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APPENDICES

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APPENDIX A
CALCULATION OF CATALYST PREPARATION

Molybdenum Impregnation

Let the amount of Mo into catalyst = 8 wt%

The catalyst used = X g

So that : from the equation

$$\text{Mo} / (\text{X} + \text{Mo}) = 8/100$$

$$100 \times \text{Mo} = 8 \times (\text{X} + \text{Mo})$$

$$(100-8) \times \text{Mo} = 8 \times \text{X}$$

$$\text{thus Mo} = (8 \times \text{X}) / (100-8) \text{ g}$$

use $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O}$ (molecular weight = 1235.86, Mo = 95.94 g)

Weight of $(\text{NH}_4)_6\text{Mo}_7\text{O}_{24} \cdot 4\text{H}_2\text{O} = [8 \times \text{X} / (100-8)] \times [1235.86 / (95.94 \times 7)] \text{ g}$

Notes $\text{NH}_4\text{ZSM-5}$ 0.7 g : Distilled water 0.45 ml

HY 0.7 g : Distilled water 0.7 ml

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APPENDIX B

SAMPLE OF CALCULATIONS

Calculation of GHSV of methane

The catalyst used = 0.2 g.

packed catalyst into stainless steel reactor (inside diameter = 0.75 cm.)

determine the average high of catalyst bed = H cm. So that,

$$\text{GHSV (h}^{-1}\text{)} = \frac{\text{Volumetric flow rate}^1 \text{ (cc/min)}}{\text{Volume of bed (cc-cat)}}$$

at STP condition :

$$\text{Volumetric flow rate} = \frac{\text{Volumetric flow rate}^1 \times (273.15 + T)}{273.15}$$

$$\text{Volume of bed} = \pi \times (0.3)^2 \times h \text{ cc-cat.}$$

where T = room temperature, °C.

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APPENDIX C

CALIBRATION CURVE

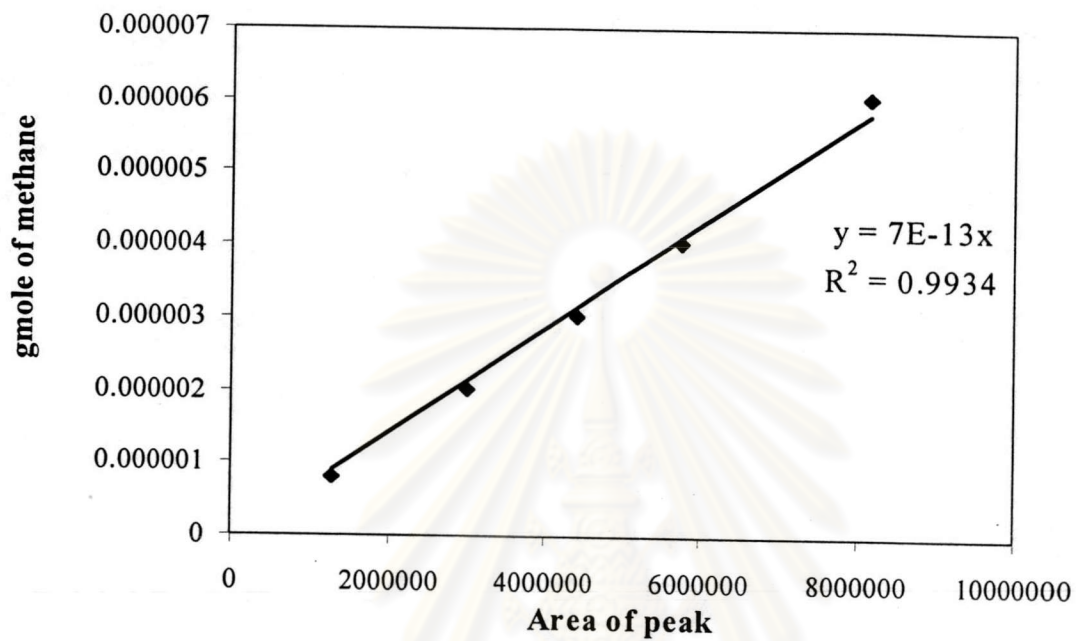
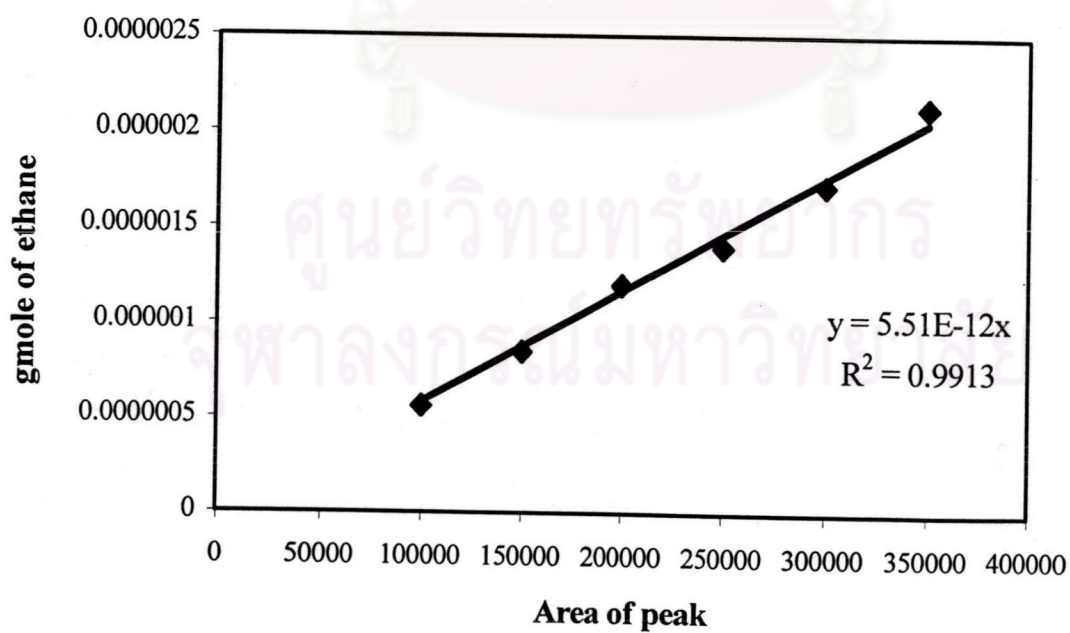
Flame ionization detector gas chromatographs, model 14A and 14B, were used to analyze the concentrations of hydrocarbons. Benzene were analyzed by GC model 14A while methane, ethane, and ethylene were analyzed by GC model 14B.

Gas chromatograph with the thermal conductivity detector, model 8A, was used to analyze the concentration of CO₂ and CO by using Porapak-Q and Molecular Sieve 5-A column, respectively.

The calibration curves of methane, ethane, ethylene, benzene, CO₂, and CO are illustrated in the following figures.



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Calibration curve**Figure C1** Calibration curve of methane**Figure C2** Calibration curve of ethane

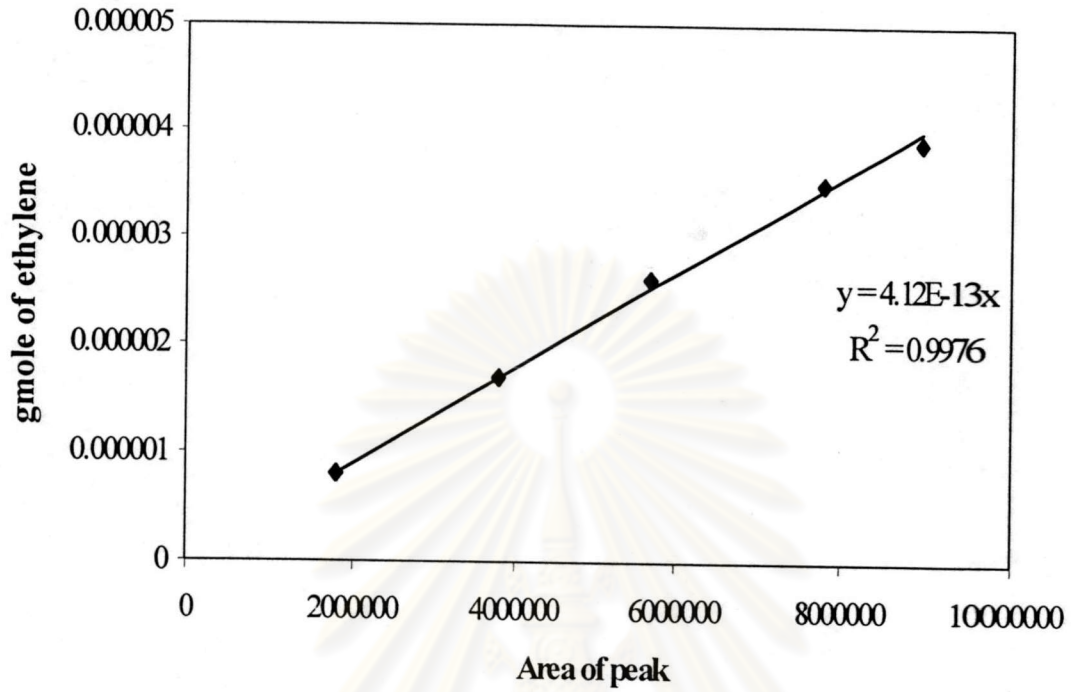


Figure C3 Calibration curve of ethylene

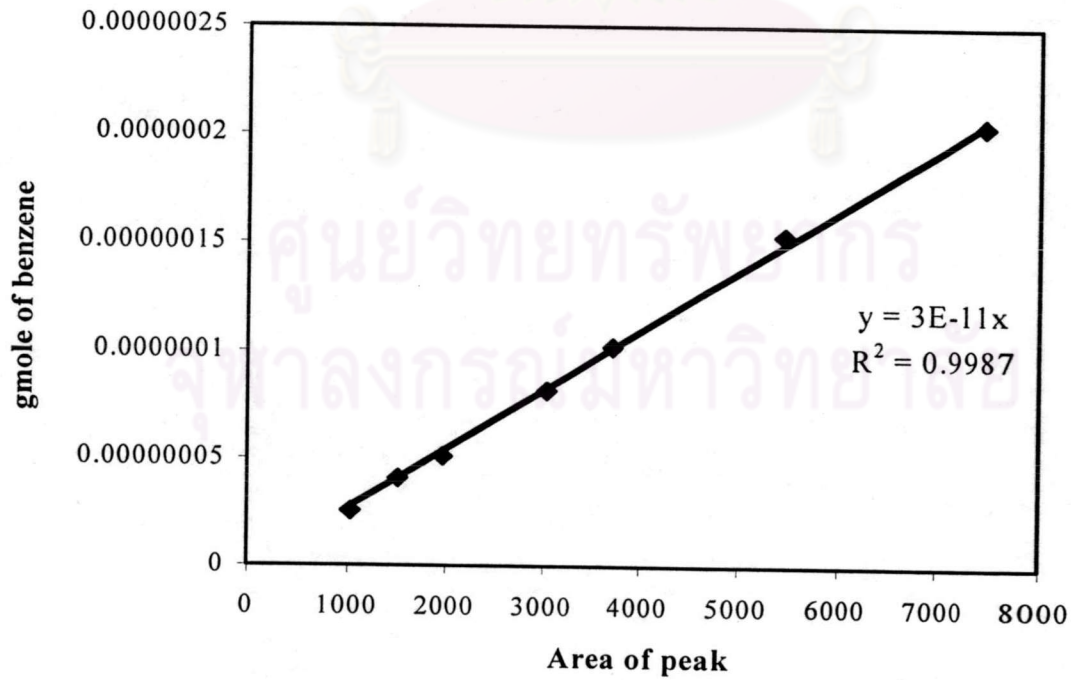


Figure C4 Calibration curve of benzene

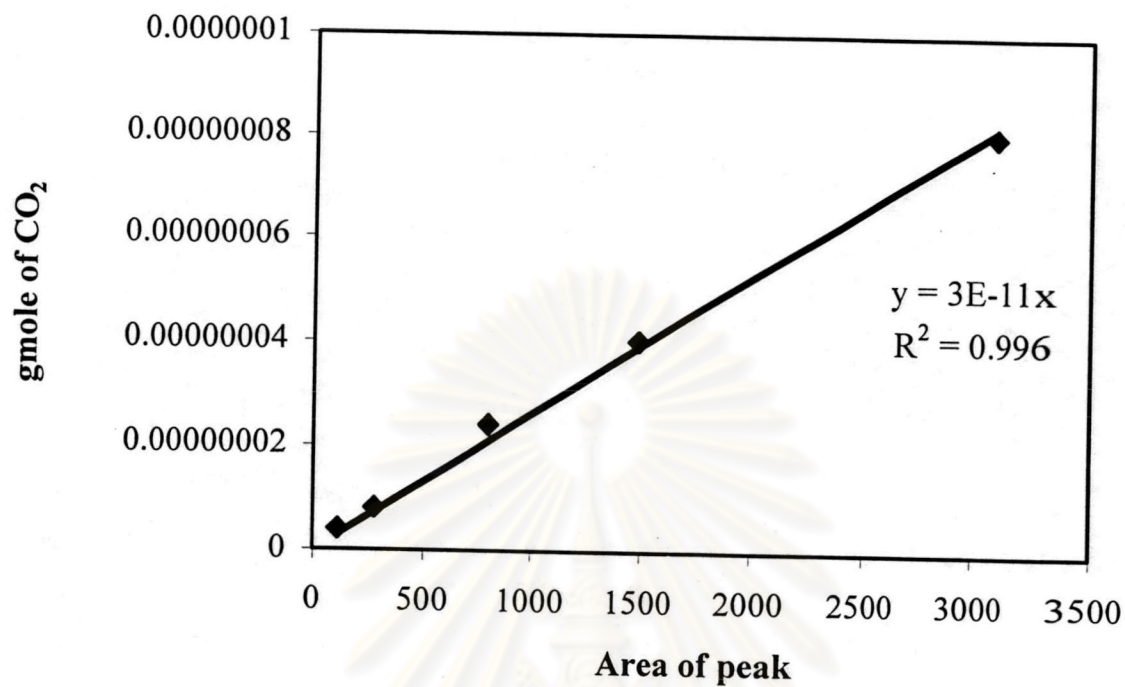


Figure C5 Calibration curve of CO₂

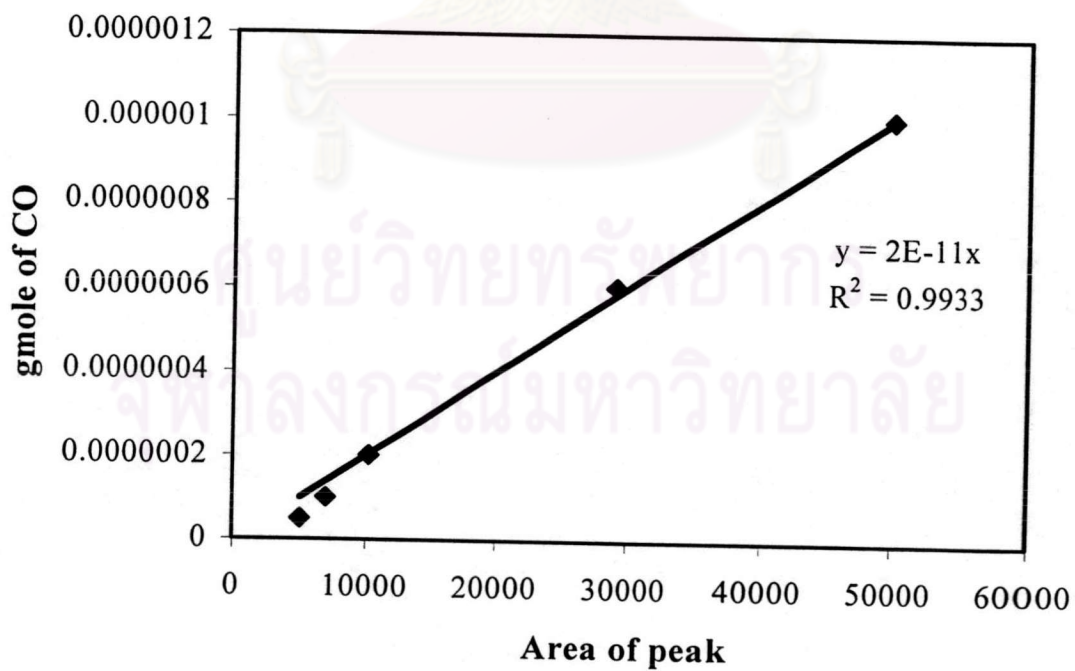


Figure C6 Calibration curve of CO

APPENDIX D
DATA OF EXPERIMENT

TABLE D1 Data of Figure 5.14

Methane Conversion (%)

TOS (min)	30	60	90	120	150	180	210	240	270	300
600°C	1.79	2.34	2.25	2.23	2.12	2.02	1.87	1.50	0.66	0.79
650°C	3.24	3.67	4.85	3.99	3.49	3.33	3.09	2.08	1.45	1.46
700°C	9.15	10.98	11.39	12.43	9.61	8.83	8.65	8.56	8.37	8.25

TABLE D2 Data of Figure 5.15

Product selectivity (%)

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	0.00	0.20	11.35	88.45
60	0.00	1.50	6.74	91.76
90	4.17	1.30	4.83	89.70
120	36.64	1.39	2.83	59.14
150	42.78	1.56	2.23	53.43
180	47.60	1.55	1.71	49.15
210	48.51	1.95	1.61	47.93
240	50.91	1.91	1.43	45.75
270	48.74	2.00	1.42	47.84
300	50.52	2.10	1.50	45.87

TABLE D3 Data of Figure 5.16*Product selectivity (%)*

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	0.00	0.14	5.64	94.22
60	0.00	0.69	4.54	94.77
90	8.17	1.52	3.97	86.34
120	20.98	1.89	3.14	74.00
150	36.89	1.99	2.29	58.83
180	43.60	2.05	1.94	52.42
210	50.60	2.06	1.61	45.74
240	53.08	1.97	1.38	43.57
270	54.97	2.03	0.98	42.02
300	55.24	2.22	0.80	41.73

TABLE D4 Data of Figure 5.17, Figure 5.20, Figure 5.23 and Figure 5.28*Product selectivity (%)*

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	4.31	1.76	1.39	92.54
60	57.80	2.88	0.71	38.61
90	73.57	3.37	0.68	22.38
120	72.29	3.57	0.56	23.58
150	74.90	3.99	0.36	20.76

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
180	73.75	4.13	0.29	21.83
210	68.82	4.77	0.33	26.08
240	67.29	5.63	0.36	26.72
270	70.80	5.30	0.34	23.56
300	69.38	5.55	0.35	24.72

TABLE D5 Data of Figure 5.18

Methane Conversion (%)

TOS (min)	30	60	90	120	150	180	210	240	270	300
5%Mo	16.59	12.70	10.68	9.00	6.89	7.37	6.71	6.79	5.97	5.55
8%Mo	9.15	10.98	11.39	12.43	9.61	8.83	8.65	8.56	8.37	8.25
10%Mo	8.29	11.85	10.86	6.79	6.96	5.32	3.68	3.30	3.23	2.86

TABLE D6 Data of Figure 5.19

Product selectivity (%)

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	0.27	2.07	2.38	95.27
60	36.45	2.90	1.68	58.97
90	55.27	2.80	0.82	41.12

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
120	55.28	3.21	0.78	40.73
150	55.73	3.59	0.70	39.98
180	58.35	3.04	0.62	37.99
210	62.42	3.26	0.60	33.73
240	63.20	3.79	0.56	32.44
270	61.99	4.22	0.55	33.24
300	61.58	4.70	0.51	33.22

TABLE D7 Data of Figure 5.21

Product selectivity (%)

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	0.00	0.02	19.18	80.81
60	9.99	2.73	10.77	76.51
90	57.28	2.68	3.46	36.58
120	55.70	3.33	1.60	39.36
150	62.69	3.20	0.73	33.38
180	64.24	3.43	0.56	31.77
210	66.35	4.15	0.44	29.07
240	69.62	4.33	0.40	25.65
270	69.14	4.42	0.38	26.06
300	67.08	5.73	0.39	26.80

TABLE D8 Data of Figure 5.22*Methane Conversion (%)*

TOS (min)	30	60	90	120	150	180	210	240	270	300
2000 h ⁻¹	9.15	10.98	11.39	12.43	9.61	8.83	8.65	8.56	8.37	8.25
4000 h ⁻¹	6.28	8.04	6.96	6.23	5.85	5.69	4.51	4.69	4.71	4.62
6000 h ⁻¹	3.50	4.83	3.75	3.83	3.61	3.30	2.98	2.85	2.52	2.51

TABLE D9 Data of Figure 5.24*Product selectivity (%)*

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	66.41	1.69	1.95	29.95
60	73.58	2.84	0.32	23.25
90	76.04	4.14	0.23	19.58
120	74.41	5.19	0.30	20.10
150	71.30	6.85	0.00	21.85
180	69.59	7.41	0.00	22.99
210	69.33	8.61	0.00	22.05
240	64.09	10.60	0.00	25.31
270	61.06	13.18	0.00	25.76
300	60.89	15.73	0.00	24.80

TABLE D10 Data of Figure 5.25*Product selectivity (%)*

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	75.24	2.48	0.50	21.77
60	76.11	5.06	0.19	18.63
90	74.32	8.92	0.17	16.58
120	68.46	11.23	0.16	20.16
150	67.83	12.10	0.14	19.93
180	60.29	16.41	0.14	23.15
210	55.75	18.57	0.15	25.52
240	55.92	18.46	0.11	25.51
270	56.07	19.33	0.07	24.53
300	55.16	18.91	0.09	25.84

TABLE D11 Data of Figure 5.26*Methane Conversion (%)*

TOS (min)	30	60	90	120	150	180	210	240	270	300
HZSM-5	1.95	2.32	2.00	1.87	1.79	1.83	-	-	-	-
8%Mo/HZSM-5	9.15	10.98	11.39	12.43	9.61	8.83	8.65	8.56	8.37	8.25
8%Mo/HY	5.01	6.67	5.67	4.96	5.12	4.81	4.39	3.30	2.85	2.18

TABLE D12 Data of Figure 5.27*Product selectivity (%)*

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	0.00	0.03	14.16	85.80
60	0.00	0.08	3.01	96.90
90	0.00	0.12	2.76	97.12
120	0.00	0.17	2.19	97.64
150	0.00	0.20	2.16	97.64
180	0.00	0.28	2.02	97.69

TABLE D13 Data of Figure 5.29*Product selectivity (%)*

TOS (min)	C ₆ H ₆	C ₂ H ₄ /C ₂ H ₆	CO ₂	CO
30	0.00	0.39	9.54	90.07
60	0.00	0.56	3.56	95.88
90	2.46	0.76	2.65	94.13
120	2.34	0.83	1.69	95.14
150	2.85	0.86	1.57	94.72
180	4.32	0.99	1.57	93.12
210	3.23	1.05	1.53	94.18
240	3.05	1.25	1.53	94.17
270	3.31	1.23	1.80	93.66
300	2.73	1.31	1.64	94.32

VITA

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