

TABLE OF CONTENTS

	Page
TABLE OF CONTENTS.....	i
LIST OF TABLES.....	ii
LIST OF FIGURES.....	v
INTRODUCTION.....	1
LITERATURE REVIEWS.....	6
MATERIALS AND METHODS.....	51
Materials.....	51
Methods.....	53
RESULTS AND DISCUSSION.....	62
CONCLUSION.....	100
LITERATURE CITED.....	103
APPENDIX.....	114

LIST OF TABLES

Table	Page
1 The sources of phosphorus compounds in municipal wastewaters..	8
2 Typical composition of untreated domestic wastewater.....	13
3 Definitions: adsorption.....	14
4 Definitions: porous solids.....	15
5 Comparison of Chemisorption and Physisorption processes.....	19
6 Some points of zero charge	31
7 The orthophosphate adsorption on the adsorbents.....	64
8 Surface characterization of mordenite.....	66
9 Chemical compositions of mordenite.....	69
10 Interpretation of mordenite at various conditions from FTIR spectra.	71
11 The calculation variables from Langmuir adsorption isotherm.....	80
12 The calculation variables from Freundlich adsorption isotherm.....	81

Appendix Table

B1 Data from experiment of non calcinations ball clay after orthophosphate adsorption.....	118
B2 Data from experiment of calcinations ball clay at 750°C after orthophosphate adsorption.....	119
B3 Data from experiment of non calcinations kaolin after orthophosphate adsorption	120
B4 Data from experiment of calcinations kaolin at 750°C after orthophosphate adsorption.....	121
B5 Data from experiment of calcinations perlite at 750°C after orthophosphate adsorption.....	122

LIST OF TABLES (Cont'd)

Appendix Table	Page
B6 Data from experiment of calcinations diatomite at 750°C after orthophosphate adsorption.....	122
G1 The calibration curve data of orthophosphate.....	157
G2 Data from experiment of uncalcined mordenite after orthophosphate adsorption.....	158
G3 Data from experiment of calcination mordenite at 150°C after orthophosphate adsorption.....	159
G4 Data from experiment of calcination mordenite at 300°C after orthophosphate adsorption.....	160
G5 Data from experiment of calcination mordenite at 450°C after orthophosphate adsorption.....	161
G6 Data from experiment of calcination mordenite at 600°C after orthophosphate adsorption.....	162
G7 Data from experiment of calcination mordenite at 750°C after orthophosphate adsorption.....	163
G8 Data from experiment of calcination mordenite at 900°C after orthophosphate adsorption.....	164
H1 The data from thermal treatment at 750°C.....	166
I1 The orthophosphate desorption from mordenite at temperature of calcinations 750°C.....	168
J1 The amount of Fe^{2+} were extracted from calcination mordenite at 750° extraction with 0.05M EDTA.....	170
J2 The amount of Fe^{2+} were extracted from calcination mordenite at 750° extraction with 0.5M HCl.....	171

LIST OF TABLES (Cont'd)

Appendix Table	Page
J3 Orthophosphate adsorption of mordenite after metal oxide extraction with 0.05M EDTA.....	172
J4 Orthophosphate adsorption of mordenite after metal oxide extraction with 0.5M HCl.....	173
K1 The zeta potential of mordenite.....	175
K2 The zeta potential of mordenite which pH of adsorption.....	176
L1 Equilibrium reactions of element at 25°C.....	178

LIST OF FIGURES

Figure	Page
1 pH-dependent variation of phosphorus speciation.....	7
2 The five main shapes of adsorption isotherm, given as plots of coverage against equilibrium pressure.....	22
3 The three mechanism of ions adsorption on siloxane surface.....	29
4 Inner-sphere surface complex of K^{2+} on mordenite.....	30
5 The variation of potential with distance from a charged wall in the presence of a Stern layer	35
6 The tetrahedra linked together to create a three-dimensional structure.....	37
7 The structure of mordenite.....	39
8 The scheme of adsorbent calcinations.....	55
9 The scheme of orthophosphate adsorption procedure.....	58
10 SEM image of mordenite (x 1,500).....	67
11 SEM image of mordenite (x 3,500).....	68
12 XRD patterns of the mordenite calcinations at various temperatures.....	70
13 The effect of adsorbing time and concentration on the removal of orthophosphate from aqueous solutions.....	74
14 Initial orthophosphate concentration adsorption.....	77
15 Langmuir adsorption isotherm calcination at 750°C.....	79
16 Freundlich adsorption isotherm calcination at 750°C.....	81
17 Desorption of orthophosphate after adsorbed on mordenite calcination at 750°	83

LIST OF FIGURES (Cont'd)

Figure	Page
18 Zeta potential of uncalcined mordenite.....	88
19 Zeta potential of mordenite calcined at 150°C.....	90
20 Zeta potential of mordenite calcined at 300°C.....	91
21 Zeta potential of mordenite calcined at 450°C.....	93
22 Zeta potential of mordenite calcined at 600°C.....	93
23 Zeta potential of mordenite calcined at 750°C.....	96
24 Zeta potential of mordenite calcined at 900°C.....	97
Appendix Figure	
A1 The reagents preparation for ascorbic acid method.....	116
C1 Nitrogen adsorption isotherms of the natural zeolite calcination at various temperatures.....	124
C2 BET analysis of non calcinations mordenite.....	125
C3 BET analysis of calcinations mordenite at 150°C.....	126
C4 BET analysis of calcinations mordenite at 300°C.....	127
C5 BET analysis of calcinations mordenite at 450°C.....	128
C6 BET analysis of calcinations mordenite at 600°C.....	129
C7 BET analysis of calcinations mordenite at 750°C.....	130
C8 BET analysis of calcinations mordenite at 900°C.....	131
D1 Chemical composition analysis of non calcinations mordenite....	133
D2 Chemical composition analysis of mordenite calcined at 150°C...	134
D3 Chemical composition analysis of mordenite calcined at 300°C...	135
D4 Chemical composition analysis of mordenite calcined at 450°C...	136
D5 Chemical composition analysis of mordenite calcined at 600°C...	137

LIST OF FIGURES (Cont'd)

Appendix Figure	Page
D6 Chemical composition analysis of mordenite calcined at 750°C...	138
D9 Chemical composition analysis of mordenite calcined at 900°C...	141
E1 XRD pattern of mordenite un- calcined.....	143
E2 XRD pattern of mordenite calcined at 150°C.....	144
E3 XRD pattern of mordenite calcined at 300°C.....	145
E4 XRD pattern of mordenite calcined at 450°C.....	146
E5 XRD pattern of mordenite calcined at 600°C.....	147
E6 XRD pattern of mordenite calcined at 750°C.....	148
E7 XRD pattern of mordenite calcined at 900°C.....	149
F1 FTIR spectra of uncalcined mordenite.....	151
F2 FTIR spectra of mordenite calcination at 150°C.....	151
F3 FTIR spectra of mordenite calcination at 300°C.....	152
F4 FTIR spectra of mordenite calcination at 450°C.....	152
F5 FTIR spectra of mordenite calcination at 600°C.....	153
F6 FTIR spectra of mordenite calcination at 750°C.....	153
F7 FTIR spectra of mordenite calcination at 900°C.....	154
F8 FTIR spectra of mordenite calcination at 750°C and treated with EDTA 0.05M.....	154
F9 FTIR spectra of mordenite calcination at 750°C and treated with HCl 0.5M.....	155
G1 Orthophosphate calibration curve.....	157

LIST OF ABBREVIATIONS

AAS	= Atomic Absorption Spectrophotometer
BJH	= Barrett-Joyner-Halenda
BET	= Brunauer-Emmett-Teller
EDS	= energy dispersive X-ray spectroscopy
FTIR	= Fourier transform infrared spectrometer
MOR	= mordenite
mg-P	= milligram phosphorus
SEM	= scanning electron microscope
XRD	= X-ray diffraction
g P	= gram phosphorus
mg-P/L	= milligram phosphorus per liter