

TABLE OF CONTENTS

COVER PAGE	i
RATIFICATION PAGE	ii
STATEMENT PAGE	iii
DEDICATION	iv
PREFACE	v
TABLE OF CONTENTS	vi
LIST OF FIGURES	viii
LIST OF TABLES	ix
LIST OF APPENDICES	x
ABSTRACT	xi
INTISARI	xii
CHAPTER I INTRODUCTION	1
I.1 Background	1
I.2 Research Objectives	3
I.3 Research Benefits	3
CHAPTER II LITERATURE REVIEW AND HYPOTHESIS FORMULATION	4
II.1 Literature Review	4
II.1.1 LDPE Plastic	4
II.1.2 Hydrothermal carbonization (HTC)	5
II.1.3 Pyrolysis	7
II.1.4 Hydrochar and biochar	7
II.1.5 Potassium	8
II.1.6 Adsorption	9
II.2 Hypotheses and Research Planning	13
II.2.1 Hypothesis formulation 1	13
II.2.2 Hypothesis formulation 2	14
II.2.3 Hypothesis formulation 3	14
II.2.4 Research Planning	15
CHAPTER III RESEARCH METHODS	16
III.1 Tools	16
III.2 Materials	16
III.3 Procedure	16
III.3.1 HTC-pyrolysis of char-Al ₂ O ₃ composite	16
III.3.2 Characterization of char-Al ₂ O ₃ composite	17
III.3.3 Preparation of potassium standard solution	17
III.3.4 Study of pH change towards char-Al ₂ O ₃ composite dosage	17
III.3.5 Study of potassium adsorption towards the char-Al ₂ O ₃ composite	18

CHAPTER IV	EXPERIMENTAL RESULTS AND DISCUSSIONS	19
	IV.1 Preparation of Char-Al ₂ O ₃ Composite	19
	IV.2 Characterization of Char-Al ₂ O ₃ Composite	19
	IV.2.1 Infrared spectroscopy analysis	20
	IV.2.2 X-Ray diffraction analysis	22
	IV.2.3 SEM-EDX analysis	23
	IV.2.4 BET analysis	26
	IV.3 Study of Composite Dosage Towards pH	28
	IV.4 Study of Potassium Adsorption Towards Composite	29
	IV.4.1 Effect of adsorbent dose	30
	IV.4.2 Effect of contact time	31
	IV.4.3 Adsorption kinetics	33
	IV.4.4 Effect of initial concentration	34
	IV.4.5 Adsorption isotherm	35
CHAPTER V	CONCLUSION AND SUGGESTIONS	37
	V.1 Conclusion	37
	V.2 Suggestions	37
REFERENCES		38
APPENDICES		42

LIST OF FIGURES

Figure II.1	Schematic representation of major polyethylene types (Malpass, 2010)	4
Figure II.2	Illustration of <i>Agus Kuncaka's</i> hydrothermal carbonization reactor (Muslem, 2017)	6
Figure II.3	Schematic of HTC process for possible application (Cha et al., 2016)	8
Figure II.4	Graphical representation of sorption reaction on an adsorbent surface (Lei et al., 2016)	10
Figure IV.1	Photos of char-Al ₂ O ₃ composite prior to sieving, post 100-mesh sieving and post 250-mesh sieving	19
Figure IV.2	Overlaid FTIR spectra of LDPE feedstock and char-Al ₂ O ₃ composite	20
Figure IV.3	XRD diffractogram of Al ₂ O ₃ and Char-Al ₂ O ₃ composite. Red dots refer to amorphous carbon, blue dots refer to Al ₂ O ₃ .	22
Figure IV.4	Microstructure image of char-Al ₂ O ₃ (a) 100x (b) 1000x (c) 2000x (d) 5000x	24
Figure IV.5	Individual elemental availability prior to overlapping (a) Carbon (b) Oxygen (c) Aluminum	25
Figure IV.6	SEM micrograph of (a) char-Al ₂ O ₃ composite and (b) elemental distribution map of char-Al ₂ O ₃ composite	25
Figure IV.7	Schematic representation of cavity formation due to nanoalumina particles on LDPE nanocomposite surface (Chee et al., 2012)	26
Figure IV.8	Isotherm of N ₂ adsorption-desorption by char-Al ₂ O ₃ composite	27
Figure IV.9	Effect of char-Al ₂ O ₃ composite dosage on the pH of solution	29
Figure IV.10	Hypothetical ion-dipole interaction between K ⁺ ions with polar molecule	30
Figure IV.11	Effect of char-Al ₂ O ₃ composite dosage towards the adsorption efficiency and adsorption amount of potassium	31
Figure IV.12	Effect of contact time towards the adsorption capacity of potassium	32
Figure IV.13	Effect of initial concentration of potassium towards adsorption efficiency and adsorption amount.	35

LIST OF TABLES

Table IV.1	Characteristic IR absorption of LDPE plastic and char-Al ₂ O ₃ composite	21
Table IV.2	BET characteristics of char-Al ₂ O ₃ composite	27
Table IV.3	Adsorption kinetics of char-Al ₂ O ₃ composite	33
Table IV.4	Isotherm models of char-Al ₂ O ₃ composite	36

LIST OF APPENDICES

Appendix 1	<i>Agus Kuncaka's</i> hydrothermal carbonization reactor setup	43
Appendix 2	Photograph of char-Al ₂ O ₃ composite slurry	44
Appendix 3	Photograph of char-Al ₂ O ₃ composite pre- and post-sieving	45
Appendix 4	IR Spectrum of LDPE plastic	46
Appendix 5	IR Spectrum of char-Al ₂ O ₃ composite	47
Appendix 6	XRD diffractogram of char-Al ₂ O ₃ composite	48
Appendix 7	SEM micrograph of char-Al ₂ O ₃ composite surface (x100 & x 1000)	49
Appendix 8	SEM micrograph of char-Al ₂ O ₃ composite surface (x2000 & x5000)	50
Appendix 9	SEM micrograph of char-Al ₂ O ₃ composite surface (x5000, alternative site)	51
Appendix 10	EDX molecular distribution mapping of char-Al ₂ O ₃ composite	52
Appendix 11	BET adsorption data of char-Al ₂ O ₃ composite	53
Appendix 12	Study of pH change towards the char-Al ₂ O ₃ composite weight	55
Appendix 13	Study of potassium adsorption towards char-Al ₂ O ₃ composite	56