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APPENDICES

Appendix A Calculations and Experimental Data

Gas Permeability

Gas permeation experiments were investigated by Illinois model 8000. The sample films were cut into circular shape with 120 mm in diameter according to ASTM D3985-02. The thickness of the films was 2-3 mm. The films were placed in a desicator over NaCl and kept for not less than 3 days prior to test.

Gas trasmission rate (GTR)

$$GTR = \frac{\Delta M}{A \cdot \Delta t \cdot \Delta p}$$

Permeability (Q)

$$Q = \frac{\Delta M \cdot L}{A \cdot \Delta t \cdot \Delta p}$$

$$\therefore Q = GTR \times L$$

where:

$\frac{\Delta M}{\Delta t}$ = amount of gas passing through film in unit time (cm^3/s)

A = area (m^2)

Δp = the differntial partial pressure of the permeat gas across the film (bar)

L = film thickness (mm)

The gas permeability rate, G, in units of $cm^3/(m^2.day.bar)$ is calculated from,

$$G = \frac{7.76 \times 10^7 \times V}{78.5K \times 29N}$$

where:

V = volume of the evacuation chamber

K = absolute temperature (degrees Kelvin)

N = the slope of the graph which is determined by dividing the time (s) by the scale divisions (mm)

if the evacuation chamber volume, V, is 0.4370 cm^3 then this expression simplifies to,

$$G = \frac{1.49 \times 10^7}{KN} \quad cm^3/(m^2 \cdot day \cdot bar)$$

$$G = \frac{1.49 \times 10^7 \times 0.9896}{KN} \quad cm^3/(m^2 \cdot day \cdot atm)$$

Table A1 Oxygen Gas Transmission Rate of PLA sheet

Oxygen Gas Transmission Rate ($cc/m^2.d$)		
Test	1st Sample	2nd Sample
1	138	125
2	139	125
3	139	125
4	139	125
5	140	124
6	139	124
7	139	124
8	139	124
9	139	124
10	139	125
Average	139	125
SD	0.5	0.5
Thickness of Sample (μm)	204	210

Oxygen Gas Transmission Rate of PLA sheet = 132 ($cc/m^2.d$)

Table A2 Oxygen Gas Transmission Rate of PLA/5%wt PCL sheet

Oxygen Gas Transmission Rate ($cc/m^2.d$)		
Test	1st Sample	2nd Sample
1	119	105
2	118	103
3	118	104
4	119	105
5	120	105
6	120	106
7	120	106
8	119	105
9	119	105
10	119	105
Average	119	105
SD	0.7	0.9
Thickness of Sample (μm)	201	212

Oxygen Gas Transmission Rate of PLA/5%wt PCL sheet = 112 ($cc/m^2.d$)

Table A3 Oxygen Gas Transmission Rate of PLA nanocomposite sheet

Oxygen Gas Transmission Rate (cc/m^2.d)		
Test	1st Sample	2nd Sample
1	106	104
2	106	104
3	106	104
4	107	104
5	107	105
6	107	105
7	107	105
8	107	105
9	106	105
10	106	104
Average	119	105
SD	0.7	0.9
Thickness of Sample (μm)	209	214

Oxygen Gas Transmission Rate of PLA nanocomposite sheet = 106 (cc/m^2.d)

<u>The molar ratio of dodecylamine and TEOS</u>

Example : D/T=20/200 in organoclay 1 g; MW of dodecylamine = 185.35

MW of TEOS = 208.33

Density of TEOS = 0.933 g/mol

CEC of bentonite = 55 mmol/100g of clay

Composition	mmol	g	ml
Organoclay	0.55	1	-
Dodecylamine	20	2.04	-
TEOS	200	-	24.56

Appendix B Types of Adsorption Isotherm and Hysteresis Loop

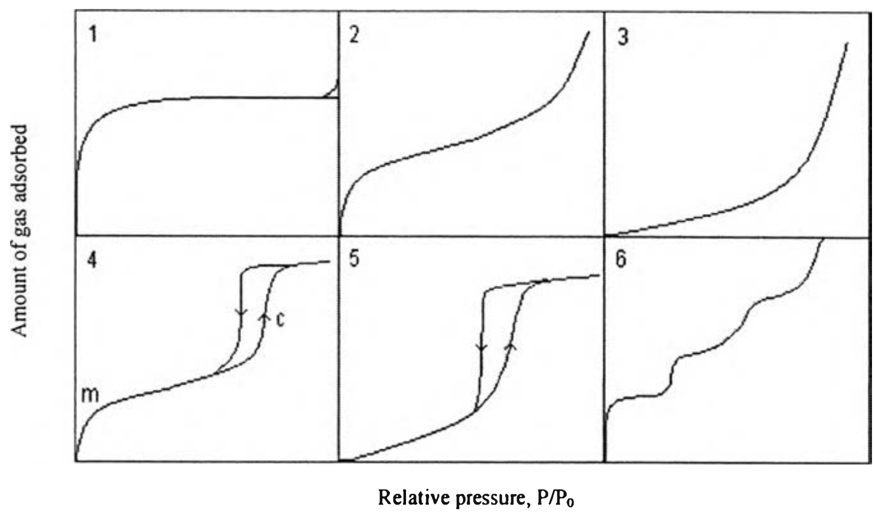

Figure B1 Types of adsorption isotherm according to BDDT classification.

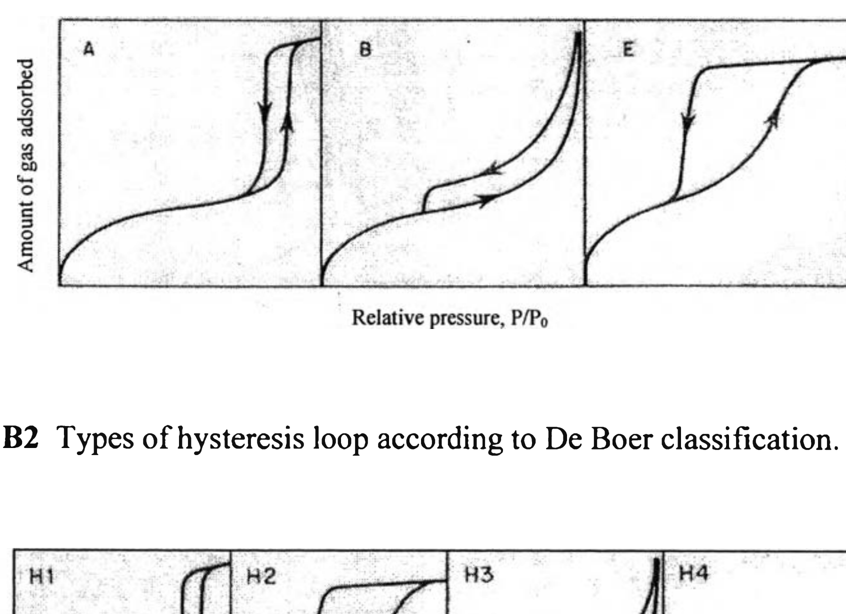

Figure B2 Types of hysteresis loop according to De Boer classification.

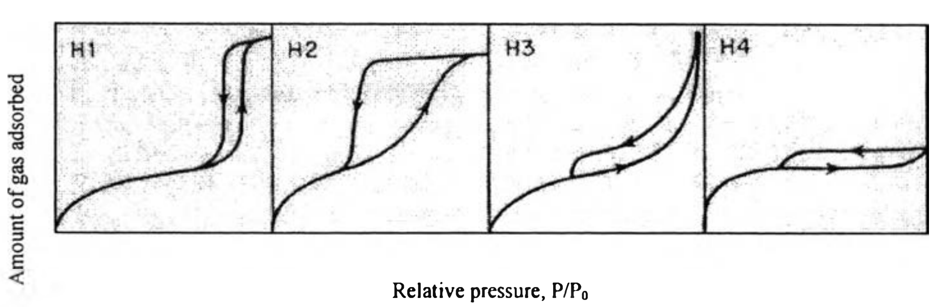

Figure B3 Types of hysteresis loop according to IUPAC classification.

Appendix C Supplementary Results

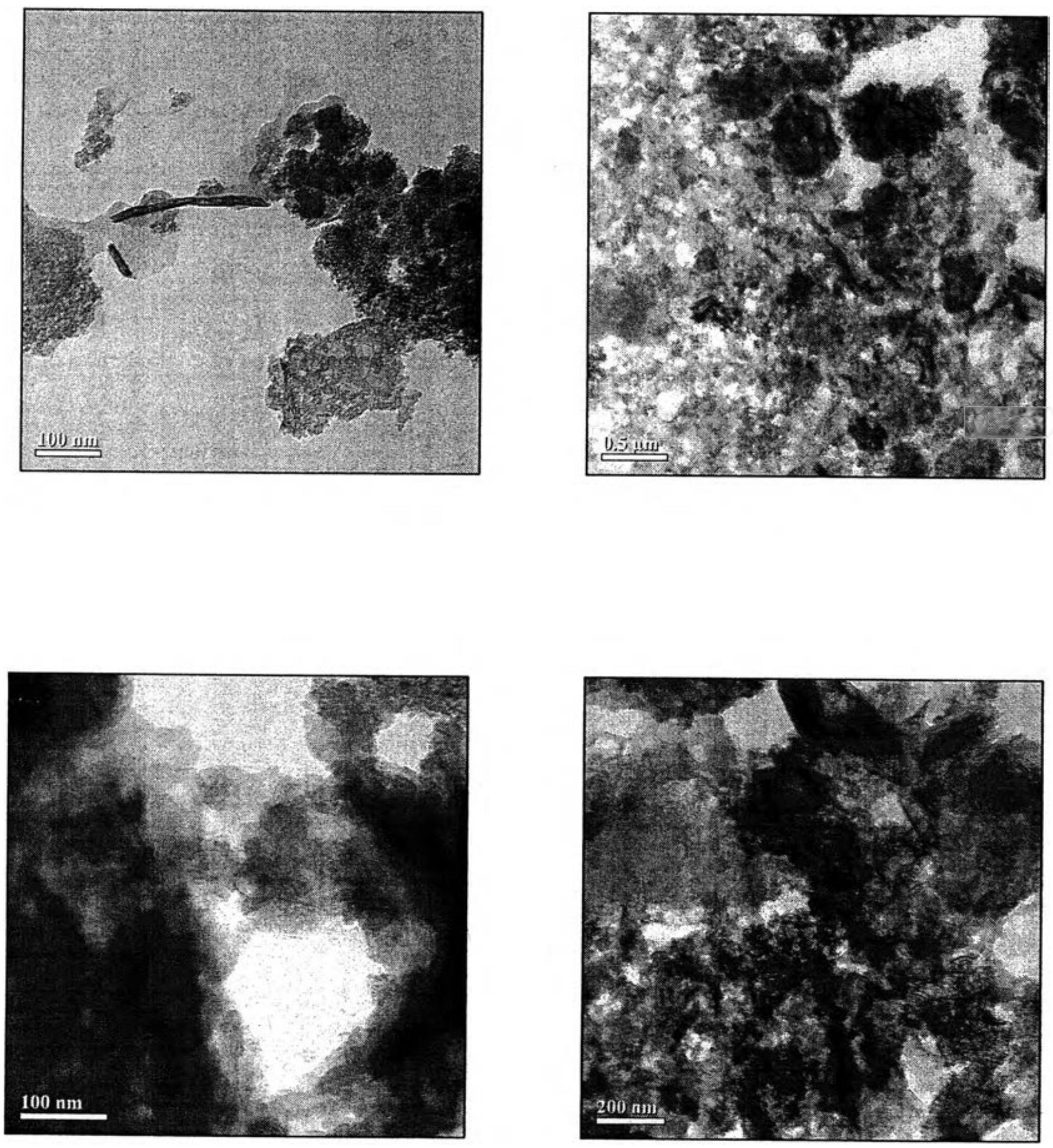

Figure C1 TEM images of magnetic PCHs

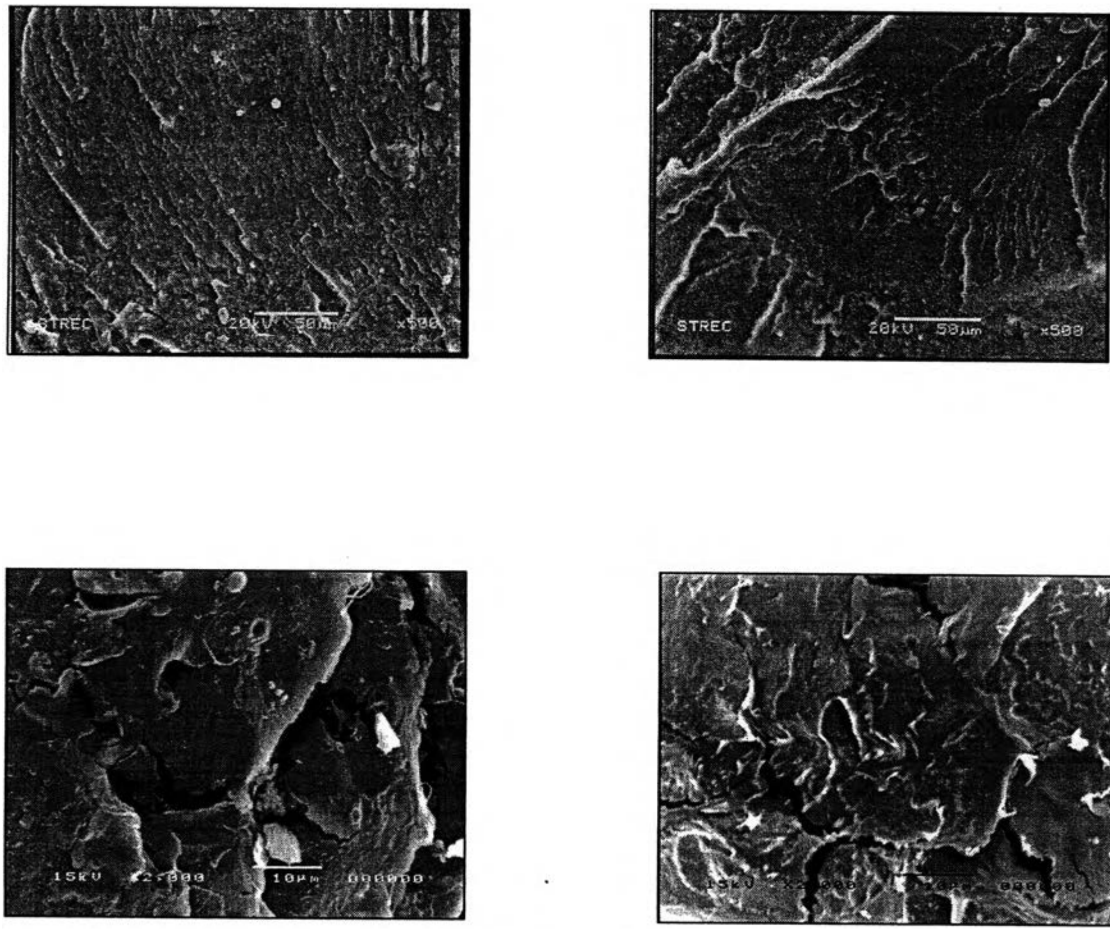

Figure C2 SEM images of PLA nanocomposites

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2. Mattayan, A., Magaraphan, R., and Manuspiya, H. (2008, November 6-8) Synthesis of Surface Modified Porous Clay Heterostructure(PCH) for Magnetic Sensor in Film Packaging. Proceedings of the NanoThailand Symposium 2008, Bangkok, Thailand.
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4. Mattayan, A., Magaraphan, R., and Manuspiya, H. (2009, April 22) Induced Magnetic Properties to Surface-Modified Mesoporous Clay Heterostructures for Sensor Application in Food Packaging. Proceedings of the 15^{th} PPC Symposium on Petroleum, Petrochems, and Polymers, Bangkok, Thailand.

Presentations:

1. Aksonnum, T., Mattayan, A., Nithithanakul, M., Magaraphan, R., and Manuspiya, H. (2008, August 19-20) Nanoclay/Polypropylene Composite for Ethylene and Carbon Dioxide Scavenging Films. Poster presented at Thai-Japan Joint Symposium on Advances in Materials Science and Environmental Technology 2008, Bangkok, Thailand.

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