REFERENCES

Anderson, B.G., Schumacher, R.R., Duren, R.V., Singh, A.P., and Santen, R.A. (2002) An attempt to predict the optimum zeolite-based catalyst for selective cracking of naphtha-range hydrocarbons to light olefins. Journal of Molecular Catalysis A: Chemical, 181, 291-301.

Buchanan, J.S. (1998) Gasoline selective ZSM-5 FCC additives: Model reactions of C_6-C_{10} olefins over steamed 55:1 and 450:1 ZSM-5. Applied Catalysis A: General, 171, 57-64.

Buchanan, J.S. (2000) The chemistry of olefins production by ZSM-5 addition to catalytic cracking units. Catalysis Today, 55, 207-212.

Corma, A. and Orchilles, A.V. (2000) Current views on the mechanism of catalytic cracking. Microporous and Mesoporous Materials, 35-36, 21-30.

Degnan, T.F., Chitnis, G.K., and Schipper, P.H. (2000) History of ZSM-5 fluid catalytic cracking additive development at Mobil. Microporous and Mesoporous Materials, 35-36, 245-252.

Guisnet, M. and Magnoux, P. (1997) Deactivation by coking of zeolite catalysts. Prevention of deactivation. Optimal conditions for regeneration. Catalysis Today, 36, 477-483.

Guisnet, M. and Magnoux, P. (2001) Organic chemistry of coke formation Applied Catalysis A: General, 212, 83-96.

Hollander, M.A. den, Wissink, M., Makkee, M., and Moulijn, J.A. (2002) Gasoline conversion: reactivity towards cracking with equilibrated FCC and ZSM-5 catalysts. Applied Catalysis A: General, 223, 85-102.

Kotrel, S., Knözinger, H., and Gates, B.C. (2000) The Haag-Dessau mechanism of protolytic cracking of alkanes. Microporous and Mesoporous Materials, 35-36, 11-20.

Li, C. and Stair, P.C. (1997) Ultraviolet Raman spectroscopy characterization of coke formation in zeolites. Catalysis Today, 33, 353-360.

Li, J., Xiong, G., Feng, Z., Liu, Z., Xin, Q., and Li, C. (2000) Coke formation during the methanol conversion to olefins in zeolites studied by UV Raman spectroscopy. Microporous and Mesoporous Materials, 39, 275-280.

Liu, C., Deng, Y., Pan, Y., Gu, Y., Qiao, B., and Gao, X. (2004) Effect of ZSM-5 on the aromatization performance in cracking catalyst Journal of Molecular Catalysis A: Chemical, 215, 195-199.

Narbeshuber, T.F., Vinek, H., and Lercher, J.A. (1995) Monomolecular Conversion of light Alkanes over H-ZSM-5. Journal of Catalysis, 163, 50-62.

Noronha, F.B., Fendley, E.C., Soares, R.R., Alvarez, W.E., and Resasco, D.E. (2001) Correlation Between Catalytic Activity and Support Reducibility in the CO_2 Reforming of Methane over $Pt/Ce_xZr_{1-x}O_2$ Catalysts. Chemical Engineering Journal, 82, 21-28.

Song, Y., Li, H., Guo, Z., Zhu, X., Liu, S., Niu, X., and Xu, L. (2005) Effect of variations in acid properties of HZSM-5 on the coking behavior and reaction stability in butene aromatization. Applied Catalysis A: General, 292, 162-170.

Trimm, D.L. (2001) The regeneration or disposal of deactivated heterogeneous catalyst. Applied Catalysis A: General, 212, 153-160.

Viswanadham, N., Murali Dhar, G., and Prasada Rao, T.S.R. (1997) Pore size analysis of ZSM-5 catalysts used in *n*-heptane aromatization reaction: An evidence for molecular traffic control (MTC) mechanism. Journal of Molecular Catalysis A: Chemical, 125, L87-L90.

Wakui, K., Satoh, K., Sawada, G., Shiozawa, K., Matano, K., and Suzuki, K. (2002) Dehydrogenative cracking of *n*-butane using double-stage reaction. Applied Catalysis A: General, 230, 195-202.

Weitkamp, J. (2000) Zeolites and catalysis. Solid State Ionics, 131, 175-188.

APPENDICES

Appendix A Retention Time of Products

The retention time of products are collected from online gas chromatography (Shimadzu, GC-14A with C-R4A Chromatopac). The column conditions start with initial temperature at 50°C hold for 9 minutes after that temperature is heated at a rate of 20°C/min to 90°C and hold for 10 minutes. Afterward the column is heated to final temperature at 230°C with heating rate 2°C/min. The data of several tested are confirmed the retention time of products in these following table.

Table A1 Retention time of products

Peak Time (min)	Species
0.788	methane
1.969	ethylene
2.614	ethane
10.140	propylene
10.863	propane
17.122	*i*-butane
18.497	*i*-butene
18.548	1-butene
21.492	*n*-butane
51.430	benzene
63.097	toluene
73.131	EB+(*m*,*p*)-xylene
75.436	*o*-xylene

Appendix B Converting Gas Chromatography Area Method

Area under the curve from online gas chromatography (Shimadzu, GC-14A with C-R4A Chromatopac) can be convert into mass percent, normalized to 100% by using the following formula to calculate the flame ionization detector respond factors that obtained from the ASTM D 5443-93 standard method.

$$Fi = \frac{\frac{(Caw \times Cn) + (Haw \times Hn)}{Cn} \times 0.7487}{Caw} \qquad (1)$$

Where:

Fi = relative response factor for a hydrocarbon type group of a particular carbon number,

Caw = atomic weight of carbon, 12.011,

Cn = number of carbon molecules in the group,

Haw = atomic weight of hydrogen, 1.008,

Hn = number of hydrogen molecules in the group, and

0.7478 = corrects the response of methane to unity.

Multiple the area associated with each of the identifield groups by the appropriate response factor to produce a corrected area for each of the group:

$$Aic = Ai \times Fi \qquad (2)$$

Where:

Aic = corrected area of an identified group, and

Ai = raw area of identified group.

Add all of the individual, corrected areas from equation (2):

$$T = \sum Aic \qquad (3)$$

Where:

T = total of corrected areas.

Divide each of the identified groups by the total corrected area determined in equation (3) to produce the normalized mass percent for each group:

$$Mi = \frac{Aic}{T} \qquad (4)$$

Where:

Mi = normalized mass % of an identified group.

From these method the relative response factor (Fi) can be calculating and presenting in Table B1

Table B1 The relative response factor (*Fi*) of any hydrocarbons in this experiment

Species	*Cn*	*Hn*	*Fi*	Species	*Cn*	*Hn*	*Fi*
methane	1	4	1.0000	1,3-pentadiene	5	8	0.8492
ethane	2	6	0.9372	benzene	6	6	0.8115
ethylene	2	4	0.8744	*i*-hexene	6	12	0.8744
propane	3	8	0.9163	*n*-hexane	6	14	0.8953
propylene	3	6	0.8744	1-hexene	6	12	0.8744
i-butane	4	10	0.9058	2-hexene	6	12	0.8744
n-butane	4	10	0.9058	*i*-hexane	6	14	0.8953
tran-2-butene	4	8	0.8744	cyclo-hexene	6	10	0.8534
1-butene	4	8	0.8744	cyclo-hexane	6	12	0.8744
i-butene	4	8	0.8744	MCP	6	12	0.8744
cis-2-butene	4	8	0.8744	*i*-heptane	7	16	0.8923
1,2-butadiene	4	6	0.8429	*n*-heptane	7	16	0.8923
1,3-butadiene	4	6	0.8429	DCP	7	14	0.8744
n-pentane	5	12	0.8995	toluene	7	8	0.8205
1-pentene	5	10	0.8744	ethylbenzene	8	10	0.8272
cyclo-pentadiene	5	10	0.8744	*o,m,p*-xylene	8	11	0.8351

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