

Contents

	Page
บทคัดย่อ	(3)
Abstract (English)	(4)
Acknowledgements	(5)
The Relevance of The Research Work	(6)
Contents	(7)
List of Tables	(9)
List of Figures	(11)
Chapter	
1. INTRODUCTION	
1.1 Introduction	1
1.2 Preliminary knowledge and Theoretical sections	3
1.3 Review of Literatures	12
1.4 Objectives	22
2. METHOD OF STUDY	
2.1 Chemical and materials	23
2.2 Instruments	23
2.3 Methods	25
2.3.1 Preparation of activated carbons	25
2.3.2 Characterization of activated carbons surfaces	28
2.3.3 Adsorption studies	30

Contents (continued)

	Page
3. RESULTS AND DISCUSSION	
3.1 Characterization of activated carbons surfaces	33
3.1.1 Scanning electron microscopy (SEM)	33
3.1.2 Surface area and pore size analysis (physical or porous texture characterization)	35
3.1.3 Fourier-transform infrared spectroscopy (FT-IR)	40
3.1.4 Point of zero charge measurement (pH_{pzc})	51
3.2 Adsorption studies	54
3.2.1 Adsorbate metal ion solution	54
3.2.2 pH effect on adsorption of cadmium and lead ions on activated carbons	56
3.2.3 Adsorption isotherm studies of cadmium and lead ions on activated carbons	58
4. CONCLUSION	86
BIBLIOGRAPHY	89
APPENDIX	95
VITAE	104

List of Tables

Table		Page
A	Criteria for distinguishing between chemisorption and Physisorption.	8
1	Sample codes of obtained activated carbons.	26
2	BET and micropore surface areas of activated carbons prepared from bagasse and pericarp of rubber fruit.	37
3	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Pb^{2+} adsorption on B-70-600 at different temperatures.	60
4	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Pb^{2+} adsorption on B-325-800 at different temperatures.	62
5	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Pb^{2+} adsorption on Pr-70-600 at different temperatures.	64
6	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Pb^{2+} adsorption on Pr-325-800 at temp = 40 °C.	65
7	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Cd^{2+} adsorption on B-70-600 at different temperatures.	67
8	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Cd^{2+} adsorption on B-325-800 at different temperatures.	69

List of Tables (continued)

Table		Page
9	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Cd^{2+} adsorption on Pr-70-600 at different temperatures.	71
10	Parameter values of the Langmuir and Freundlich equations fitted to the experiment of Cd^{2+} adsorption on Pr-325-800 at temp = 40 °C.	72
A1	Data of adsorption isotherm of Pb^{2+} on B-70-600.	96
A2	Data of adsorption isotherm of Pb^{2+} on B-325-800.	97
A3	Data of adsorption isotherm of Pb^{2+} on Pr-70-600.	98
A4	Data of adsorption isotherm of Pb^{2+} on Pr-325-800.	99
A5	Data of adsorption isotherm of Cd^{2+} on B-70-600.	100
A6	Data of adsorption isotherm of Cd^{2+} on B-325-800.	101
A7	Data of adsorption isotherm of Cd^{2+} on Pr-70-600.	102
A8	Data of adsorption isotherm of Cd^{2+} on Pr-325-800.	103

List of Figures

Figure		Page
1	Schematic representation of the activation procedure.	27
2	SEM micrographs of (a) B-70-600 (×150), (b) B-70-600 (×1000), (c) Pr-70-600 (×150), (d) Pr-70-600 (×1000) activated carbons.	34
3	Adsorption isotherms of N ₂ at 77 K on the carbons prepared from two agricultural wastes.	35
4	BJH pore size distribution of all activated carbons prepared from two agricultural wastes.	38
5	FT-IR spectrum of raw bagasse.	41
6	FT-IR spectrum of raw pericarp of rubber fruit.	42
7	Chemical structures of cellulose, hemicellulose and lignin.	43
8	FT-IR spectrum of carbonized char of bagasse.	44
9	FT-IR spectrum of carbonized char of pericarp of rubber fruit.	45
10	FT-IR spectrum of B-70-600.	46
11	FT-IR spectrum of B-325-800.	47
12	FT-IR spectrum of Pr-70-600.	48
13	FT-IR spectrum of Pr-325-800.	49
14	Graph of final pH versus initial pH initial obtained by using the pH drift method.	52
15	pecciation diagram of surface functional groups on activated carbons.	54

List of Figures (continued)

Figure		Page
16	Adsorption of Cd^{2+} (a) and Pb^{2+} (b) by the obtained activated carbon samples as a function of initial pH of solution: (concentration = 80 ppm).	57
17	Adsorption isotherm of Pb^{2+} on B-70-600 at temp = 40°C .	59
18	Adsorption isotherm of Pb^{2+} on B-70-600 at temp = 60°C .	59
19	Adsorption isotherm of Pb^{2+} on B-70-600 at temp = 80°C .	60
20	Adsorption isotherm of Pb^{2+} on B-325-800 at temp = 40°C .	61
21	Adsorption isotherm of Pb^{2+} on B-325-800 at temp = 60°C .	61
22	Adsorption isotherm of Pb^{2+} on B-325-800 at temp = 80°C .	62
23	Adsorption isotherm of Pb^{2+} on Pr-70-600 at temp = 40°C .	63
24	Adsorption isotherm of Pb^{2+} on Pr-70-600 at temp = 60°C .	63
25	Adsorption isotherm of Pb^{2+} on Pr-70-600 at temp = 80°C .	64
26	Adsorption isotherm of Pb^{2+} on Pr-325-800 at temp = 40°C .	65
27	Adsorption isotherm of Cd^{2+} on B-70-600 at temp = 40°C .	66
28	Adsorption isotherm of Cd^{2+} on B-70-600 at temp = 60°C .	66
29	Adsorption isotherm of Cd^{2+} on B-70-600 at temp = 80°C .	67
30	Adsorption isotherm of Cd^{2+} on B-325-800 at temp = 40°C .	68
31	Adsorption isotherm of Cd^{2+} on B-325-800 at temp = 60°C .	68
32	Adsorption isotherm of Cd^{2+} on B-325-800 at temp = 80°C .	69
33	Adsorption isotherm of Cd^{2+} on Pr-70-600 at temp = 40°C .	70
34	Adsorption isotherm of Cd^{2+} on Pr-70-600 at temp = 60°C .	70

List of Figures (continued)

Figure		Page
35	Adsorption isotherm of Cd^{2+} on Pr-70-600 at temp = 80°C .	71
36	Adsorption isotherm of Cd^{2+} on Pr-325-800 at temp = 40°C .	72
37	EDA spectrometry of B-70-600 (a), B-70-600/ Cd^{2+} (b) and B-70-600/ Pb^{2+} (c).	81
38	EDA spectrometry of B-325-800 (a), B-325-800/ Cd^{2+} (b) and B-325-800/ Pb^{2+} (c).	82
39	EDA spectrometry of Pr-70-600 (a), Pr-70-600/ Cd^{2+} (b) and Pr-70-600/ Pb^{2+} (c).	83
40	EDA spectrometry of Pr-325-800 (a), Pr-325-800/ Cd^{2+} (b) and Pr-325-800/ Pb^{2+} (c).	84