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APPENDICES

Appendix A Gel Batch Composition Calculations

As mentioned previously in Chapter 3, Na-Y zeolite was prepared by using the recipe $4Na_2O$: $1Al_2O_3$: $10SiO_2$: $180H_2O$. The calculations to estimate the required weights of gel as follows:

The Composition of desired NaY Zeolite is

$$4Na_2O: 1Al_2O_3: 10SiO_2: 180H_2O$$

So

- $\frac{SiO_2}{Al_2O_3}$ molar ratio = 10
- $\frac{Na_2O}{SiO_2}$ molar ratio = 0.4
- $\frac{H_2O}{SiO_2}$ molar ratio = 18

Basis; The initial mole of SiO_2 which I want to synthesis equal to 10 g or 0.1664 mole

So; Ludox HS-40 = 0.1664 mole

= 9.9992 g

- 40% Ludox = 9.9992/0.4 = 24.9982 g = 19.2293 mL
- 40% Ludox consist of water 24.9982 × 0.6 = 14.9989 g = 14.9989 mL

Al Content: From $\frac{SiO_2}{Al_2O_3} = 10$

So ; Al_2O_3 = mole of SiO_2 / 10

= 0.1664/10 = 0.01664 mole

Since $NaAlO_2$ is used for Al source, Mole of $NaAlO_2$ be used equal to 0.01664 × 2 mole

= 0.0333 mole

= 0.0333 × 81.97 = 2.729 g

And $NaAlO_2$ consist of Al, Na equal to 53.5 and 45% respectively, So the real content of Al that will be used equal to 2.729/0.535 = 5.1 g and have a Na content equal to 2.2949

Na Content: From $\frac{Na_2O}{SiO_2} = 0.4$

So ; Na_2O = mole of $SiO_2 \times 0.4$

= 0.1664 × 0.4 = 0.067mole

Since NaOH is used for Na source, Mole of NaOH be used equal to 0.067 × 2

= 0.13312 mole

= 0.13312× 39.997 = 5.3244 g

Since assay percentage of NaOH = 99.17%, the content of Na that will be used for synthesis equal to 5.3244/0.9917 = 5.369 g and the content of Na in $NaAlO_2$ equal to 2.2949, So the real content of NaOH equal to 5.369 - 2.2949 = 3.0741 g

H_2O Content: From $\frac{H_2O}{SiO_2} = 18$

So ; Mole of H_2O = mole of $SiO_2 \times 18$

= 0.1664 × 18 = 2.9952 mole

= 53.9136 g or 53.9136 mL

The real content of water that we want equal to 53.9136 - 14.9989 = 38.9147 ml (14.9989 mL of water is found in Ludox).

Table A1 Molecular weight of each used chemical as follow in the table A1

Component	MW
40% Ludox	60.08
NaAlO2	81.97
SiO_2	60.08
Al_2O_3	101.9
NaOH	39.9
H_2O	18.01

Appendix B Atlas and Simulated XRD Power Patters of Zeolite Structure Types

Framework Type: FAU

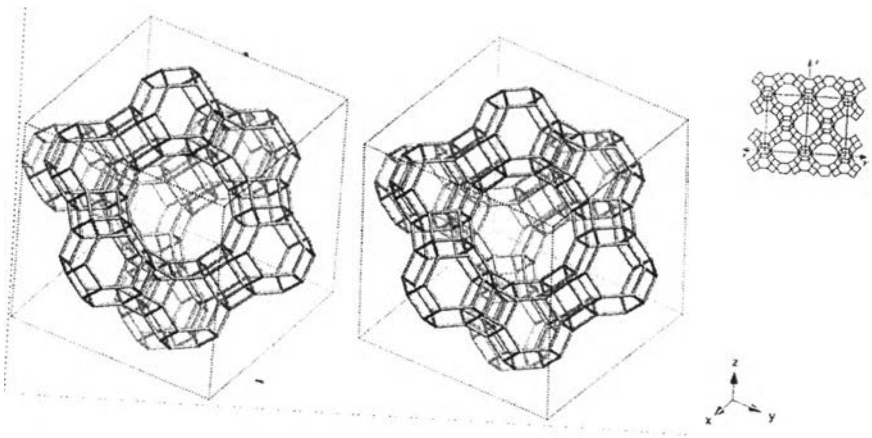


Figure B1 Framework viewed along [111] (upper right: projection down [110])

Cell Parameters:

a = 24.345 Å	b = 24.345 Å	c = 24.345 Å
α = 90.000°	β = 90.000°	γ = 90.000°
Volume =	14428.77 Å^3	
R_{DLS} =	0.0009	

Framework density (FD_{Si}): 13.3 T/1000 Å^3

Topological density: TD_{10} = 579 TD = 0.476190

Ring sizes (# T-atoms): 12 6 4

Channel system: 3-dimensional

Maximum diameter of a sphere:

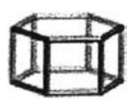
that can be included 11.24 Å

that can diffuse along

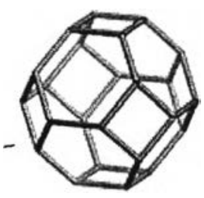
a: 7.35 Å b: 7.35 Å c: 7.35 Å

Accessible volume: 27.6 %

Composite Building Units:



d6r (t-hpr)



sod (t-toc)

FAU Na-Y, Siliceous

CHEMICAL COMPOSITION: $[Si_{192}O_{384}]$

REFINED COMPOSITION: $[Si_{188.16}O_{384}]$

CRYSTAL DATA: $Fd\bar{3}m$ (No. 227) origin at centre ($\bar{3}m$)
a = 24.2576 Å b = 24.2576 Å c = 24.2576 Å
α = 90° β = 90° γ = 90°
Neutron Rietveld refinement, R_{exp} = 0.022, R_{wp} = 0.031

REFERENCE: J. J. Hriljac, M. M. Eddy, A. K. Cheetham, J. A. Donohue and G. J. Ray, *J. Solid State Chem.* **106** 66–72 (1993).

h	k	l	2θ	d	M	I_{rel}
1	1	1	6.31	14.005	8	100.0
2	2	0	10.31	8.576	12	13.6
3	1	1	12.10	7.314	24	12.5
4	0	0	14.61	6.064	6	0.3
3	3	1	15.92	5.565	24	16.0
4	2	2	17.91	4.952	24	0.1
5	1	1	19.01	4.668	24	4.3
3	3	3	19.01	4.668	8	0.2
4	4	0	20.71	4.288	12	6.4
5	3	1	21.67	4.100	48	0.3
4	4	2	21.98	4.043	24	0.1
6	2	0	23.19	3.835	24	1.3
5	3	3	24.06	3.699	24	7.6
4	4	4	25.44	3.501	8	0.3
5	5	1	26.24	3.397	24	1.2
6	4	2	27.52	3.242	48	4.6

h	k	l	2θ	d	M	I_{rel}
7	3	1	28.26	3.158	48	0.2
7	3	3	30.16	2.964	24	1.5
8	2	2	31.29	2.859	24	0.7
6	6	0	31.29	2.859	12	1.9
7	5	1	31.95	2.801	48	0.5
5	5	5	31.95	2.801	8	4.4
8	4	0	33.03	2.712	24	1.2
7	5	3	33.66	2.663	48	0.5
8	4	2	33.87	2.647	48	0.1
6	6	4	34.69	2.586	24	2.4
9	3	1	35.29	2.543	48	1.0
8	4	4	36.28	2.476	24	0.3
7	5	5	36.87	2.438	24	0.2
8	6	2	37.82	2.379	48	0.2
9	5	1	38.38	2.345	48	0.1
6	6	6	38.57	2.334	8	1.1

h	k	l	2θ	d	M	I_{rel}
8	6	4	40.03	2.252	48	0.2
11	1	1	41.28	2.187	24	0.4
7	7	5	41.28	2.187	24	0.2
8	8	0	42.14	2.144	12	0.6
9	7	1	42.66	2.119	48	0.1
10	6	0	43.51	2.080	24	0.1
9	7	3	44.01	2.058	48	0.1
11	3	3	44.01	2.058	24	0.5
10	6	2	44.18	2.050	48	0.2
12	0	0	44.84	2.021	6	0.3
8	8	4	44.84	2.021	24	0.7
9	7	5	46.61	1.948	48	0.1
12	4	2	48.03	1.894	48	0.1
8	8	6	48.03	1.894	24	0.2
10	8	2	48.65	1.872	48	1.1

Figure B2 XRD power patterns of zeolite structure types.

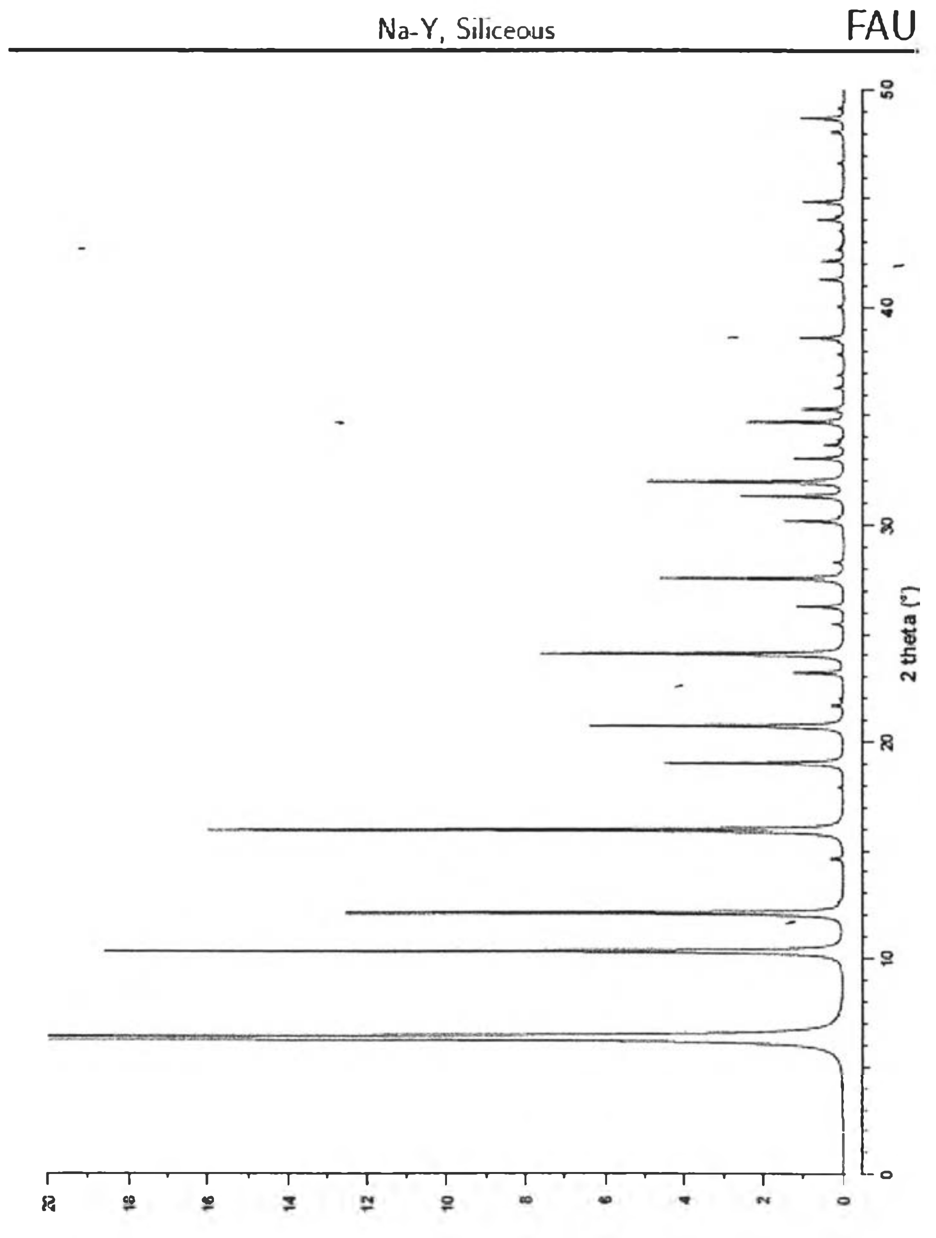


Table B1 Physical and chemical properties of commercial HY zeolite

Zeolite	Surface area (m^2/g)	Crystal size (μm)	Na_2O (%)	SiO_2/Al_2O_3
Commercial HY	696.7	1.1	0.203	103.94

Appendix C Products Obtained over Tested Catalyst in Different Crystallite Sizes

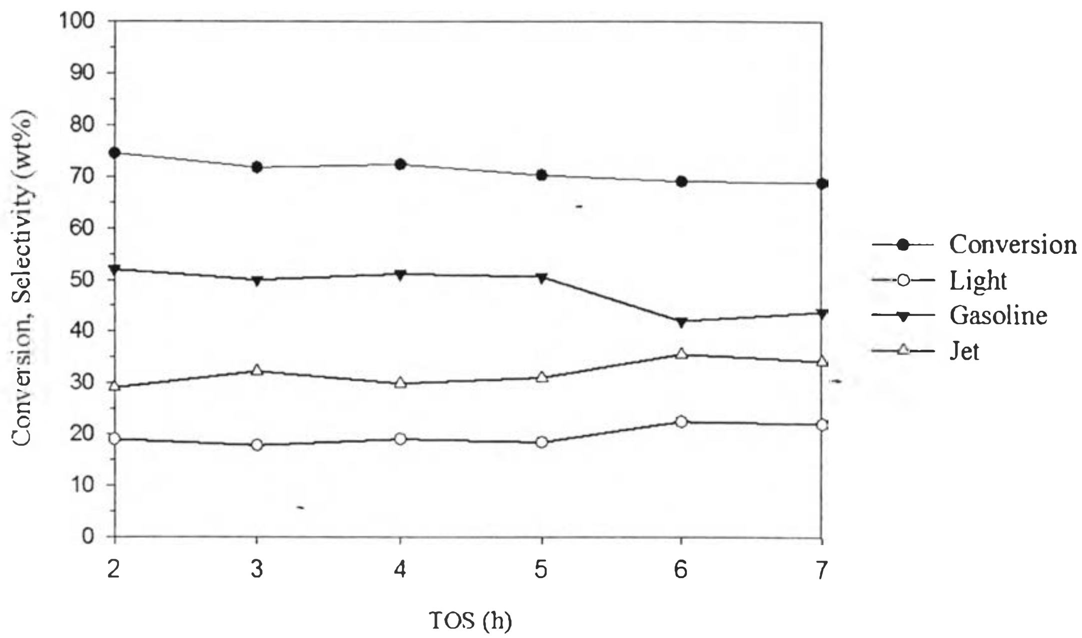


Figure C1 Conversion and selectivity of products obtained over Y-100A3 sample (Reaction condition: 450 °C, 500 psig, LHSV of 1.0 h^{-1}, H_2/ feed molar ratio of 30).

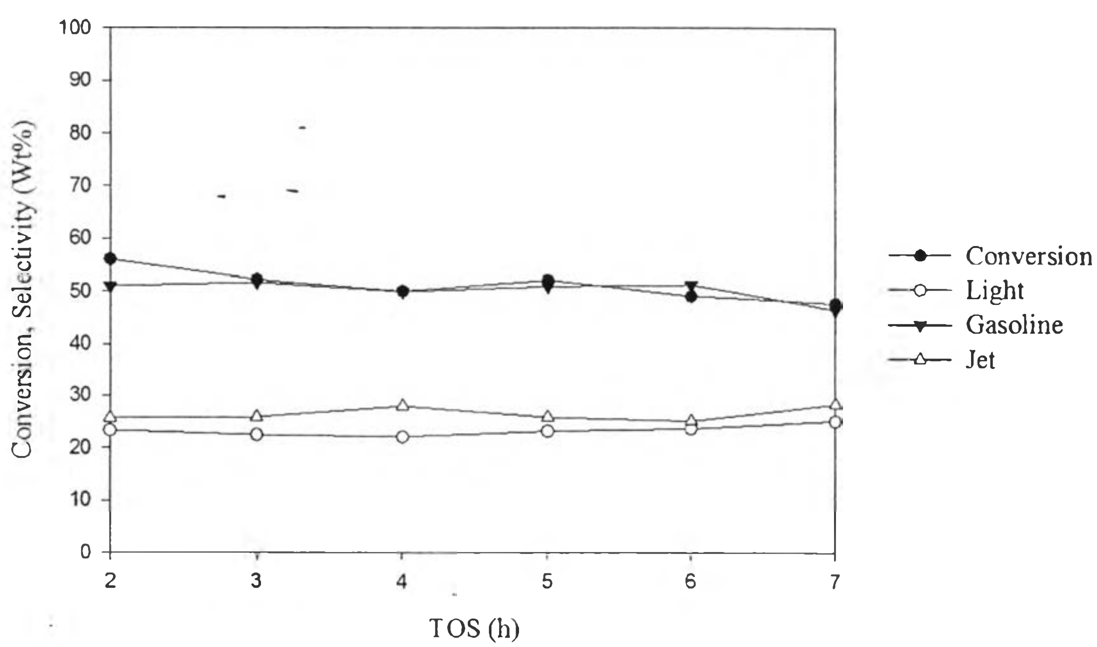


Figure C2 Conversion and selectivity of products obtained over Y-110A2 sample (Reaction condition: 450 °C, 500 psig, LHSV of 1.0 h-1, H2/ feed molar ratio of 30).

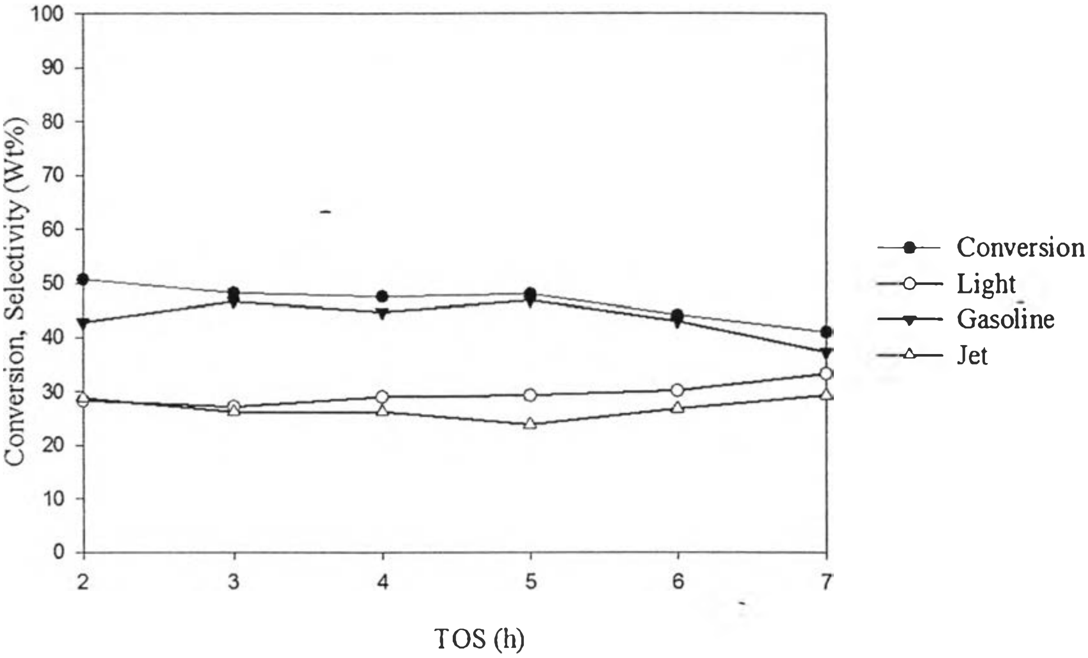


Figure C3 Conversion and selectivity of products obtained over Y-110A1 sample (Reaction condition: 450 °C, 500 psig, LHSV of 1.0 h-1, H2/ feed molar ratio of 30).

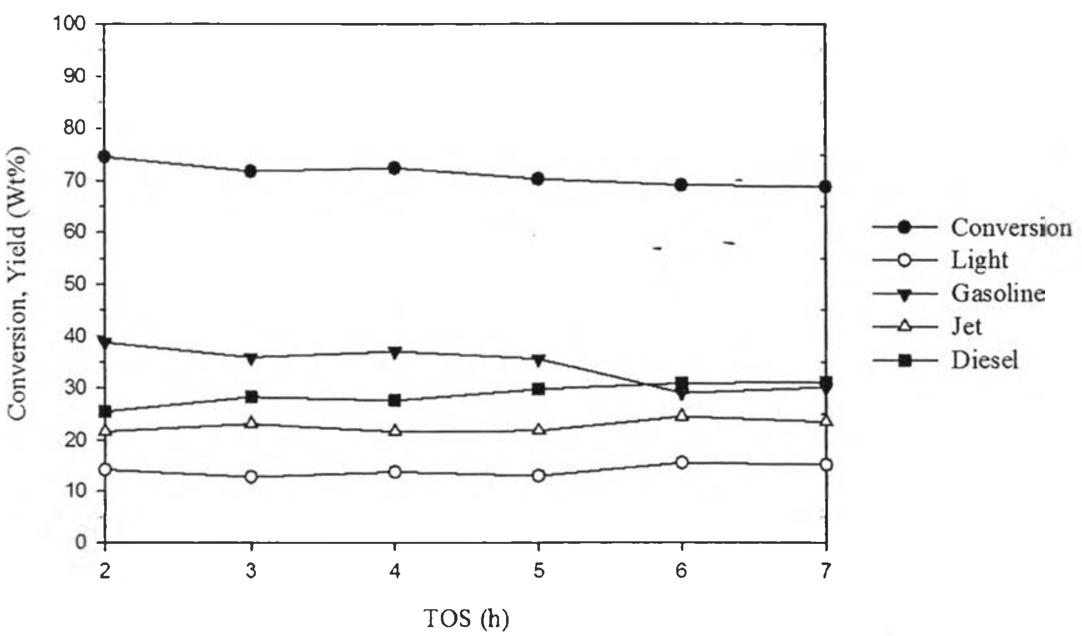


Figure C4 Conversion and yield of products obtained over Y-100A3 sample (Reaction condition: 450 °C, 500 psig, LHSV of 1.0 h-1, H2/ feed molar ratio of 30).

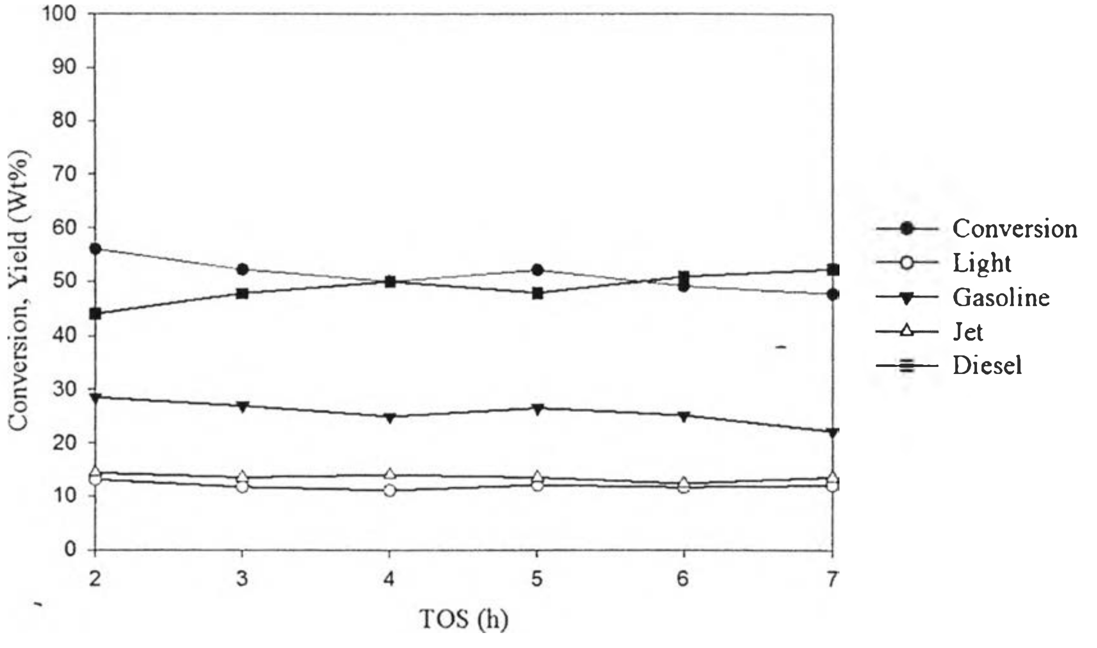


Figure C5 Conversion and yield of products obtained over Y-110A2 sample (Reaction condition: 450 °C, 500 psig, LHSV of 1.0 h-1, H2/ feed molar ratio of 30).

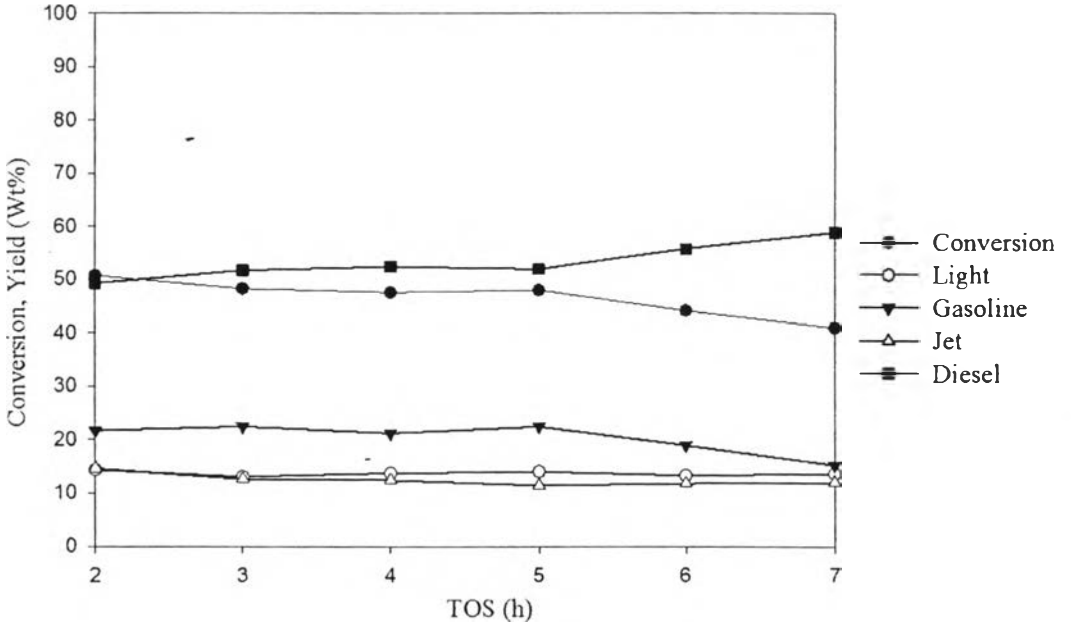


Figure C6 Conversion and yield of products obtained over Y-110A1 sample (Reaction condition: 450 °C, 500 psig, LHSV of 1.0 h-1, H2/ feed molar ratio of 30).

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Presentations:

1. Jadpon, N.;Hengsawad, T.;Jongpatiwut, S.;ChareonpanichM., andButnark, S. (2014, March 10-12)Production of Biojet from Hydrogenated Biodiesel over Pt/HY Catalysts: Effect of Zeolite Crystals Size.Paper presented atNCCC XVth: Netherlands' Catalysis and Chemistry Conference 2014, Noordwijkerhout, Netherlands.
2. Jadpon, N.; Hengsawad, T.; Jongpatiwut, S.; Chareonpanich M., and Butnark, S. (2014, April 22)Microwave Hydrothermal (M-H) Synthesis of Small Crystal Sizes of Y Zeolite for Producing Hydrotreated Renewable Jet Fuel from Hydrogenated Biodiesel. Paper presented atThe 5th Research Symposium on Petrochemical and Materials Technology and The20th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.