxide at 35^{0}C

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