

ADSORPTION KINETICS OF AN ION EXCHANGE COLUMN



Mr. Manat Manantapong

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for the Degree of Master of Science
The Petroleum and Petrochemical College, Chulalongkorn University
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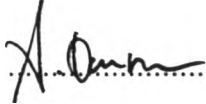
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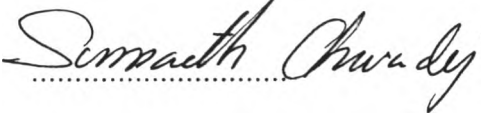
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By : Mr. Manat Manantapong
Program : Petrochemical Technology
Thesis Advisors : Prof. James O. Wilkes
Dr. Sumaeth Chavadej


Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfillment of the requirements for the Degree of Master of Science.


..... Director of the college
(Prof. Somchai Osuwan)

Thesis Committee


.....
(Prof. James O. Wilkes)


.....
(Dr. Sumaeth Chavadej)


.....
(Dr. Thirasak Rirksomboon)

ABSTRACT

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KEYWORD: ION EXCHANGE/KINETICS ADSORPTION ION EXCHANGE /
CATIONIC ION EXCHANGE RESIN/ION EXCHANGE
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The behavior of exchange of Na^+ ions for H^+ ions on strongly-acid cation resin (Dowex 50) was studied in a packed column. Operating variables such as the inlet concentration and the flow rate of sodium chloride solution strongly influence the rate of ion exchange. The characteristics of the flow in the column were examined using a no-adsorption experiment, and the kinetics of adsorption were determined from batchwise experiments. The rate of ion exchange based on a relative volatility concept was successful for describing the experimental rate. Numerical methods were employed for solving the equations. Labtech Notebook software was used for data acquisition.

บทคัดย่อ

มนัส มานันตพงษ์: กลไกการดูดซับของ การแลกเปลี่ยนไอออนในคอลัมน์ (Adsorption kinetics of an Ion Exchange Column) อ.ที่ปรึกษา :ศ.ดร. เจมส์ โอ วิลค์ และ ดร. สุเมธ ชวเดช 84หน้า ISBN 974-636-043-4

การวิจัยนี้ได้ทำการศึกษาพฤติกรรมของ การแลกเปลี่ยนไอออนในคอลัมน์ของ โซเดียมไอออน สำหรับไฮโดรเจนไอออน บนเรซินที่มีประจุบวกและชอบกรดแก่(Dowex 50) ตัวแปรที่มีผลต่อการทดลอง เช่น ความเข้มข้นเริ่มต้นและอัตราการไหลของสารละลายโซเดียมคลอไรด์ มีอิทธิพลสูงมากต่ออัตราการแลกเปลี่ยนไอออน ลักษณะการไหลของของเหลวในคอลัมน์ได้ทำการตรวจสอบโดยการทดลองแบบไม่มีการดูดซับ การศึกษาพลจลนศาสตร์ของการดูดซับได้ใช้การทดลองแบบกะ(Batch) อัตราการแลกเปลี่ยนไอออนที่คำนวณได้โดยอาศัยหลักการของของการระเหยสัมพัทธ์(Relative Volatility) มีความสมเหตุสมผลในการกล่าวถึง อัตราของการแลกเปลี่ยนไอออนที่ได้จากการทดลอง การประมาณการทางคณิตศาสตร์เชิงตัวเลข (Numerical Approximation) ได้นำมาใช้ในการแก้ปัญหาในสมการที่เกี่ยวข้อง โปรแกรมสำเร็จรูป Labtech Notebook ได้นำมาใช้เป็นอุปกรณ์ในการบรรลุข้อมูล(Data Acquisition)

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TABLE OF CONTENTS

CHAPTER	PAGE
Title Page	i
Abstract	iii
Acknowledgments	v
Table of Contents	vi
List of Figures	ix
Notation	xi
I INTRODUCTION	1
II THEORY	
2.1 Literature Review	3
2.2 Theoretical Consideration of Ion-Exchange Kinetics	6
2.2.1 Batchwise Operation	6
2.2.2 Fluidized-bed Operation(Upflow Direction)	8
2.2.3 Fixed-bed Operation(Downflow Direction)	8
2.3 Description of Process Kinetic Models	9
2.3.1 Modeling a Response Time of pH Electrode	10
2.3.2 Modeling No Adsorption with Upflow Operations	11
2.3.3 Modeling a Batch Operation	15
2.3.4 Modeling Adsorption with Upflow Operation	17
2.4 Data Acquisition with Labtech Notebook	20

CHAPTER	PAGE
III METHODOLOGY	
3.1 Materials	23
3.1.1 Ion Exchange Resin	23
3.1.2 Other Chemicals	23
3.2 Experimental Setup	24
3.3 Experimental Procedure	24
3.3.1 Batch Experiment	24
3.3.2 Continuous Flow Experiment	25
IV RESULTS AND DISCUSSION	
4.1 Batch System	28
4.2 Continuous Flow System	35
4.3 Analysis of Response Time Experiment	37
4.4 Analysis of No Adsorption Experiment	37
4.4.1 Modeling with one CSTR and one PFR in Series (Case I)	37
4.4.2 Modeling with two CSTRs and one PFR in Series (Case II)	38
4.5 Analysis of Batch Operation	38
4.6 Analysis of Ion Exchange in Column by Fluidized-Bed Operation	43
V CONCLUSIONS AND RECOMMENDATIONS	
5.1 Conclusions	45
5.2 Recommendations	46

CHAPTER	PAGE
REFERENCES	47
APPENDICES	49
CURRICULUM VITAE	84

LIST OF FIGURES

FIGURE	PAGE
2.1 Representation of the response time experiment	10
2.2 Representation of no adsorption experiment as one CSTR and one PFR in series together with a pH electrode	12
2.3 Representation of no adsorption experiment as two CSTRs and one PFR in series together with a pH electrode	13
2.4 Notation for sodium ion concentration	15
2.5 Representation of ion exchange column as one CSTR and one PFR in series together with a pH electrode	18
2.6 Communication between the experiment and the computer	22
3.1 Schematic diagram of experimental apparatus for batch operation	25
3.2 Schematic diagram of experiment apparatus for continuous flow operation	26
4.1 Hydrogen desorption dynamics of Dowex 50 with various initial sodium ion concentrations	29
4.2 Adsorption of sodium ion in the resin with various initial sodium ion concentration	30
4.3 Total equilibrium exchange capacity as a function of initial concentration of sodium chloride	31

FIGURES	PAGE
4.4 Desorption of hydrogen ions at different mixing speed with initial NaCl concentration = 0.2 N	33
4.5 The exiting hydrogen ions as a function of time with 0.2 N sodium ion concentration	34
4.6 The exiting hydrogen ion concentration as a function of time with 2.5 ml/s of flowrate at various initial concentrations	36
4.7 The comparison of the experimental data and the modeling of the response time experiment	39
4.8 The comparison of the experimental data and the modeling of no adsorption experiment with one CSTR and one PFR in series	40
4.9 The comparison of the experimental data and the modeling of the no adsorption experiment with two CSTRs and one PFR in series	41
4.10 The comparison of the experimental data and the modeling of the batch experiment	42
4.11 The comparison of the predicted model and the experimental data of the ion exchange with fluidized-bed operation	44
A.1 Build time of Labtech Notebook	51

NOTATION

<u>Symbol</u>	<u>Definition</u>
c_1, c_2	Concentration of Na^+ ion in solution leaving the CSTR, meq/ml.
c_0	Entering concentration of Na^+ , meq/ml.
h	H^+ concentration in the solution leaving the column, meq/ml.
h_e	H^+ concentration in solution at equilibrium, meq/ml.
h_m	H^+ concentration measured by pH electrode, meq/ml.
H	Height of fluidized bed, cm
H_0	The height of packed bed, cm
k_1	Rate constant, s^{-1}
k_2	Relative volatility coefficient, dimensionless
k_L	Resistance constant in liquid phase
k_R	Resistance constant in resin phase
K	Equilibrium constant
q	Concentration of Na^+ ion in the resin, meq/ml. of resin
q_s	Concentration of Na^+ ion on the surface of resin, meq/ml. of resin
q_0	Total exchange capacity, meq/ml. of resin

t	Time, s
t_r	Residence time in plug-flow volume, s
v	Volumetric flow rate of solution, ml/s
V_1	Total volume of CSTR, ml
V_2	Total volume of plug-flow volume, ml
V_R	Volume occupied by the resin bed in the column, ml
V_L	Volume occupied by the liquid bed in the column, ml
α_e	Constant in the response-time model for the pH electrode, s^{-1}
Δt	Time step used in finite-difference approximation, s
ε	Bed void fraction
ε_0	The compacted value of void fraction, 0.41, dimensionless