

شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلو

بسم الله الرحمن الرحيم





MONA MAGHRABY



شبكة المعلومات الجامعية التوثيق الإلكتروني والميكروفيلو



شبكة المعلومات الجامعية التوثيق الالكتروني والميكروفيلم



MONA MAGHRABY



شبكة المعلومات الجامعية التوثيق الإلكترونى والميكروفيلم

جامعة عين شمس التوثيق الإلكتروني والميكروفيلم قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات



يجب أن

تحفظ هذه الأقراص المدمجة بعيدا عن الغبار



MONA MAGHRABY



Ain Shams University Faculty of Science Chemistry Department

"Removal of Certain Radionuclides from Liquid Radioactive Waste Treatment Station using Prepared Sorbent Materials"

A Thesis Submitted for

Doctorate of Philosophy (Ph.D.) Degree of Science in Chemistry

Submitted By

Heba Mostafa Mohamed Said

Assistant Lecturer – Anylatical chemistry and control Department Hot Laboratories Centre - Atomic Energy Authority B. Sc. of Science (Microbiology and Chemistry) (M.Sc. in Chemistry, 2016)

To

Department of Chemistry, Faculty of Science
Ain Shams Universty
Supervised By

Prof. Dr./ Saad Abd el Wahab Mohamed

Prof. of physical chemistry Faculty of Science- Chemistry Department Ain Shams University

Prof. Dr./Sohair A. EL Reefy

Prof. of Radiochemistry Analytical chemistry and control department. Hot Laboratories Centre - Atomic Energy Authority

Prof. Dr./Fatma Abdo Shehata

Prof. of Radiochemistry Analytical chemistry and control department. Hot Laboratories Centre - Atomic Energy Authority

Ass. Prof./Reham El sayed Hassan

Assistant prof. of Inorganic Chemistry Analytical chemistry and control department. Hot Laboratories Centre - Atomic Energy Authority

بسم الله الرحمن الرحيم

﴿ قَالُواْ سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ إِلاَّ مَا عَلَّمْتَنَا إِنَّكَ أَنتَ الْحَكِيمُ ﴾ الْحَلِيمُ الْحَكِيمُ ﴾

صدق الله العظيم

سورة البقرة الآية (٣٢)

My father and my mother

To

My husband and mother in law

To
My sons and daughter

And To

My brother and sister

hope that I fulfilled my duty to be proud of me always



Ain Shams University Faculty of science

Approval Sheet

Title of submission:-

"Removal of certain radionuclides from liquid radioactive waste treatment station using prepared sorbent materials"

Submitted By

Heba Mostafa Mohamed Said

Supervisors	<u>Approved</u>
Prof.Dr./ Saad A. Mohamed Prof. of physical Chemistry	
Faculty of Science Ainshams Universit	y
Prof. Dr./ Sohair A. El Reefy	
Prof. of Radio chemistry Atomic Energy Authority	
Prof. Dr./ Fatma Abdo Shehata	
Prof. of Radio chemistry Atomic Energy Authority	
Prof. Dr./Reham. E. Hassan Ass.Prof. Inorganic chemistry Atomic Energy Authority	
	Head of Chemistry Department
	Prof. Dr./ Ayman Ayoub Abdel-Shafi



Ain Shams University Faculty of science

Research Data

Name	:-	Heba Mostafa Mohamed said
Date of Birth	:-	20/9/1990
Academic Degree	:-	M.Sc
Field of Speciation	:-	Chemistry
University issued the degr	ee:-	Benha
Graduation Year	:-	2011
Date of issued the degree	:-	2016

Acknowledgement

First, I am deeply thankful to my God "ALLAH", by the grace of whom, the progress and success of this work were possible.

I am much indebted to **Prof.Dr./Saad A. Mohamed**, Prof. of physical chemistry, Ain Shams University; for his sponsorship of this work, kind help and support, constructive discussions, continuous encouragement and sincere advice.

I am greatly indebted to **Prof. Dr./Sohair A. El Reefy,** Prof. of radiochemistry (EAEA) for her supervision, suggesting the problem and plan of work, continuous advice and support during the course of the entire work, for her fruitful discussions, careful guidance and critical review of the entire manuscript.

I am greatly grateful to **Prof. Dr./ Fatma A. Shehata**, Prof. of radiochemistry, (EAEA); for her supervision, kind help and support, effective and valuable discussions, sincere advices, and careful quidance.

Heartly, I would like to express my grateful gratitude to **Ass. Prof./Reham E. Hassan**, Ass. Prof. of inorganic chemistry, (EAEA); for her great help during the experimental work, sincere advice during all phases of carrying this work, and for her contribution in reviewing the thesis.

I would like to thank my colleagues and all the staff members for their help and support.

Heba Mostafa Mohamed Said



I would like to express my deepest thanks to late prof. Dr. Hamdi M.H. Gad for his contribution in suggesting the problem and in planning this work

CONTENTS

LIST OF FIGURES	I
LIST OF TABLES	VI
LIST OF ABBREVIATIONS	VII
THE AIM OF THE WORK	IX
ABSTRACT	X
INTRODUCTION	1
EXPERIMENTAL	44
RESULTS AND DISSCUTIONS	66
English summary	156
References	164
A rabic summary	5-1

CHAPTER I

INTRODUCTION

1.1	Radioactive waste	1
1.2	Classification of radioactive waste	1
1.2.1	According to physical state	2
1.2.2.	According to Radioactivity level	3
1.2.2.1	Exempt waste (EW)	3
1.2.2.2	Very low level waste (VLLW)	3
1.2.2.3	Low level waste (LLW)	4
1.2.2.4	Intermediate level waste (ILW)	5
1.2.2.5	High level waste (HLW)	5
1.2.2.6	Very short lived waste (VSLW)	6
1.3.	Types of radiation	6
1.3.1.	Types of Ionizing Radiation	7
1.3.1.1	Alpha Particles	7
1.3.1.2	Beta Particles	8
1.3.1.3	Gamma Rays	8
1.3.1.4	X-Rays	9
1.4.	Treatment of Radioactive Liquid Waste	10
<i>1.4.1</i> .	Chemical precipitation	11

1.4.2.	Evaporation	11
1.4.3.	Solvent extraction	12
1.4.4.	Ion exchange/sorption	13
1.4.4.1.	Adsorption process	14
1.4.4.2.	Types of Adsorption	14
1.4.4.3.	Sorption kinetics	15
1.5.	Some Aspects of Investigated Radionuclide	16
1.5.1.	Iodine	16
1.5.2.	Caesium	17
1.5.3.	Europium	18
1.6.	Organic polymer	19
1.6.1	Radiation induced polymerization	20
1.7	Natural polymer	21
1.7.1 .	The classification of natural polymer	22
1.7.2.	Advantages and disadvantages of natural polymers	22
1.7.3.	Alginate polymer	24
1.7.4.	Alginate modification	27
1.8.	Litrature survey	27-43

CHAPTER II

EXPERIMENTAL

2.1.	Chemicals and Reagents.	44
2.2.	Instruments	45
2.2.1	General	45
2.2.2.	pH measurements	45
2.2.3.	Oven	46
2.2.4.	Shaker	46
2.2.5.	Centerfugation	46
2.2.6.	Cobalt-60 gamma cell	46
2.2.7.	Activity measurement	46
2.3.	Characterization	47
2.3.1.	Scanning electron microscope (SEM)	47
2.3.2.	Thermal analysis(DTA&TGA)	47
2.3.3	FTIR analysis	47
2.4.	Swelling Studies	48
2.5.	Preparation of working solutions	48
2.5.1	Cesium, Iodine and Europium stock solutions	48
2.5.2	Radionuclides	49

2.6.	Preparation of Adsorbents(solid materials)	49
2.6.1.	Preparation of poly(acrylamide/acrylic acid/sodium styrene sulfonate)	49
2.6.2.	Preparation of poly(sodium alginate-acrylic acid)	50
2.6.3.	Preparation of poly(sodium alginate-acrylic acid-methacrylic acid)(Na Alg-AcA- MAcA)	50
2.7.	Bach Adsorption Studies	51
2.7.1.	Effect of pH	52
2.7.2.	Effect of shaking time	52
2.7.3	Effect of sorbate ion concentration	52
2.7.4.	Effect of adsorbent amount	53
2.7.5.	Effect of temperature	53
2.8.	Sorption Kinetics	54
2.8.1	Pseudo first-order(Lagergren) model	55
2.8.2.	Pseudo second-order model	55
2.8.3	Intraparticle diffusion	56
2.8.4.	Elovich model	57
2.9.	Isotherm and Equilibrium	58
2.9.1.	Langmuir isotherm	58
2.9.2.	Freundlich isotherm	60
2.9.3.	Dubinin-Radushkviech isotherm	61
<i>2.9.4</i> .	Temkin isotherm	62