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DETERMINATION OF DISPERSION COEFFICIENTS FOR GAS FLOW THROUGH  
A MOLECULAR SIEVE CARBON PACKED BED



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งานวิจัยนี้มุ่งหาสัมประสิทธิ์การกระจายตัวของก๊าซในท่อคูดซับขนาดเล็ก โดยเน้นถึงอิทธิพลจากขนาดอนุภาคเฉลี่ยระหว่าง 0.4919 - 0.9861 มิลลิเมตร และขนาดท่อที่มีเส้นผ่าศูนย์กลางภายใน 0.216 - 0.450 นิ้ว

ในการทดลองครั้งนี้ใช้เทคนิคการติดตามแบบฟีดส์ แล้วศึกษาการกระจายของเรลิเคนซ์ไทม์ของสารติดตาม(ก๊าซมีเทน)ในกระแสก๊าซโพรเพน ซึ่งไหลผ่านท่อที่บรรจุด้วยอนุภาคขนาดเล็กของโมเลคิวลาร์ซีฟคาร์บอนขนาด 3 อังสตรอม โดยปราศจากการคูดซับของก๊าซทั้งสอง จากวิธีโมเมนต์ไดวีเคอเรชท์หาพารามิเตอร์การกระจายตัวของเรลิเคนซ์ไทม์และสัมประสิทธิ์การกระจายตัว สำหรับอนุภาคขนาดต่าง ๆ และเส้นผ่าศูนย์กลางขนาดต่าง ๆ

ผลการทดลองพบว่าสัมประสิทธิ์การกระจายตัวที่หาได้นั้นมีระดับขนาดเดียวกับสัมประสิทธิ์การแพร่เชิงโมเลกุล ซึ่งแสดงให้เห็นว่าลักษณะการไหลเป็นการไหลแบบลูกสูบ นอกจากนี้ข้อมูลยังระบุว่าสัมประสิทธิ์การกระจายตัวเพิ่มขึ้นในขณะที่ขนาดอนุภาคเล็กลง แต่สัมประสิทธิ์การกระจายตัวนี้จะเพิ่มขึ้นตามการเพิ่มขึ้นของขนาดท่อ

ศูนย์วิทยทรัพยากร  
จุฬาลงกรณ์มหาวิทยาลัย

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ลายมือชื่อนิสิต .....  
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CHUKIAT CHAILITLERD : DETERMINATION OF DISPERSION COEFFICIENTS  
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This study involves the measurement of axial dispersion coefficient in small gas adsorption column as a function of adsorbent particle size ( average diameter between 0.4919 - 0.9861 mm ) and column diameter ( 0.216 - 0.450 in ID ) .

An experimental method based on a pulse tracer injection was used to obtain residence time distributions of a methane tracer gas in a stream of propane gas passing through a packed column filled with small particles of molecular sieve carbons 3 Å which do not adsorb either of the gases . A method of moments was then used to measure average residence times and axial dispersion coefficients for several adsorbent particle sizes and column diameters .

The results indicate that axial dispersion coefficients obtained have the same order of magnitude as molecular diffusion coefficients indicating that flow is essentially plug flow for practical purposes . The data indicates that axial dispersion increases with decreasing particle size and the data also indicate that axial dispersion has a tendency to increase with column diameter .

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CONTENTS

	page
THAI ABSTRACT.....	IV
ENGLISH ABSTRACT.....	V
ACKNOWLEDGEMENT.....	VI
LIST OF TABLES.....	X
LIST OF FIGURES.....	XV
NOTATIONS.....	XVI
Chapter	
1 INTRODUCTION.....	1
1.1 Previous studies on axial dispersion for gas systems in packed beds.....	3
1.2 Statement of the problem.....	5
1.3 Objective of the study.....	6
1.4 Scope of study.....	6
2 CONCEPTS, MODELS, BOUNDARY CONDITIONS AND TRANSIENT SOLUTION FOR AXIAL DISPERSION FLOW IN PACKED BED.....	8
2.1 Concepts of axial dispersion in packed beds.....	8
2.1.1 The axial dispersion mechanism.....	8
2.1.2 Definitions of axial dispersion.....	12
2.2 Models for axial dispersion in packed bed.....	12
2.2.1 The ideal plug flow model and the perfect mixing model.....	13
2.2.2 The axial dispersed plug flow model.....	14
2.2.3 The relationship between the dispersion model and the compartments in series model.....	15
2.3 General boundary conditions for axial dispersion in packed beds.....	18
2.3.1 General boundary conditions formulation.....	18
2.3.2 Boundary conditions at the tracer input point...	21

CHAPTER	PAGE
2.3.3	Boundary conditions at the tracer detection point.....25
2.4	Transient equation for the axial dispersed plug - flow model with delta function .....29
3	METHODOLOGY AND RESPONSE DATA ANALYSIS.....33
3.1	Dynamic methods.....33
3.1.1	Foundation of the method.....34
3.1.2	Pulse testing method for axial dispersion measurement.....36
3.2	Response data analysis.....37
3.2.1	Frequency response analysis.....37
3.2.2	The moment's method of analysis.....40
3.3	Modification of data analysis for this study.....44
4	EXPERIMENTAL APPARATUS , MATERIALS AND PROCEDURE FOR DETERMINATION OF AXIAL DISPERSION COEFFICIENTS.....48
4.1	Schematic diagram of apparatus.....48
4.1.1	The packed column.....48
4.1.2	The gas flow meter.....50
4.1.3	The air bath system.....50
4.1.4	The gas analysis system.....51
4.2	Materials.....52
4.3	The experimental procedure.....53
5	RESULTS.....55
5.1	Experimental data and results presentation.....55
5.1.1	Characteristics of systems studied.....55
5.1.2	Typical experimental data and results.....55
5.1.3	Graphical descriptions of the results.....58
5.2	Comparison of results of this work and others.....66
6	Discussion.....68



CHAPTER	PAGE
6.1 Assumptions implied in the mathematical model.....	68
6.1.1 Radial gradients.....	68
6.1.2 Velocity profile.....	69
6.2 Influence of controlled variables.....	69
6.2.1 Particle size.....	69
6.2.2 Tube diameter.....	71
6.2.3 Flow rate.....	72
6.3 The prediction of axial dispersion coefficient.....	73
6.4 Comparative analysis for experimental axial dispersion coefficient.....	77
7 CONCLUSIONS AND RECOMMENDATIONS.....	78
7.1 Conclusions.....	78
7.2 Recommendations.....	79
REFERENCES.....	80
APPENDICES.....	84
A Relationship between axial dispersion coefficient and velocity and particle size.....	85
B Derivation of model's transfer function.....	90
C Simplification of model's transfer function to complex form.....	100
D Curve fitting between theoretical relation and experimental data.....	102
E Moment's method for derivation of mean residence time and variance.....	115
F Determination of particle sizes.....	121
G Sample calculations.....	123
H Basic programming for calculation of Peclet number.....	130
I Examples of chromatographic peaks.....	132
AUTOBIOGRAPHY.....	136

## LIST OF TABLES

TABLE	PAGE
1.1 Summary of experimental axial dispersion data for gases in packed columns.....	2
2.1 Various possibilities of boundary conditions.....	22
2.2 Transfer functions and boundary conditions for axial dispersion model.....	27
4.1 Properties of gases used in this investigation.....	52
5.1 Characteristics of experimental systems.....	56
5.2 Results obtained.....	57
6.1 Molecular diffusion coefficients in binary hydrocarbon gas systems.....	77
G.1 Data , means and variances for sample calculation.....	128

  
 ศูนย์วิทยุทรัพยากร  
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LIST OF FIGURES

FIGURE	PAGE
1.1 Schematic of bed showing stagnant and flowing regions for Cross Flow Model.....	4
1.2 One Alternating Flow Model repeating A/B cell.....	4
2.1 Schematic diagram of packed bed illustrating the nature of tortuous and constricted paths.....	9
2.2 Plug Flow Model and Its Pulse dispersion.....	13
2.3 Complete Mixing Model and Its Pulse dispersion.....	13
2.4 Compartments - in - series with back - flow model.....	16
2.5 Compartments - in - series without back - flow model.....	17
2.6 Column showing dispersion in fore - , packed - , aft - sections of flow system.....	20
2.7 Tracer input to the dispersion model with an open entrance and to the compartments - in - series with back - flow model.....	22
2.8 Tracer input to the dispersion model with a closed entrance and to the compartments in - series - model.....	24
2.9 Tracer detection at an open exit point for the dispersion model and the compartments-in-series model.....	25
2.10 Tracer detection at a closed exit point for the dispersion model and the compartments-in-series model.....	26
4.1 Schematic diagram of apparatus used for determining axial dispersion coefficients.....	49
4.2 Performance curve for the temperature control system by PID.....	51

## LIST OF FIGURES (continued)

FIGURE	PAGE
5.1 Effect of particle size on dispersion in a 4/8 inch diameter column.....	58
5.2 Peclet numbers versus Reynolds numbers showing effect of particle size in 4/8 inch column.....	59
5.3 Effect of particle size on dispersion in a 3/8 inch diameter column.....	60
5.4 Axial Peclet numbers versus Reynolds numbers showing effect of particle size in 3/8 inch column.....	60
5.5 Effect of particle size on dispersion in a 3/8 inch diameter column and a 4/8 inch diameter column.....	61
5.6 Effect of column diameter on dispersion in columns packed with 0.4919 mm particles.....	62
5.7 Peclet numbers versus Reynolds numbers showing effect of column diameter on dispersion for bed packed with 0.4919 mm particles.....	62
5.8 Axial dispersion vs velocity showing effect of column diameter on dispersion for bed packed with 0.4919 mm particles.....	63
5.9 Axial dispersion vs velocity showing effect of column diameter on dispersion for bed packed with 0.6314 mm particles.....	64
5.10 Axial dispersion vs velocity showing effect of column diameter on dispersion for bed packed with 0.8075 mm particles.....	64
5.11 Effect of velocity on dispersion for entire set of data.....	65

## LIST OF FIGURES (continued)

FIGURE	PAGE
5.12 Comparison of results obtained from the literature and this work showing the variations of Peclet number with Reynolds numbers for flow of gases through packed beds.....	67
6.1 Peclet numbers vs Reynolds numbers for $d_p$ equal to 0.36 (1) , 0.52 (2) , and 0.75 (3).....	70
6.2 Relationship between particle size and axial dispersion coefficient based on Hsu & Hyne's equation.....	71
6.3 Relationship between velocity and axial dispersion coefficient based on Hsu & Hyne's equation.....	72
6.4 Axial dispersion coefficient vs velocity for entire set of data showing linear regression line.....	74
6.5 Axial dispersion coefficient vs particle size for entire set of data showing linear regression line.....	74
6.6 Axial dispersion coefficient vs tube diameter for entire set of data showing linear regression line.....	75
6.7 Average minimal deviation of theoretical axial dispersion coefficient from experimental values.....	76
6.8 Comparison of measured dispersion coefficient with that obtained with empirical formula.....	76
A1 Einstein's kinetic - diffusion model.....	86
B1 Packed bed system.....	90
B2 Mass conservation at the inlet point.....	92
B3 Mass conservation at the outlet point.....	93
D1 Curve showing magnitude of transfer function vs. frequency for $Pe = 208$ and $\tau = 50.53148$ .....	103

## LIST OF FIGURES (continued)

FIGURE	PAGE
D2	The argument of transfer function vs frequency for $Pe = 208$ and $\tau = 50.53148$ .....104
D3	Curve of transfer function vs frequency for $Pe = 208$ and $\tau = 50.53148$ .....104
D4	Theoretical normalized concentration - time curve for $Pe = 208$ and $\tau = 50.5318$ .....105
D5	Comparison of experimental response curve and theoretical response for $Pe = 208$ and $\tau = 50.5318$ .....106
D6	Curve showing magnitude of transfer function vs frequency for $Pe = 230$ and $\tau = 82.39171$ .....107
D7	The argument of transfer function vs frequency for $Pe = 230$ and $\tau = 82.39171$ .....108
D8	Curve of transfer function vs frequency for $Pe = 230$ and $\tau = 82.39171$ .....108
D9	Theoretical normalized concentration -time curve for $Pe = 230$ and $\tau = 82.39171$ .....109
D10	Comparison for experimental response curve and theoretical response for $Pe = 230$ and $\tau = 82.39171$ .....110
D11	Curve showing magnitude of transfer function vs frequency for $Pe = 260$ and $\tau = 209.0635$ .....111
D12	The argument of transfer function vs frequency for $Pe = 260$ and $\tau = 209.0635$ .....112
D13	Curve of transfer function vs frequency for $Pe = 260$ and $\tau = 209.0635$ .....112

LIST OF FIGURES (continued)

FIGURE	PAGE
D14 Theoretical normalized concentration - time curve for $Pe = 260$ and $\tau = 209.0635$ .....	113
D15 Comparison of experimental response curve and theoretical response for $Pe = 260$ and $\tau = 209.0635$ .....	114
F1 Ferret's diameter , must be the longest dimension along the line parallel to the base of the field of view.....	121
F2 Particle size distribution with an average of 0.6314 mm....	122
H1 Flow chart for Peclet number calculation.....	130
I1 Three impulse responses of methane tracer in propane at a flow rate of 0.81 cc/sec.....	132
I2 Two chromatographic peaks of blank performances at flow rate of 0.81 cc/sec.....	133
I3 The chromatogram showing adsorption of carbondioxide by MSC-3 A.....	134
I4 Chromatogram showing that methane is not adsorbed by MSC-3 A adsorbent.....	135

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## LIST OF FIGURES (continued)

FIGURE	PAGE
D14	Theoretical normalized concentration - time curve for $Pe = 260$ and $\tau = 209.0635$ .....113
D15	Comparison of experimental response curve and theoretical response for $Pe = 260$ and $\tau = 209.0635$ .....114
F1	Ferret's diameter , must be the longest dimension along the line parallel to the base of the field of view.....121
F2	Particle size distribution with an average of 0.6314 mm....122
H1	Flow chart for Peclet number calculation.....130
I1	Three impulse responses of methane tracer in propane at a flow rate of 0.81 cc/sec.....132
I2	Two chromatographic peaks of blank performances at flow rate of 0.81 cc/sec.....133
I3	The chromatogram showing adsorption of carbondioxide by MSC-3 A.....134
I4	Chromatogram showing that methane is not adsorbed by MSC-3 A adsorbent.....135

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**NOTATIONS**

A	Cross sectional area
C	Fluid concentration
$C_+$	The concentration of reactant in the well - mixed fore section
$C_-$	The concentration of reactant in the well - mixed aft section
$C_e$	Tracer concentration in the effluent stream
$C_f$	The concentration of the reactant in the feed
$C_i$	Tracer concentration in the influent stream
$\bar{D}$	Dispersion coefficient in all direction , $\text{cm}^2/\text{sec}$
$D_m$	Molecular diffusivity , $\text{cm}^2/\text{sec}$
$d_p$	Particle diameter , cm
$\bar{d}_p$	Average particle diameter , cm
$d_t$	Tube diameter , cm
$E_z$	Axial dispersion coefficient , $\text{cm}^2/\text{sec}$
e	Cell mixing efficiency
F	Fraction of a particle diameter equal to a perfect mixing length
f	Fraction of back - flow fluid
$H(s)$	Transfer function in Laplace domain
$H(j\omega)$	Transfer function in Frequency domain
k	Proportionality constant

L	length of test section , cm
M	$uL/2E_2$
M'	Amount of miscible tracer
N	number of mixers
$n_p$	number of perfect mixers , $L/Fd_p$
Pe	Peclet number based on particled diameter , $ud_p/E_2$
$Pe_L$	Peclet number based on bed length , $uL/E_2$ , dimensionless
$Pe_\infty$	Peclet number at perfect mixing
Q	Fluid volumetric flow rate
Q'	Tracer rate
$r_c$	Chemical reaction
Re	Reynolds number based on particle diameter , $Ud_p\rho/\mu$ , dimensionless
S	Laplace domain variable
S'	Source term
Sc	Schmidt number based on molecular diffusivity , $\nu/D_m$ , dimensionless
t	time , sec
u	Superficial velocity of fluid , cm/sec
$u_i$	Interstitial velocity of fluid , cm/sec
V	Vessel volume
$V_+$	Volume of well - mixed aft section
x	Distance parameter in Einstein model
z	distance along the column

$\Delta z$       L/N

Greek Letter

$\epsilon$	Void fraction , dimensionless
$\gamma$	Bed tortuosity factor
$\mu$	Bulk viscosity of fluid , g/cm*sec
$\rho$	Bulk density of fluid , g/ml
$\sigma^2$	Variance of time concentration curve , dimensionless
$\beta$	Constant
$\nabla$	Gradient of vectors
$\bar{t}$	Dimensionless mean residence time
$\bar{\phi}$	Minimum summation of square of theoretical and experimental deviation value
$\bar{\mu}$	Mean residence time
$\theta$	Holding time
$\theta_n$	Cell holding time
$\theta_p$	Perfect mixing time
$\theta_D$	Diffusion time constant

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