UNIVERSITI TEKNOLOGI MARA

REMOVAL OF Cu (II) AND Mg (II) BY USING MODIFIED MESOPOROUS SILICATES MCM-41 AND SBA-15 FROM AQUEOUS SOLUTION

FAUSTINA ELFRIDA ANAK SANGOK

Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

April 2014

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

Name of student	:	Faustina Elfrida anak Sangok
Student I.D. No.	:	2010819742
Programme	:	Master of Science (Chemistry)
Faculty	:	Applied Sciences
Thesis title	:	Removal of Cu (II) and Mg (II) by using Modified Mesoporus Silicates MCM-41 and SBA-15 from Aqueous Solution
Signature	:	
Date	:	April 2014

ABSTRACT

The objective of this research was to develop an effective and efficient heavy metal ions adsorbent with high removal percentage at various optimum conditions. In this research, mesoporous silicate, Santa Barbara Amorphous-15 (SBA-15) and Mobil Composition Matter-41 (MCM-41) were modified by using 3-aminopropyltriethoxysilane (APTES), 3-mercaptopropyltrietoxysilane (MPTS) and triethoxyvinylsilane (TEVS) to produce adsorbents. Six types of modified mesoporous silicate namely; ASBA-15, MSBA-15, TSBA-15, AMCM-41, MMCM-41 and TMCM-41 were synthesized and tested as heavy metal ions adsorbent. These adsorbent were characterized for their mesoscopic array, crystalinity, functional group, surface morphology, percentage and decomposition of organic component. Adsorption study was carried out at various parameters, namely contact time, concentration, pH, temperature, agitation speed and adsorbent dosage. Optimum condition for removal of Cu (II) ions was found to be at 30 minutes, 150 mg L^{-1}, pH 5, 25°C, 400 rpm and 0.05 g adsorbent whereas for Mg^{2+} ions, the highest removal percentage was at 240 minutes, 150 mg L^{-1}, pH 3, 25°C, 800 rpm and 0.05 g adsorbent. ASBA-15 was found to show the highest efficiency to adsorb Cu (II) whereas AMCM-41 was found to show the highest efficiency to adsorb Mg (II). Equilibrium adsorption study was carried out to study isothermal model. Langmuir isotherm was well fitted to adsorption study compared with Freundlich isotherm, with favorable adsorption process. Meanwhile, kinetic study was carried out and adsorption process was found to be best presented by using pseudo-second order kinetic model with correlation coefficient R^2>0.99. Adsorption process also was found to be controlled by intraparticle diffusion and was found to occur spontaneously. Regeneration of adsorbent was done by two methods, EDTA treatment and acid-base treatment. It was found that EDTA treatment was a better choice of regeneration with 90% of heavy metal recovery. This indicated that an efficient adsorbent have been successfully synthesized.

ACKNOWLEDGEMENT

Firstly, thanks to God for giving me strength and good health to complete my studies.

I would like to express my deep gratitude to Ministry of Higher Education (MOHE) and Universiti Teknologi Mara (UiTM) for their financial support of the project through Fundamental Research Grant Scheme (FRGS) 600-RMI/ST/FRGS 5/3/Fst (4/2009).

Next, I would like to thank Assoc. Prof. Dr. Siti Zaleha Sa'ad, Pn. Sabrina M. Yahaya and Pn. Nurul Izza Taib for their guidance, encouragement and supervision throughout my studies.

I also would like to thank the research team and lab assistants for their endless effort in assisting my research.

To my family and friends, without their endless love, support and encouragement, I would have never made it.

TABLE OF CONTENTS

		Page
AUTHOR'S DECLARATION		**ii**
ABSTRACT		**iii**
AKCNOWLEDGEMENT		**iv**
TABLE OF CONTENTS		**v**
LIST OF TABLES		**vii**
LIST OF FIGURES		**viii**
LIST OF ABBREVIATIONS		**xi**
CHAPTER ONE: INTRODUCTION		**1**
1.1	Research Background	1
1.2	Problem Statement	4
1.3	Significance of study	5
1.4	Research objectives	5
1.5	Scope and limitations of the study	6
	1.5.1 Scope of Study	6
	1.5.2 Limitations of Study	6
CHAPTER TWO: LITERATURE REVIEW		**7**
2.1	Environmental Issues of Heavy Metal Ions Pollution	7
2.2	Introduction to Mesoporous Material	10
	2.2.1 Mobil Composition Matter-41 (MCM-41)	15
	2.2.1.1 MCM-41 as Heavy Metal Adsorbent	16
	2.2.2 Santa Barbara Amorphous-15 (SBA-15)	18
	2.2.2.1 SBA-15 as Heavy Metal Adsorbent	18
2.3	Modified Mesoporous Silica as Heavy Metal Adsorbent	20
CHAPTER THREE: METHODOLOGY		**23**
3.1	Materials	23