International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 7
July 2017

Study of Photocatalytic Degradation of Industrial Effluent Rhodamine B Dye Using Nano Titanium Di Oxide

[1]Rakhi Goyal,[1]D. Kishore
[1]Department of chemistry, Banasthali University, Banasthali (Raj.)

Abstract
Present study deals with the Photocatalytic Degradation of Industrial Effluent Rhodamine B Dye Using Nano Titanium Di Oxide. UV illumination has been used for this purpose. Spectrophotometer has been used to measure the absorbance of the reaction. Control experiments confirm the necessity of light, semiconductor catalyst and oxygen to follow the photocatalytic path to proceed the photo bleaching of dye. Effect of various parameters has been studied over photocatalytic degradation of Rhodamine B. Results reveals that degradation follows the first order kinetics. It has also been observed that parameter like pH and dye concentration effects the degradation.

Keywords
Industrial Effluent, Rhodamine B, Photocatalytic Degradation

Introduction

Today heterogeneous photo- catalysis is a popularly employed process. It is used to eliminate hazardous waste materials especially organic compounds which are degraded to less toxic or less harmful materials [1].Many attempts have been made to study the photocatalytic activity of different semiconductors such as SnO_2, ZrO_2, Fe_2O_3, CdS and ZnO[2-3]. Titanium dioxide (TiO2) is one of functional metal oxide semiconductor that performs high efficiency in photocatalytic activities because of non-toxicity, excellent energy conversion efficiency and long-term chemical stability [4,6]. Rhodamine B represents one of the most important dyes, extensively used in the textile industry due to its high stability. Its release into the environment is dangerous for aquatic life as in many cases; it is carcinogenic and mutagenic for both humans and animals. Thus, decomposition of such organic dyes is significantly important [7-11].

Experimental

In present work stock solution of concentration 1 X 10^{-3} M has been prepared to study the photocatalytic degradation. Spectrophotometer has been used to measure the absorbance of the reaction. Control experiments confirm that both light and semiconductor photocatalyst are necessary for the photodegradation and oxygen increases the rate of photodegradation. To study photocatalytic degradation of Rhodamine B 100 ml stock solution has been taken in flask and TiO_2 nanoparticles have been added to it. The pH of the reaction mixture has been made alkaline by adding NaOH. The mixture has been then irradiated under visible light source (Tungsten lamps). A water filter has been placed between light source and reaction vessel to cut off thermal radiations. Air has been used to purge reaction mixture.

Results and Discussion

The dye solution has been taken after a specific time interval (40 min) and its absorbance has been measured using spectrophotometer at 554 nm after removing TiO_2 . The rate of change in absorbance of the reaction mixture with time has been continuously measured. A plot of (1+ log absorbance) with irradiation time has been shown in Fig 1. It has been observed by fig 1 that the plot between absorbance and time is linear, which indicates the photocatalytic degradation of rhodamine B follows the first order kinetics. Rate constant of photocatalytic degradation of rhodamine B has been calculated and found **6.4×10^{-5} sec^{-1}.**

International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 7
July 2017

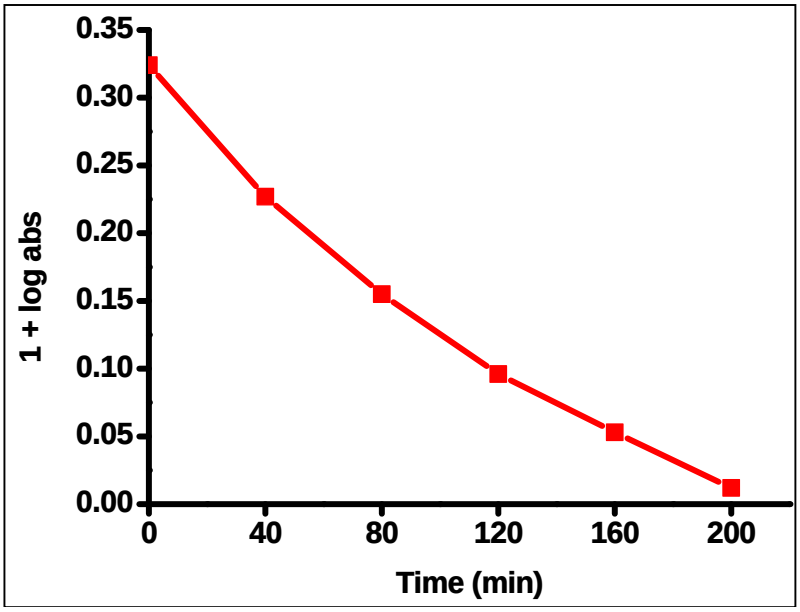

Fig 1: A plot showing typical run of photocatalytic degradation of Rhodamine B

Effect of variation in pH

pH value effects the surface properties of TiO_2 nanoparticles. Attempts have been made to study the influence of pH to the photocatalytic degradation of rhodamine B dye. The pH of the dye solution has been varied using HCl and NaOH solution. Effect of variation in pH to photocatalytic degradation and hence to rate constant has been shown in fig 2.

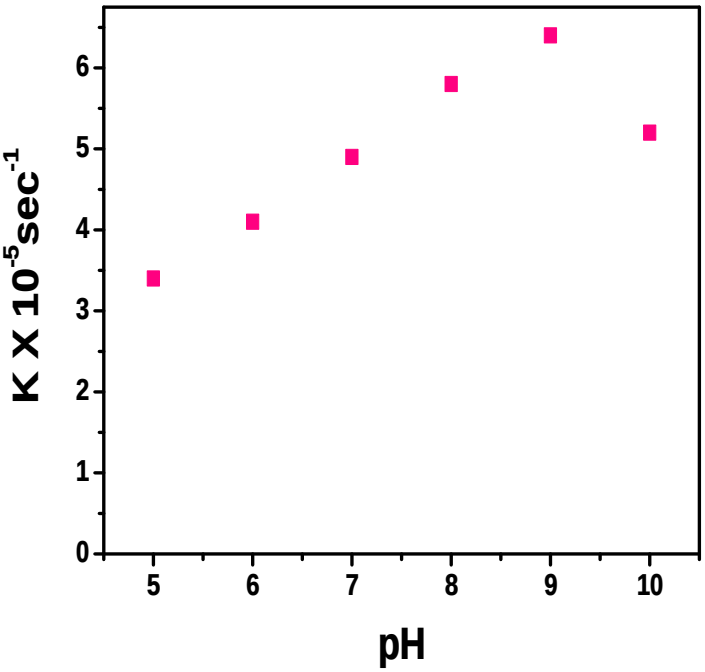

Fig 2: Effect of variation in pH to photocatalytic degradation of Rhodamine B dye

It is evident by fig 2 that rate of degradation increases in pH range 5 to 9. Maximum degradation has been occurred at pH = 9 whereas it decrease after pH = 9. As the pH increases the oxidizing ability of holes of semiconductor increases. Therefore, the photocatalytic degradation of Rhodamine B has become more efficient due to the increase in pH value.

Conclusion

Study of photocatalytic degradation has been carried out using TiO_2 nanoparticles. Kinetic analysis of degradation revels that the degradation follows the first order kinetics. rate constant has been comes out as 6.4 x 10^{-5} sec^{-1}. Results reveals that as the pH value increases the photocatalytic degradation of Rhodamine B has become more efficient.it has also been observed that the increase in the TiO_2 catalyst concentration leads to an increase in the rate constant.

Acknowledgement

Authors are thankful to DST, Govt. of India for supporting Banasthali University.

References

1. Q. I. Rahman , M. Ahmad, S. K. Misra , M. Lohani, Effective photocatalytic degradation of Rhodamine B dye by ZnO nanoparticles, *Materials Letters* 91 (2013) 170–174
2. R. Nagaraja, K. Nagaraju, C.R. Girija , B.M. Nagabhushana, Photocatalytic degradation of Rhodamine B dye under UV/solar light using ZnO nanopowder synthesized by solution combustion route,Powder technology 215-216 (2012)91-97
3. S.Agarwal, S.K.Gupta, Y. K. Saraswat, V.K. Saraswat, Structural and Thermal Study of ZnO filled Polymer Blends, ISROSET- Int. J. Sci. Res. Physics and Applied Sciences 3(1)2015, 9-14
4. W. Mekprasart, W. Pecharapa, Synthesis and characterization of nitrogen-doped TiO2 and its photocatalytic activity enhancement under visible light, *Energy Procedia* 9 (2011) 509 – 514
5. S. Agarwal, V. K. Saraswat, Synthesis and Thermal Characterization of PMMA-TiO2 Nanocomposites *Mat. Sci. Res. India*, 11(2), (2014) 168-172
6. S. Agarwal, Y. K. Saraswat, V.K. Saraswat, Synthesis and Thermal Characterization of Titanium-Dioxide Filled polycarbonate/Polystyrene Blend Nanocomposites Macromol. Symp. 2015, 357, 70–73
7. A. Kunz, P. Peralta-Zamora, S. G. De Moraes, and N. Dur´an, "New tendencies on textile effluent treatment," *Quimica Nova*, 25(1) 78–82, 2002.
8. Q. I. Rahman , M. Ahmad, S. K. Misra , M. Lohani, Effective photocatalytic degradation of Rhodamine B dye by ZnO nanoparticles, *Materials Letters* 91 (2013) 170–174
9. E.E. Baldez, N.F. Robaina, R.J. Cassella. *J. Hazard Mater* 159 (2008)580–586
10. D. Li, H. Zheng, Q. Wang et al., "A novel double-cylindricalshell, photoreactor immobilized with monolayer TiO2-coated silica gel beads for photocatalytic degradation of Rhodamine B and Methyl Orange in aqueous solution," *Separation and Purification Technology*, 123, 130–138, 2014
11. R.Thapa, S. Maiti, T. H. Rana, U. N. Maiti, and K. K. Chattopadhyay, "Anatase TiO2 nanoparticles synthesis via simple hydrothermal route: degradation of orange II, Methyl Orange and Rhodamine B," *Journal of Molecular Catalysis A: Chemical*, 363-364, 223–229, 2012