

الايه

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ
{ رَبِّ اَوْزِعْنِيْ اَنْ اَشْكُرَ نِعْمَتَكَ الَّتِيْ اَنْعَمْتَ
عَلَيَّ وَعَلَىٰ وَالِدَيَّ وَاَنْ اَعْمَلَ صَالِحًا تَرْضَاهُ
وَاَصْلِحْ لِيْ فِيْ ذُرِّيَّتِيْ اِنِّيْ تُبْتُ اِلَيْكَ وَاِنِّيْ مِنَ
الْمُسْلِمِيْنَ }

صدق الله العظيم

[الأحقاف: 15]

Dedication

To my father,

To my mother,

To my brothers,

To my distinguished colleagues and

To my friends

Acknowledgments

I would like to express my special appreciation and thanks to my supervisor Professor Dr. Nafie A. Almuslet for encouraging me and for allowing me to grow as a research scientist. I would also like to thank Dr. Abdu Elftah and Mr. Abdu Alsakhi from Alneelian University for their support. I would like to thank the staff of chemist department from Sudan University for science and technology for their help. I would especially like to thank the staff of laser institute for their support.

Special thanks to my family. Words cannot express how grateful I am to my mother, father and brothers for all of the sacrifices that they made on my behalf. Your prayer for me was what sustained me thus far. I would also like to thank all of my friends who support me in writing, and incited me to reach my goal.

Abstract

In this research different amounts of semiconductor photocatalyst (TiO_2) were added to Rhodamine 6G and the mixture were irradiated by narrow band of wavelengths of Ultra violet light in the range of 270 to 280 nanometers. The UV light has energy of 750 mj. In order to study the effect of TiO_2 , the mixture was irradiated for different exposure time. The reason of different exposure time was to investigate the efficiency of photodegradation of Rhodamine 6G in waste water.

The absorption spectra of Rhodamine 6G with different amounts of catalyst, were recorded and compared before and after irradiation by UV light. The results showed that, the efficiency of the photodegradation process was increased with the amount of semiconductor (TiO_2) and irradiation time as well. The lower percentage of Rhodamine 6G degraation from waste water was 16% when 100 mg of TiO_2 was added and irradiated for 10 min, while the highest percentage of Rhodamine 6G degradation was 82% when 600mg of TiO_2 was added and irradiated for 30 min.

The study concluded that the degradation of Rhodamine 6G is increased with increasing the amount of semiconductor (TiO_2) as well as with increasing the irradiation time.

المستخلص

في هذا البحث تم تشييع مادة الرودامين 6ج لفترات زمنية مختلفة بحزمة ضيقة جدا من الاطوال الموجية من الاشعة الفوق البنفسجية في المدى بين 270 الى 280 نانوميتر، بطاقة قدرها 750 ملي جول ومساحة تعريض قدرها 4 سم² وكما تم إضافة كميات مختلفة من مادة ثاني اوكسيد التيتانيوم (TiO₂) كمحفز ضوئي لدراسة تأثير كميات المادة المحفزة وزمن التشييع على فعالية تفكك الرودامين 6ج في الماء الملوث. سجلت أطيايف الامتصاص لعينات من مادة الرودامين 6ج مضاف اليها المادة الشبه الموصلة المحفزة قبل التشييع وبعدها، فبينت النتائج أنه بزيادة وزن المادة المحفزة وزيادة زمن التعريض للضوء تزداد فعالية إزالة الرودامين 6ج من الماء الملوث. حيث كانت أقل نسبة لتكسير الرودامين 6ج من الماء الملوث قدرها 16% عند إضافة 100 ملي جرام من ثاني اوكسيد التيتانيوم وتعريض المادة لزمن قدره 10 دقائق، في حين كانت أعلى نسبة لتكسير الرودامين 6ج قدرها 82% عند إضافة 600 ملي جرام من ثاني اوكسيد التيتانيوم عند تعريض المادة لزمن قدره 30 دقيقة. يستنتج من هذه الدراسة انه بزيادة كمية المادة المحفزة وزيادة زمن التعريض يمكن زيادة تفكك الرودامين 6ج.

CONTENTS

Article	Page number
الاية	I
Dedication	II
Acknowledgement	III
Abstract	IV
المستخلص	V
Contents	VI
List of figures	VII
List of tables	VIII
Chapter one	

Introduction and basic concepts	
1.1 Introduction	1
1.2 Brief history of photocatalysis	2
1.3 Mechanism of UV photocatalysis	4
1.4 Semiconductor photocatalytic materials	10
1.5 UV photocatalytic degradation of organic compounds	12
1.5.1 Dyes	14
1.5.2 Pesticides	15
1.6 Visible light degradation of organic compounds	17
1.7 Literature review	17
1.8 Aim of the work	19
Chapter Two The Experiment Part	
2.1 Introduction	20
2.2 The materials	20
2.2.1 Titanium dioxide (TiO ₂)	20
2.2.1.1 Physical properties and Chemical properties	20
2.2.2 Rhodamine 6G	22
2.2.2.1 Physical properties and chemical properties	23
2.2.2.2 Health and Environment Affect of Rhodamine 6G	23
2.3 Equipments, tools and setup	24
2.3.1 The UV Light Source	25
2.3.2 The Magnetic Stirrer	25
2.3.3 The Glass beaker	25
2.3.4 The UV -VIS 1240 Spectrophotometer	26
2.3.5 The Experimental methodology	26
Chapter Three Results and Discussion	
3.1 Introduction	27
3.2 Absorption spectrum of Rhodamine 6G in 100 ml of water without irradiation	28
3.3 Absorption spectra of Rhodamine 6G mixed with 100 mg of TiO ₂ irradiated by UV light source for different times	29
3.4 Absorption spectra of Rhodamine 6G mixed with 300 mg of TiO ₂ irradiated by UV light source for different times	30

3.5 Absorption spectra of Rhodamine 6G mixed with 600 mg of TiO ₂ irradiated by UV light source for different times	34
3.6 Comparison of the degradation rate of Rhodamine 6G with different irradiation times and different TiO ₂ weights	35
3.7 Discussion	37
3.8 Conclusions	39
3.9 Recommendations	40
References	41

List of Figures

Figures	Page number
Figure (1.1): Evolution of international journal publications in the field of photocatalysis since 1990.	4
Figure (1.2): The mechanism of photocatalysis using TiO ₂ in presence of UV light.	5
Figure (1.3): The band gap energy and band edge positions of different semiconductors, along with selected redox potentials	11
Figure (2.1): Chemical structure of Rhodamine 6G.	23
Figure (2.2) schematic diagram of setup used in this work.	24
Figure (2.3): The UV light source.	25
Figure (2.4): The UV-VIS 1420 spectrometer.	26

Figure (3.1): The absorption spectrum of pure Rhodamine 6G in 100 ml of distilled water without irradiation and without semiconductor added.	29
Figure (3.2): The absorption spectrum of Rhodamine 6G mixed with 100 mg of TiO ₂ and irradiated by UV light for different exposure times.	30
Figure (3.3): The ratio between the amount of Rhodamine 6G after and before irradiation mixed with 100 mg of TiO ₂ and irradiated for different exposure times.	31
Figure (3.4): The absorption spectrum of Rhodamine 6G mixed with 300 mg of TiO ₂ irradiated by UV light for different exposure times.	32
Figure (3.5): The ratio between the amount of Rhodamine 6G after and before irradiation mixed with 300 mg of TiO ₂ and irradiated for different exposure times.	33
Figure (3.6): The absorption spectrum of Rhodamine 6G mixed with 600 mg of TiO ₂ irradiated by UV light for different exposure times.	34
Figure (3.7): The ratio between the amount of Rhodamine 6G after and before irradiation mixed with 600 mg of TiO ₂ and irradiated for different exposure times.	35
Figure (3.8): The degradation percentage of Rhodamine 6G at different exposure times with different weight of TiO ₂ catalyst.	36

List of Tables

Tables	Page number
Table (1.1): The energy band gap and wavelength sensitivity of semiconductors.	12
Table (2.1): The physical properties of TiO ₂ .	21
Table (3.1): The peak absorption intensity at 525nm of Rhodamine 6G mixed with 100 mg of TiO ₂ after irradiated for different exposure times.	30

Table (3.2): The absorption intensity at 525nm of Rhodamine 6G mixed with 300 mg of TiO ₂ irradiated with different exposure times.	32
Table (3.3): The absorption intensity at 525nm of Rhodamine 6G mixed with 600 mg of TiO ₂ for different exposure times.	34
Table (3.4): The degradation percentage of Rhodamine 6G at different exposures times with different wieght of TiO ₂ .	36