

**CONVERSION OF CYCLOHEXENE TO CYCLOHEXANOL IN
A CHROMATOGRAPHIC REACTOR**



Mr. Visava Lertrodjanapanya

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By : Mr. Visava Lertrodjanapanya
Program : Petrochemical Technology
Thesis Advisors : Asst. Prof. Pramoch Rangsunvigit
Asst. Prof. Thirasak Rirksomboon
Dr. Santi Kulprathipanja

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

K. Bunyakiat.
..... College Director
(Assoc. Prof. Kunchana Bunyakiat)

Thesis Committee:

Pramoch R.
.....
(Asst. Prof. Pramoch Rangsunvigit)

T. Rirksomboon
.....
(Asst. Prof. Thirasak Rirksomboon)

Santi Kulprathip
.....
(Dr. Santi Kulprathipanja)

A. Osuwan
.....
(Prof. Somchai Osuwan)

K. Bunyakiat.
.....
(Assoc. Prof. Kunchana Bunyakiat)

ABSTRACT

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Cyclohexanol is mainly used for the production of adipic acid, which is an intermediate for the production of nylon-6,6. The production of cyclohexanol through the hydration of cyclohexene with an acidic catalyst, e.g., ZSM-5, is an important process in the petrochemical industry. However, this process yields low cyclohexene conversion, i.e. 7-10%, due to thermodynamic equilibrium of the reaction. In this work, to improve the yield of cyclohexene conversion, the reaction was carried out at 80, 100, 120 and 140 °C in a chromatographic reactor, in which the reaction and separation of the product took place, simultaneously. Results from this reactive separation system indicated that the thermodynamic equilibrium could be overcome with essentially 100% selectivity for cyclohexanol at the temperature higher than 130 °C. The effect of catalyst acidity on the cyclohexene hydration was also studied in a batch system with different catalysts, i.e., Amberlyst-15 and ZSM-5, at 80, 100, 120 and 130 °C. The results showed that the catalyst acidity did affect the conversion of cyclohexene.

บทคัดย่อ

วิศว เลิศโรจน์ปัญญา : การเปลี่ยนไซโคลเฮกซีนไปเป็นไซโคลเฮกซานอลในเครื่องปฏิกรณ์เคมีชนิดโครมาโตกราฟฟิก (Conversion of Cyclohexene to Cyclohexanol in a Chromatographic Reactor) อ.ที่ปรึกษา : ดร. สันติ กุลประทีปปัญญา ผศ.ดร. ปราโมช รังสรรค์วิจิตร ผศ.ดร. ชีรศักดิ์ ฤกษ์สมบูรณ์ 43 หน้า, ISBN 974-03-1562-3

ไซโคลเฮกซานอล (cyclohexanol) เป็นสารตั้งต้นที่สำคัญในกระบวนการผลิตกรดอะดิพิก (adipic acid) ซึ่งเป็นวัตถุดิบที่สำคัญในอุตสาหกรรมการผลิตไนลอน 6,6 (nylon-6,6) ไซโคลเฮกซานอลสามารถผลิตได้จากปฏิกิริยาการรวมตัวกับน้ำของไซโคลเฮกซีน (cyclohexene hydration) โดยใช้ตัวเร่งปฏิกิริยาชนิดกรด (acid catalyst) เช่น ตัวเร่งปฏิกิริยาซีโอไลต์ชนิด ZSM-5 อย่างไรก็ตามปฏิกิริยาการรวมตัวกับน้ำนี้มีข้อจำกัดที่ความสามารถในการเปลี่ยนแปลงของไซโคลเฮกซีน (cyclohexene conversion) ต่ำประมาณ 7-10 เปอร์เซ็นต์เนื่องมาจากข้อจำกัดทางสมดุล (equilibrium limitation) ในงานวิจัยนี้ได้นำเครื่องปฏิกรณ์เคมีแบบโครมาโตกราฟฟิก (chromatographic reactor) ซึ่งสามารถทำให้เกิดการแยกผลิตภัณฑ์ออกจากระบบในระหว่างการเกิดปฏิกิริยา (reactive separation) มาประยุกต์ใช้ที่อุณหภูมิ 80, 100, 120, และ 140 °C เพื่อแก้ไขข้อจำกัดดังกล่าว ผลการทดลองพบว่าเครื่องปฏิกรณ์เคมีแบบโครมาโตกราฟฟิกสามารถเอาชนะ (overcome) ข้อจำกัดทางสมดุลได้เมื่อดำเนินปฏิกิริยาที่อุณหภูมิสูงกว่า 130 °C และได้ไซโคลเฮกซานอล (cyclohexanol selectivity) เกือบ 100 % นอกจากนี้ผลการทดลองในเครื่องปฏิกรณ์เคมีแบบกะของปฏิกิริยานี้โดยใช้ตัวเร่งปฏิกิริยา ZSM-5 และแอมเบอร์ลิสต์-15 (Amberlyst-15) ที่อุณหภูมิ 80, 100, 120, และ 130 °C พบว่าความสามารถในการเปลี่ยนของไซโคลเฮกซีน แปรผันโดยตรงกับความเป็นกรด (acidity) ของตัวเร่งปฏิกิริยา

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TABLE OF CONTENTS

	PAGE
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgement	v
Table of Contents	vi
List of Tables	vii
List of Figures	viii
CHAPTER	
I INTRODUCTION	1
Background	2
Literature Survey	7
II CONVERSION OF CYCLOHEXENE TO CYCLOHEXANOL IN A CHROMATOGRAPHIC REACTOR	11
Abstract	11
Introduction	12
Experimental Section	13
Results and Discussion	16
Conclusions	19
References	28
III CONCLUSION AND RECOMMENDATIONS	29
REFERENCES	30
APPENDIX	32
CURRICULUM VITAE	43

LIST OF TABLES

TABLE	PAGE
1 The Experimental conditions for the cyclohexene hydration experiments in the batch reactor	26
2 The experimental conditions of cyclohexene hydration in the chromatographic reactor	26
3 The cyclohexene hydration with ZSM-5 and Amberlyst-15 at 120 °C	27
A.1 The adsorption experiment conditions in the chromatographic system	33
A.2 The feed composition used for equilibrium the adsorption study in the batch system	33
A.3 The results of equilibrium adsorption in the batch reactor	35
A.4 The results of the chromatographic adsorption with acetone as a desorbent	35

LIST OF FIGURES

FIGURE	PAGE
1 A schematic diagram of set-up of the batch reactor	20
2 A schematic diagram of the chromatographic reactor for the cyclohexene hydration	21
3 Cyclohexene hydration with Amberlyst-15 at 120 °C with different continuous phase reactants in the chromatographic reactor	22
4 The comparison of cyclohexene conversion with Amberlyst-15 as a catalyst from the batch reactor and the chromatographic reactor with cyclohexene as a continuous phase reactant	23
5 The cyclohexene and cyclohexanol adsorption on Amberlyst-15 at 120 °C in the chromatographic reactor	24
6 The plot $-\ln(1-(1+1/K_C)*X_{HE})$ vs time versus time (min) from cyclohexene hydration in the batch reactor	25
A.1 The equilibrium adsorption of cyclohexene and cyclohexanol on ZSM-5 using n-hexane as a tracer at 120 °C	38
A.2 The equilibrium adsorption of cyclohexene and cyclohexanol on Amberlyst-15 using n-hexane as a tracer at 120 °C	39
A.3 The equilibrium adsorption of cyclohexene and cyclohexanol on Amberlyst-15 using cyclohexane as a tracer at 120 °C	40
A.4 The equilibrium adsorption of cyclohexene, cyclohexanol, and n-hexane on Amberlyst-15 in the chromatographic reactor using methanol as a desorbent	41
A.5 The effect of cyclohexene and cyclohexanol loaded on Amberlyst-15 on the cyclohexene hydration in the chromatographic reactor	42