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## APPENDICES

### Appendix A Temperature Profiles

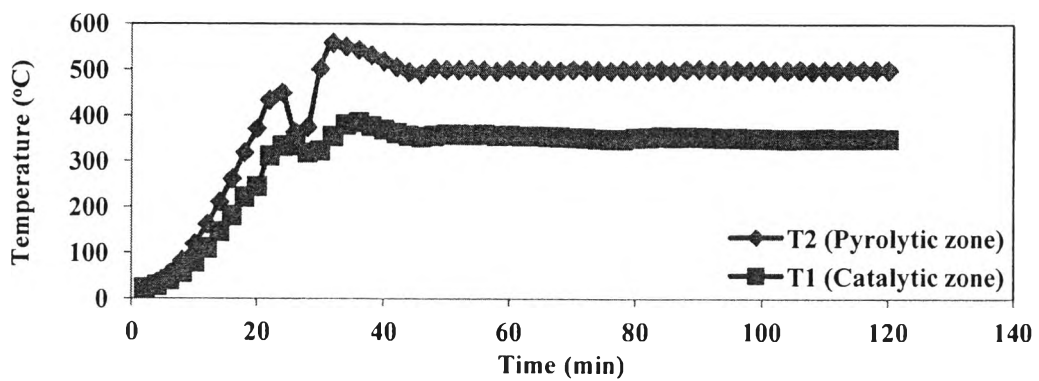
**Table A1** Pyrolysis conditions: Non-catalytic Pyrolysis

Tire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	23.0	24.5	32	355.0	558.4	62	356.1	498.7	92	352.9	501.4
4	29.0	35.7	34	380.7	550.5	64	356.1	500.0	94	352.1	501.2
6	40.7	55.6	36	386.0	543.8	66	355.0	499.4	96	352.5	500.5
8	57.2	83.2	38	377.4	531.5	68	354.3	498.7	98	350.7	499.3
10	80.1	119.3	40	369.9	518.7	70	352.7	501.1	100	350.7	501.1
12	110.6	162.2	42	362.1	506.1	72	352.0	500.9	102	350.1	499.2
14	146.3	211.1	44	356.5	495.4	74	350.2	499.4	104	349.5	499.7
16	181.4	261.8	46	353.8	491.8	76	349.2	498.1	106	349.7	501.3
18	221.7	319.1	48	356.7	503.5	78	348.8	500.5	108	350.0	498.4
20	245.2	371.6	50	359.8	500.5	80	352.0	500.2	110	350.7	499.8
22	312.3	434.5	52	359.4	499.9	82	353.2	498.8	112	350.5	499.4
24	333.9	450.0	54	358.3	501.2	84	355.0	500.4	114	350.1	500.0
26	334.9	363.5	56	359.4	499.5	86	353.7	497.8	116	350.2	500.5
28	319.4	374.6	58	356.8	497.1	88	354.4	501.8	118	350.7	500.8
30	323.5	501.7	60	357.5	501.5	90	354.2	502.1	120	350.4	500.5



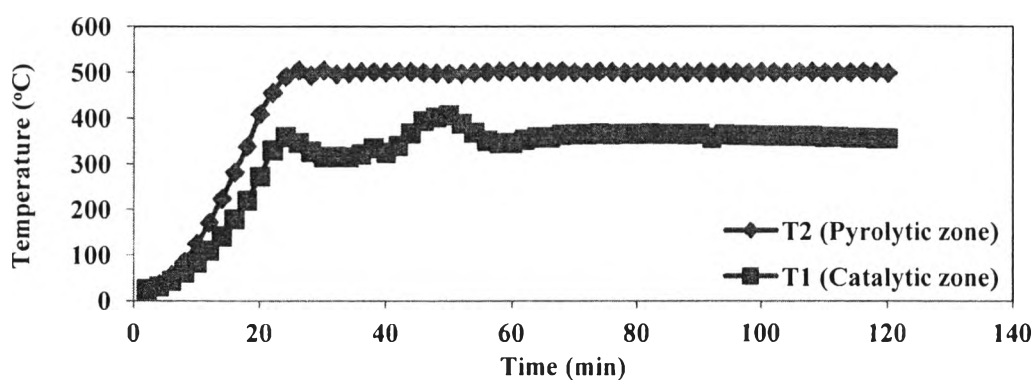
**Figure A1** Temperature profiles of waste non-catalytic pyrolysis.

**Table A2** Pyrolysis conditions: HBETA catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.6	24.9	32	315.8	496.1	62	353.4	501.2	92	356.7	499.1
4	31.4	35.9	34	315.2	498.3	64	358.4	501.1	94	364.2	499.2
6	43.7	56.1	36	321.3	500.9	66	358.4	501.1	96	363.3	499.1
8	61.9	85.5	38	334.9	501.0	68	363.8	502.9	98	363.0	498.6
10	83.9	125.0	40	324.7	499.9	70	364.9	500.2	100	362.2	501.1
12	109.9	171.3	42	339.9	501.7	72	365.4	499.4	102	361.6	499.9
14	141.2	223.4	44	367.0	501.2	74	366.5	501.6	104	361.5	499.5
16	178.5	281.5	46	394.0	499.6	76	365.4	501.0	106	361.3	501.0
18	219.5	338.6	48	401.9	497.6	78	366.3	499.3	108	361.1	500.7
20	272.7	409.1	50	406.2	497.2	80	366.1	499.4	110	359.0	500.1
22	330.2	455.5	52	388.4	496.9	82	366.5	500.1	112	359.2	500.0
24	359.2	490.2	54	369.0	499.0	84	365.9	500.3	114	357.4	499.8
26	346.6	504.2	56	351.3	500.7	86	365.7	499.9	116	357.2	500.7
28	327.0	493.0	58	346.2	501.9	88	365.3	499.2	118	355.9	500.1
30	315.6	504.3	60	346.1	502.0	90	365.6	500.2	120	355.7	498.1

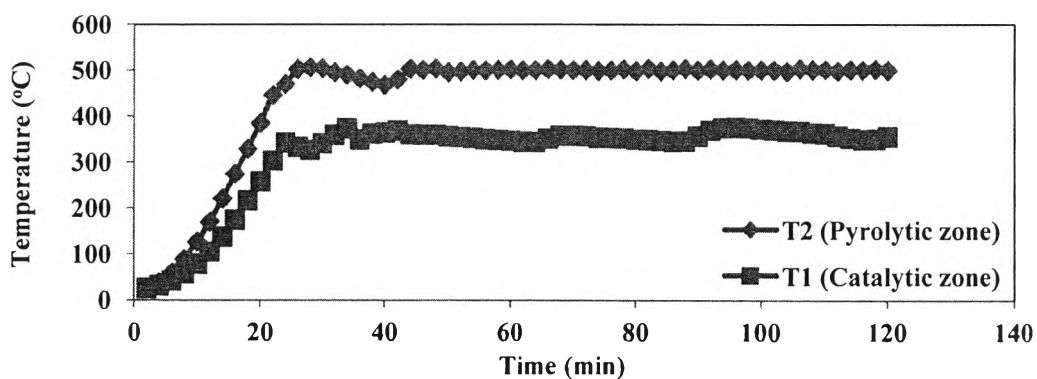
**Figure A2** Temperature profiles of waste tire pyrolysis with using HBETA catalyst.

**Table A3** Pyrolysis conditions: HY catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	26.5	27.0	32	359.0	494.9	62	344.1	499.4	92	369.3	502.1
4	32.1	38.9	34	373.1	489.7	64	343.6	499.8	94	374.6	499.9
6	42.8	59.5	36	348.8	481.4	66	350.8	501.9	96	375.1	500.8
8	58.5	89.0	38	361.3	474.1	68	357.3	501.0	98	374.0	499.6
10	78.9	126.7	40	363.8	467.6	70	357.4	500.2	100	371.9	500.2
12	105.5	170.4	42	368.1	479.0	72	356.3	499.8	102	370.0	500.0
14	137.9	220.7	44	360.5	502.7	74	353.4	498.2	104	367.3	497.1
16	174.7	274.4	46	359.4	500.5	76	352.8	499.2	106	366.5	503.0
18	216.7	328.5	48	359.3	503.5	78	351.9	501.7	108	363.3	500.7
20	258.3	384.5	50	356.1	495.2	80	349.3	497.8	110	361.6	501.1
22	303.2	445.8	52	354.4	496.7	82	348.1	503.6	112	356.7	497.9
24	342.2	469.1	54	352.4	500.3	84	346.6	497.5	114	352.1	500.6
26	333.0	502.3	56	349.7	499.4	86	344.4	499.8	116	349.1	500.2
28	326.6	506.1	58	347.8	500.5	88	345.0	502.7	118	349.5	501.8
30	340.9	504.0	60	346.6	501.6	90	356.1	499.0	120	355.2	499.1

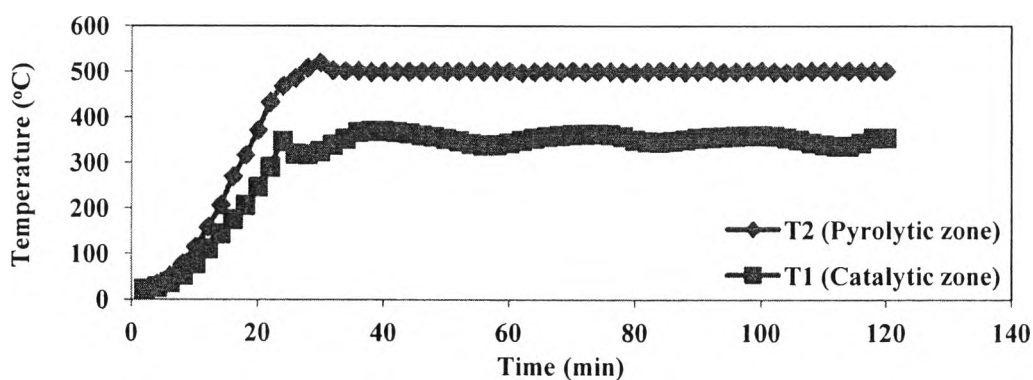
**Figure A3** Temperature profiles of waste tire pyrolysis with using HY catalyst.

**Table A4** Pyrolysis conditions: 1%Pd/HBETA catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	22.1	22.3	32	339.0	502.7	62	349.0	497.5	92	355.3	501.9
4	27.0	33.4	34	352.4	501.2	64	354.0	499.3	94	356.8	498.4
6	36.9	51.4	36	367.0	501.5	66	357.5	500.4	96	358.0	499.8
8	53.5	78.5	38	369.7	498.6	68	359.8	499.5	98	359.2	499.9
10	78.2	114.3	40	369.6	499.5	70	361.6	501.7	100	359.7	501.3
12	110.9	158.7	42	367.5	500.0	72	362.4	498.7	102	358.5	499.4
14	143.8	207.3	44	364.7	500.0	74	363.2	500.9	104	354.8	498.0
16	175.3	269.6	46	360.5	500.1	76	361.7	500.0	106	350.0	500.4
18	206.5	316.5	48	357.0	501.1	78	357.3	498.6	108	343.7	500.6
20	246.5	370.9	50	352.5	499.9	80	349.8	498.2	110	339.5	501.3
22	290.5	432.5	52	347.6	500.7	82	346.1	500.1	112	336.7	501.0
24	346.9	468.4	54	341.6	500.9	84	345.2	501.1	114	336.7	501.7
26	319.3	485.7	56	338.2	500.2	86	347.1	500.4	116	343.7	499.8
28	318.2	507.9	58	339.1	500.9	88	349.9	498.2	118	354.7	501.0
30	324.8	519.4	60	343.1	500.5	90	353.8	500.7	120	355.0	501.1

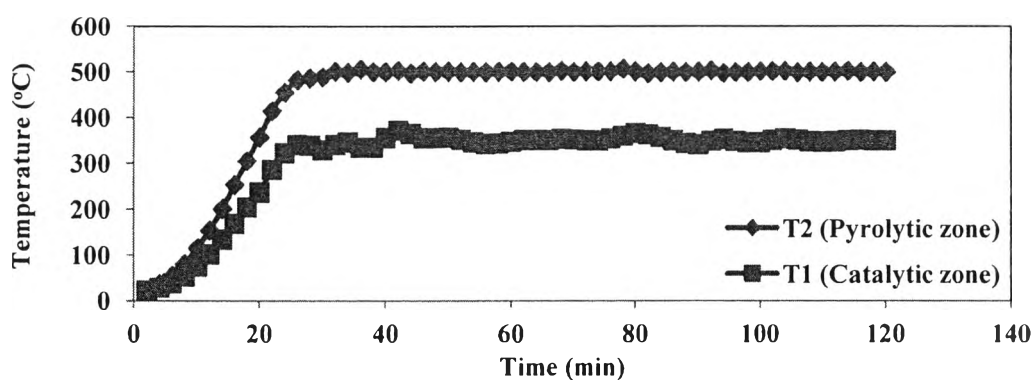
**Figure A4** Temperature profiles of waste tire pyrolysis with using 1%Pd/HBETA catalyst.

**Table A5** Pyrolysis conditions: 1%Pd/HBETA+10%HY catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	22.8	23.6	32	340.5	500.3	62	351.2	499.8	92	349.4	502.8
4	28.9	36.3	34	346.1	498.2	64	351.1	499.1	94	353.1	497.2
6	38.2	54.6	36	334.5	504.9	66	350.8	499.3	96	348.8	498.9
8	53.0	80.2	38	334.4	499.7	68	353.6	502.2	98	346.1	499.0
10	75.2	115.4	40	355.5	499.2	70	352.2	499.7	100	346.3	501.1
12	101.7	153.9	42	372.1	502.2	72	350.5	500.8	102	351.3	501.2
14	134.1	201.0	44	364.6	496.3	74	349.9	500.6	104	354.5	501.8
16	168.5	253.4	46	355.5	500.7	76	354.8	501.0	106	351.7	498.3
18	204.7	305.2	48	355.7	500.1	78	360.0	506.6	108	348.4	500.2
20	237.0	356.4	50	356.4	500.8	80	366.1	500.8	110	347.6	499.5
22	286.2	413.7	52	351.8	499.0	82	363.2	496.5	112	348.3	500.2
24	322.5	454.5	54	346.3	499.9	84	357.6	498.6	114	350.8	501.7
26	340.4	481.5	56	342.7	499.2	86	350.5	500.0	116	351.9	499.1
28	338.7	485.8	58	343.6	500.2	88	344.4	499.4	118	350.0	500.3
30	328.7	488.2	60	347.3	500.4	90	341.6	500.0	120	350.1	499.3

**Figure A5** Temperature profiles of waste tire pyrolysis with using 1%Pd/HBETA+10%HY catalyst.

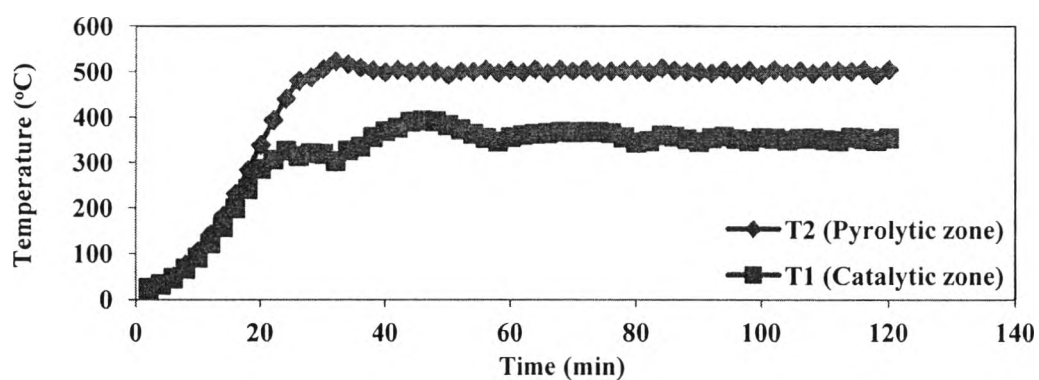


**Table A6** Pyrolysis conditions: 1%Pd/HBETA+20%HY catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.0	23.6	32	303.1	522.4	62	360.7	498.5	92	354.0	496.7
4	32.9	33.8	34	326.8	516.6	64	363.2	504.9	94	357.8	503.8
6	46.3	49.5	36	334.8	509.0	66	364.4	496.8	96	352.1	496.5
8	67.3	75.7	38	356.2	502.7	68	367.7	505.3	98	347.1	502.7
10	91.2	104.7	40	369.1	498.4	70	366.8	501.0	100	355.0	494.2
12	122.6	142.1	42	376.8	504.1	72	367.4	504.2	102	353.2	504.3
14	158.3	182.7	44	389.6	499.4	74	367.6	499.7	104	349.0	497.6
16	199.0	230.6	46	392.7	502.3	76	364.8	501.0	106	353.0	502.2
18	241.4	283.4	48	390.7	499.7	78	355.4	501.5	108	353.4	496.5
20	285.5	338.4	50	382.2	492.6	80	344.0	504.4	110	350.0	502.2
22	306.2	393.6	52	372.9	500.9	82	346.7	498.3	112	347.5	502.2
24	325.9	440.6	54	363.0	500.0	84	360.1	507.8	114	355.3	500.7
26	314.2	480.0	56	354.0	504.1	86	357.0	503.1	116	352.4	504.6
28	320.9	487.5	58	346.2	497.2	88	351.4	500.1	118	348.4	492.6
30	318.9	505.8	60	355.7	503.2	90	345.0	499.5	120	354.1	504.7

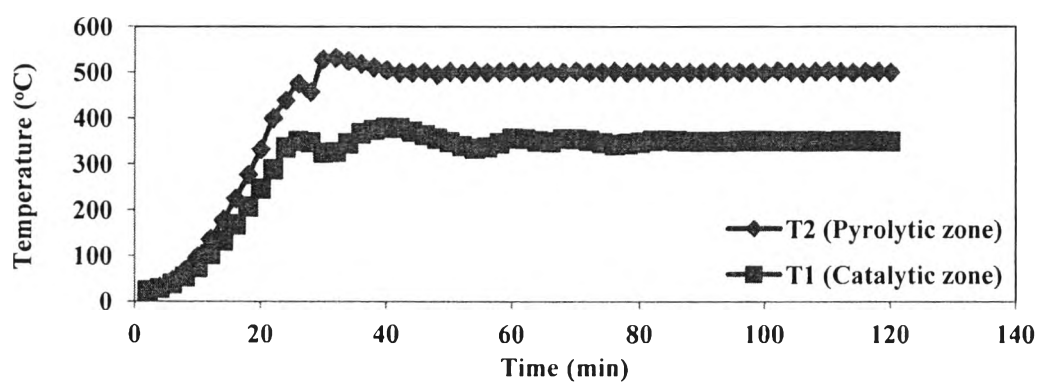
**Figure A6** Temperature profiles of waste tire pyrolysis with using 1%Pd/HBETA+20%HY catalyst.

**Table A7** Pyrolysis conditions: 1%Pd/HY catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	23.7	23.5	32	325.9	531.4	62	354.9	499.7	92	348.8	501.0
4	29.0	31.5	34	344.8	524.0	64	349.6	501.8	94	349.1	499.8
6	38.8	46.9	36	366.8	518.1	66	347.9	498.8	96	350.4	499.7
8	53.9	68.5	38	374.0	510.6	68	355.1	499.4	98	350.4	499.6
10	74.8	98.2	40	379.1	504.2	70	354.2	501.9	100	350.2	498.6
12	102.6	136.5	42	378.5	498.5	72	350.9	499.1	102	350.1	502.4
14	132.9	177.6	44	370.6	498.3	74	346.3	500.1	104	349.9	499.9
16	168.1	224.6	46	362.8	500.4	76	341.7	501.4	106	349.8	498.4
18	207.2	276.7	48	355.3	494.1	78	343.9	499.3	108	349.5	501.1
20	245.9	331.7	50	347.8	500.8	80	347.0	499.9	110	349.3	502.3
22	287.9	399.5	52	339.4	497.5	82	351.2	499.2	112	350.6	500.8
24	335.5	437.9	54	333.6	501.2	84	351.5	501.2	114	350.6	499.0
26	350.0	474.8	56	336.5	499.1	86	350.6	500.3	116	350.2	500.8
28	347.3	456.4	58	345.4	499.9	88	349.3	499.4	118	349.6	500.7
30	324.5	527.6	60	355.8	501.2	90	348.9	498.9	120	349.4	499.5

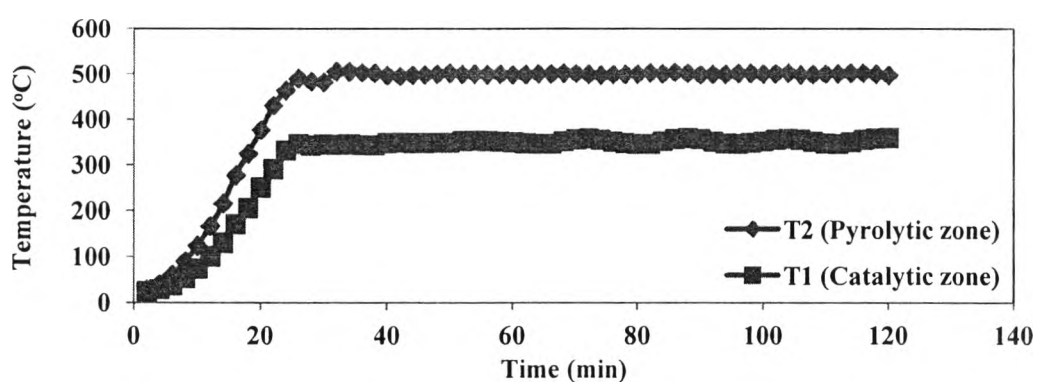
**Figure A7** Temperature profiles of waste tire pyrolysis with using 1%Pd/HY catalyst.

**Table A8** Pyrolysis conditions: 1%Pd/HY+10%HBETA catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	24.3	27.0	32	344.3	505.1	62	347.6	498.6	92	351.1	499.6
4	28.9	39.4	34	345.3	505.0	64	346.6	500.3	94	347.2	499.0
6	37.7	60.6	36	343.8	503.2	66	346.6	500.3	96	346.5	501.2
8	53.3	89.6	38	343.4	501.6	68	351.7	502.2	98	348.6	501.5
10	73.8	123.4	40	348.4	496.7	70	356.0	501.1	100	351.6	500.0
12	100.1	166.0	42	349.2	494.7	72	358.0	499.3	102	355.2	500.9
14	130.1	214.9	44	348.2	497.5	74	355.2	497.5	104	357.4	502.3
16	170.5	276.8	46	348.3	498.2	76	351.2	498.7	106	355.5	498.2
18	205.4	324.5	48	348.7	499.7	78	347.8	499.5	108	351.2	498.7
20	250.4	376.2	50	349.1	501.9	80	346.2	499.4	110	347.2	500.2
22	290.8	430.1	52	352.4	499.5	82	346.1	502.6	112	345.8	500.4
24	331.8	464.0	54	353.6	500.0	84	352.3	500.6	114	349.9	502.0
26	346.2	490.0	56	352.4	498.7	86	356.9	503.7	116	355.2	501.9
28	342.8	483.5	58	351.3	499.3	88	359.0	501.3	118	358.1	500.0
30	345.0	481.3	60	349.6	498.1	90	356.9	498.2	120	359.6	497.3

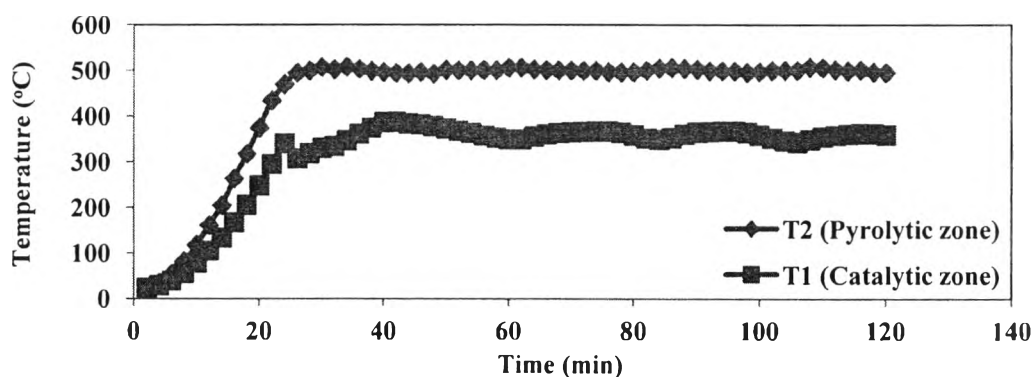
**Figure A8** Temperature profiles of waste tire pyrolysis with using 1%Pd/HY+10%HBETA catalyst.

**Table A9** Pyrolysis conditions: 1%Pd/HY+10%HBETA catalyst (repeated)Tire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	24.1	23.6	32	334.7	502.1	62	349.3	506.0	92	365.9	498.7
4	29.3	34.4	34	346.9	507.4	64	355.5	501.9	94	367.1	498.6
6	39.5	54.1	36	361.5	503.2	66	360.4	500.6	96	367.2	498.1
8	55.9	81.5	38	374.1	498.6	68	363.2	499.7	98	363.8	494.9
10	78.7	117.8	40	386.4	496.1	70	364.9	500.0	100	358.3	496.7
12	105.5	161.3	42	387.4	494.2	72	365.9	498.9	102	351.8	499.4
14	133.8	204.3	44	383.7	493.1	74	366.9	499.6	104	346.0	499.9
16	167.5	263.5	46	381.9	496.2	76	366.6	496.5	106	342.7	499.9
18	205.7	317.5	48	378.2	492.5	78	363.8	495.6	108	348.2	506.8
20	248.5	374.5	50	372.8	500.7	80	358.4	496.2	110	354.5	505.7
22	295.5	433.9	52	367.9	499.8	82	352.0	499.6	112	357.7	501.5
24	340.2	469.3	54	363.0	500.0	84	348.8	504.6	114	360.3	498.7
26	307.4	494.7	56	357.2	500.7	86	352.5	505.6	116	361.8	500.6
28	318.4	499.2	58	352.8	499.9	88	360.4	503.9	118	361.5	496.1
30	330.7	506.8	60	349.3	505.4	90	364.6	501.9	120	358.9	495.0

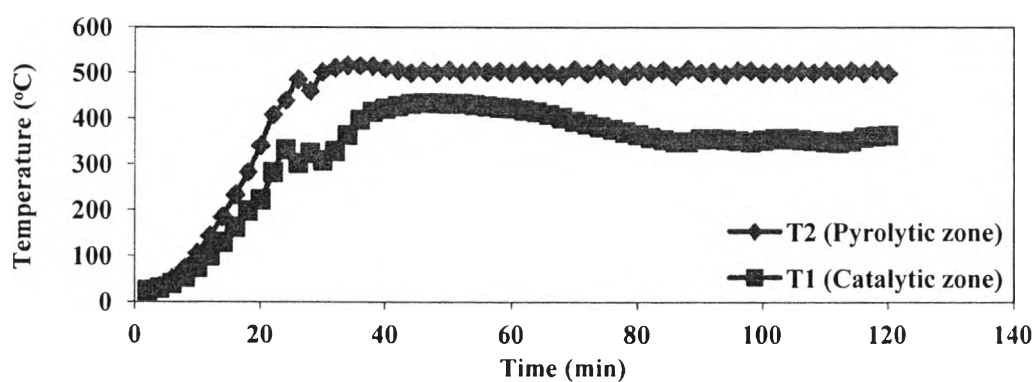
**Figure A9** Temperature profiles of waste tire pyrolysis with using 1%Pd/HY+10%HBETA (repeat) catalyst.

**Table A10** Pyrolysis conditions: 1%Pd/HY+20%HBETA catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.3	24.7	32	328.4	510.7	62	417.9	504.7	92	355.7	502.5
4	29.9	33.5	34	363.5	516.0	64	414.1	497.7	94	354.0	496.2
6	40.1	51.6	36	396.9	515.2	66	408.5	500.2	96	351.5	504.4
8	53.7	73.6	38	414.0	514.5	68	401.6	494.7	98	348.6	504.1
10	74.9	105.9	40	421.1	509.4	70	393.7	507.1	100	352.6	498.6
12	100.0	143.5	42	426.9	504.7	72	387.6	498.2	102	356.2	501.6
14	129.6	185.5	44	432.0	499.2	74	381.4	508.7	104	355.9	498.3
16	162.6	232.7	46	434.4	503.9	76	376.3	500.0	106	354.1	503.5
18	198.1	282.4	48	433.5	499.4	78	370.4	493.8	108	351.9	499.4
20	221.9	340.1	50	432.4	505.4	80	364.2	504.2	110	349.0	504.3
22	281.9	407.5	52	432.2	498.4	82	358.4	499.0	112	347.7	498.8
24	331.9	438.6	54	429.6	505.2	84	353.7	506.0	114	351.0	504.6
26	301.8	485.3	56	426.9	501.5	86	349.0	494.2	116	358.7	499.3
28	324.2	459.8	58	424.3	503.4	88	349.0	507.6	118	361.3	505.6
30	307.7	501.2	60	422.8	499.1	90	355.5	498.6	120	363.1	498.1

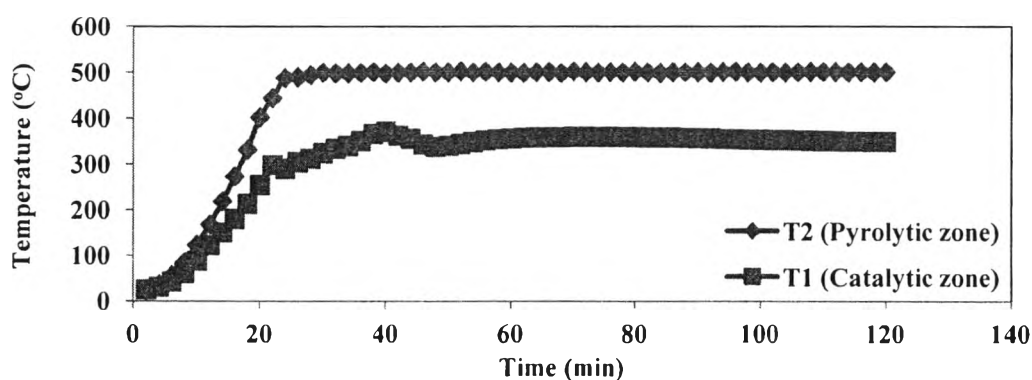
**Figure A10** Temperature profiles of waste tire pyrolysis with using 1%Pd/HY+20%HBETA catalyst.

**Table A11** Pyrolysis conditions: 1%Pd/HBETA+20%HY+10%HZSM-5 catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	26.0	24.6	32	333.8	497.9	62	357.4	498.7	92	356.0	499.3
4	31.1	36.2	34	339.8	497.9	64	358.1	500.2	94	355.1	500.7
6	42.6	56.5	36	350.3	498.6	66	358.5	500.7	96	354.2	501.2
8	61.3	85.4	38	366.0	500.7	68	358.5	498.2	98	353.7	499.7
10	88.6	123.4	40	370.8	497.5	70	359.6	501.8	100	353.1	499.3
12	122.6	168.2	42	362.0	499.0	72	359.6	499.9	102	352.6	500.4
14	151.0	219.1	44	355.2	499.7	74	359.3	499.6	104	352.4	499.4
16	180.3	273.6	46	343.4	501.9	76	359.6	500.3	106	351.8	500.3
18	213.5	331.3	48	338.0	500.0	78	359.2	499.7	108	351.0	500.9
20	254.8	401.9	50	340.0	499.8	80	358.7	501.2	110	350.2	500.8
22	298.3	443.7	52	344.0	502.2	82	358.3	499.7	112	350.0	500.9
24	290.0	487.5	54	348.4	499.6	84	358.0	498.5	114	349.3	500.1
26	304.5	489.2	56	352.0	501.2	86	358.1	500.0	116	349.2	500.5
28	311.9	493.9	58	354.4	499.6	88	357.1	500.3	118	349.1	500.0
30	324.1	499.1	60	355.6	499.3	90	356.5	500.1	120	349.1	500.5

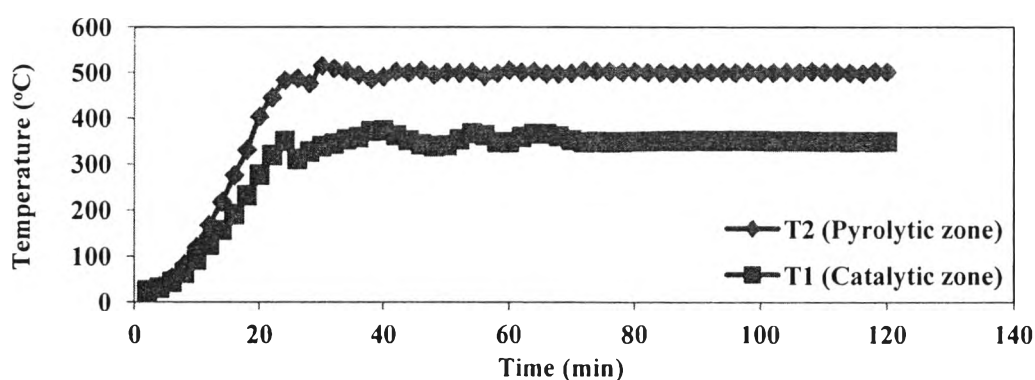
**Figure A11** Temperature profiles of waste tire pyrolysis with using 1%Pd/HBETA+20%HY+10%HZSM-5 catalyst.

**Table A12** Pyrolysis conditions: 1%Pd/HBETA+20%HY+20%HZSM-5 catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.3	23.3	32	344.0	508.8	62	359.1	500.7	92	350.5	500.4
4	31.1	33.9	34	353.3	502.9	64	366.1	502.5	94	350.6	500.0
6	43.6	53.5	36	358.4	494.6	66	365.7	497.2	96	351.3	499.2
8	63.7	81.9	38	371.8	485.1	68	360.6	496.9	98	350.9	501.3
10	91.7	119.5	40	373.3	490.6	70	352.1	498.3	100	350.5	498.3
12	124.5	167.2	42	362.6	502.0	72	347.2	504.2	102	350.0	499.5
14	156.9	218.0	44	351.7	499.4	74	348.5	501.9	104	350.2	500.5
16	191.0	275.5	46	342.6	504.1	76	347.9	502.0	106	349.7	500.4
18	232.4	330.7	48	338.3	494.9	78	348.2	500.7	108	349.6	502.3
20	276.9	403.3	50	340.8	500.1	80	348.8	501.6	110	348.8	500.7
22	319.2	445.3	52	353.5	498.4	82	349.5	500.2	112	349.1	500.4
24	350.2	482.6	54	367.0	501.1	84	350.1	500.0	114	348.5	499.1
26	310.7	486.9	56	362.7	492.4	86	350.4	498.0	116	348.9	497.3
28	327.1	475.7	58	347.2	497.8	88	350.7	499.4	118	348.2	502.4
30	338.4	514.6	60	346.9	504.7	90	351.1	499.5	120	348.7	501.0

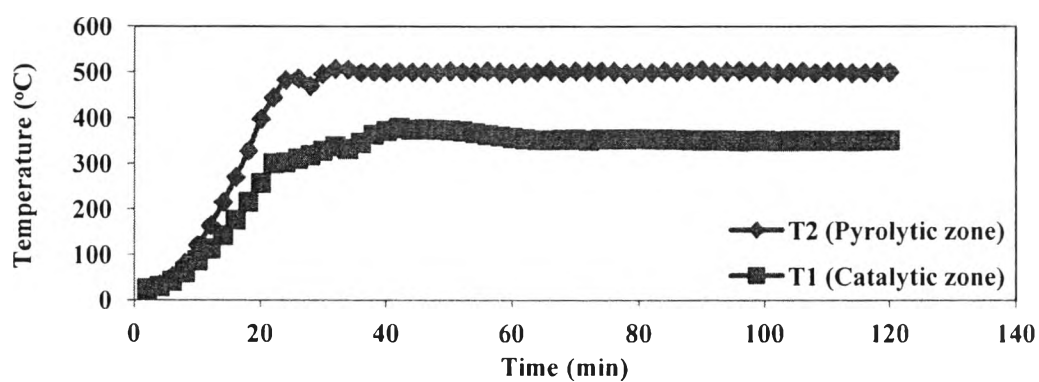
**Figure A12** Temperature profiles of waste tire pyrolysis with using 1%Pd/HBETA+20%HY+20%HZSM-5 catalyst.

**Table A13** Pyrolysis conditions: 1%Pd/HY+10%HBETA+10%HZSM-5 catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.1	23.0	32	337.9	506.7	62	354.0	499.3	92	351.2	500.1
4	30.0	33.5	34	332.1	505.3	64	352.3	499.8	94	351.0	501.6
6	41.8	53.1	36	345.4	498.7	66	352.0	503.3	96	349.7	502.8
8	60.6	81.3	38	363.5	500.3	68	352.4	498.8	98	350.1	500.4
10	86.7	120.5	40	371.8	498.5	70	353.3	501.9	100	350.3	501.2
12	112.8	163.9	42	378.1	500.6	72	351.2	501.0	102	349.4	497.5
14	142.5	215.1	44	374.7	499.6	74	353.7	501.6	104	349.7	499.5
16	176.4	270.1	46	375.7	500.0	76	353.5	501.2	106	350.3	501.8
18	215.6	327.7	48	374.2	498.7	78	353.7	497.5	108	350.0	498.0
20	257.1	397.9	50	372.8	502.2	80	354.2	498.9	110	349.9	501.5
22	300.8	444.4	52	370.9	500.3	82	353.5	498.8	112	350.0	499.4
24	302.5	482.6	54	367.0	499.5	84	353.1	501.7	114	349.5	497.6
26	310.6	486.1	56	363.0	502.2	86	353.0	500.4	116	350.3	498.1
28	318.7	469.7	58	360.0	499.9	88	351.9	501.2	118	351.3	499.9
30	328.1	495.5	60	356.7	497.3	90	351.3	504.1	120	351.2	500.0

**Figure A13** Temperature profiles of waste tire pyrolysis with using 1%Pd/HY+10%HBETA+10%HZSM-5 catalyst.

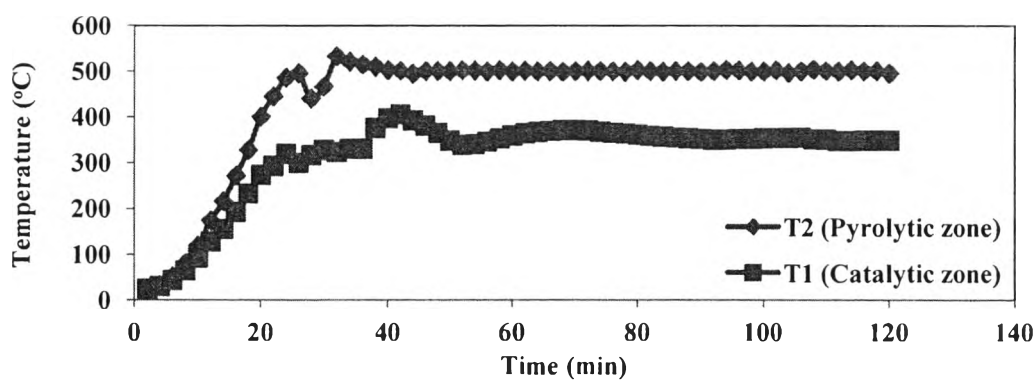


**Table A14** Pyrolysis conditions: 1%Pd/HY+10%HBETA+20%HZSM-5 catalystTire = 30 g, N<sub>2</sub> flow = 30ml/min

Pyrolysis Temperature (T2) = 500 °C

Catalytic Temperature (T1) = 350 °C

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	24.6	21.9	32	323.3	532.4	62	363.9	500.9	92	350.0	500.1
4	30.2	32.2	34	330.4	520.8	64	366.9	499.2	94	350.2	502.7
6	43.6	52.0	36	330.8	514.6	66	369.3	500.2	96	351.5	501.2
8	64.8	80.2	38	375.9	510.1	68	371.0	498.3	98	351.9	499.1
10	92.3	118.6	40	397.0	502.4	70	371.2	500.1	100	353.4	499.1
12	128.1	174.0	42	405.3	501.1	72	370.4	500.5	102	353.7	501.9
14	155.3	215.7	44	392.3	494.5	74	367.5	500.5	104	354.2	496.3
16	192.5	271.8	46	381.0	500.0	76	365.2	499.6	106	355.1	500.0
18	233.3	327.9	48	365.2	500.5	78	363.6	498.8	108	350.9	503.6
20	273.6	400.5	50	348.6	500.1	80	361.1	502.1	110	350.7	500.5
22	293.3	445.3	52	338.9	502.0	82	358.6	500.2	112	347.4	499.4
24	319.3	486.0	54	340.4	501.3	84	356.9	498.9	114	347.4	502.1
26	300.0	496.0	56	346.0	499.4	86	355.1	500.4	116	348.5	500.0
28	316.9	440.6	58	352.9	502.2	88	353.5	499.9	118	348.5	500.2
30	327.8	466.4	60	359.2	499.1	90	351.6	498.2	120	348.5	495.1

**Figure A14** Temperature profiles of waste tire pyrolysis with using 1%Pd/HY+10%HBETA+20%HZSM-5 catalyst.

## Appendix B Yield of Pyrolysis Products

**Table B1** Yield of pyrolysis products obtained from pyrolysis with varied percentages of HY in Pd/HBETA

Catalysts	Name	Non-catalyst	HBETA	Pd/HBETA	1PB10Y	1PB20Y	HY
	Metal	-	-	1% Pd			-
	Support	-	-	HBETA			-
	Additive	-	-	-	10% HY	20% HY	-
Yield (wt%)	Gas	16.07	22.05	27.83	26.44	25.84	16.13
	Liquid	40.04	35.03	29.63	29.93	30.36	37.07
	Solid	44.09	42.92	42.55	43.64	43.80	46.80

**Table B2** Yield of pyrolysis products obtained from pyrolysis with varied percentages of HBETA in Pd/HY

Catalysts	Name	Non-catalyst	HY	Pd/HY	1PY10B	1PY20B	HBETA
	Metal	-	-	1% Pd			-
	Support	-	-	HY			-
	Additive	-	-	-	10% HBETA	20% HBETA	-
Yield (wt%)	Gas	16.07	16.13	20.12	27.46	18.30	22.05
	Liquid	40.04	37.07	33.66	29.66	39.65	35.03
	Solid	44.09	46.80	46.22	42.87	42.05	42.92

**Table B3** Yield of pyrolysis products obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HBETA mixed with 20%HY

	Name	Non-catalyst	1PB20Y	1PB20Y10Z	1PB20Y20Z	HZSM-5
<b>Catalysts</b>	<b>Metal</b>	-	1% Pd			-
	<b>Support</b>	-	HBETA			-
	<b>1<sup>st</sup> Additive</b>	-	20% HY			-
	<b>2<sup>nd</sup> Additive</b>	-	-	10% HZSM-5	20% HZSM-5	-
	<b>Yield (wt%)</b>					
	<b>Gas</b>	16.07	25.84	27.07	29.04	15.88
	<b>Liquid</b>	40.04	30.36	30.73	28.93	37.18
	<b>Solid</b>	44.09	43.80	42.20	42.04	46.95

**Table B4** Yield of pyrolysis products obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HY mixed with 10%HBETA

	Name	Non-catalyst	1PY10B	1PY10B10Z	1PY10B20Z	HZSM-5
<b>Catalysts</b>	<b>Metal</b>	-	1% Pd			-
	<b>Support</b>	-	HY			-
	<b>1<sup>st</sup> Additive</b>	-	10% HBETA			-
	<b>2<sup>nd</sup> Additive</b>	-	-	10% HZSM-5	20% HZSM-5	-
	<b>Yield (wt%)</b>					
	<b>Gas</b>	16.07	27.46	28.29	24.02	15.88
	<b>Liquid</b>	40.04	29.66	30.23	33.89	37.18
	<b>Solid</b>	44.09	42.87	41.47	42.08	46.95

### Appendix C Gas Products (wt%)

**Table C1** Distribution and yield of gases obtained from pyrolysis with varied percentages of HY in Pd/HBETA

Catalysts	Name	Non-catalyst	HBETA	Pd/HBETA	1PB10Y	1PB20Y	HY
	Metal	-	-	1% Pd			-
	Support	-	-	HBETA			-
	Additive	-	-	-	10% HY	20% HY	-
Gas composition (wt%)	Methane	21.89	12.56	17.21	18.00	16.04	21.54
	Ethylene	10.25	6.13	6.11	5.77	6.35	7.70
	Ethane	17.86	15.74	14.52	14.91	13.57	19.43
	Propylene	11.36	8.00	5.94	9.66	10.27	9.01
	Propane	9.05	14.77	13.13	10.34	8.87	12.51
	Mixed C4	20.10	31.52	27.03	26.72	24.37	19.00
	Mixed C5	8.10	11.28	12.12	11.25	14.25	8.12
	C6+	1.39	0.00	3.94	3.35	6.27	2.70
Gas yield (wt%)	Methane	3.52	2.77	4.79	4.76	4.14	3.47
	Ethylene	1.65	1.35	1.70	1.52	1.64	1.24
	Ethane	2.87	3.47	4.04	3.94	3.51	3.13
	Propylene	1.83	1.76	1.65	2.55	2.65	1.45
	Propane	1.45	3.26	3.65	2.73	2.29	2.02
	Mixed C4	3.23	6.95	7.52	7.06	6.30	3.07
	Mixed C5	1.30	2.49	3.37	2.97	3.68	1.31
	C6+	0.22	0.00	1.10	0.89	1.62	0.43

**Table C2** Distribution and yield of gases obtained from pyrolysis with varied percentages of HBETA in Pd/HY

Catalysts	Name	Non-catalyst	HY	Pd/HY	1PY10B	1PY20B	HBETA
	Metal	-	-	1% Pd			-
	Support	-	-	HY			-
	Additive	-	-	-	10% HBETA	20% HBETA	-
Gas composition (wt%)	Methane	21.89	21.54	19.54	19.91	17.31	12.56
	Ethylene	10.25	7.70	8.65	7.33	7.88	6.13
	Ethane	17.86	19.43	16.89	18.23	15.57	15.74
	Propylene	11.36	9.01	10.98	10.17	10.94	8.00
	Propane	9.05	12.51	9.37	10.92	9.71	14.77
	Mixed C4	20.10	19.00	19.46	20.41	23.30	31.52
	Mixed C5	8.10	8.12	11.80	9.54	11.54	11.28
	C6+	1.39	2.70	3.30	3.49	3.74	0.00
Gas yield (wt%)	Methane	3.52	3.47	3.93	5.47	3.17	2.77
	Ethylene	1.65	1.24	1.74	2.01	1.44	1.35
	Ethane	2.87	3.13	3.40	5.01	2.85	3.47
	Propylene	1.83	1.45	2.21	2.79	2.00	1.76
	Propane	1.45	2.02	1.89	3.00	1.78	3.26
	Mixed C4	3.23	3.07	3.92	5.61	4.26	6.95
	Mixed C5	1.30	1.31	2.37	2.62	2.11	2.49
	C6+	0.22	0.43	0.66	0.96	0.69	0.00

**Table C3** Distribution and yield of gases obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HBETA mixed with 20%HY

Catalysts	Name	Non-catalyst	1PB20Y	1PB20Y10Z	1PB20Y20Z	HZSM-5
	Metal	-	1% Pd			-
	Support	-	HBETA			-
	1 <sup>st</sup> Additive	-	20% HY			-
	2 <sup>nd</sup> Additive	-	-	10% HZSM-5	20% HZSM-5	-
Gas composition (wt%)	Methane	21.89	16.04	13.88	13.87	18.72
	Ethylene	10.25	6.35	6.39	6.11	9.63
	Ethane	17.86	13.57	17.39	16.86	15.94
	Propylene	11.36	10.27	8.43	7.78	11.07
	Propane	9.05	8.87	14.37	16.21	14.49
	Mixed C4	20.10	24.37	28.01	29.80	19.48
	Mixed C5	8.10	14.25	11.53	9.37	8.15
	C6+	1.39	6.27	0.00	0.00	2.52
Gas yield (wt%)	Methane	3.52	4.14	3.76	4.03	2.97
	Ethylene	1.65	1.64	1.73	1.78	1.53
	Ethane	2.87	3.51	4.71	4.90	2.53
	Propylene	1.83	2.65	2.28	2.26	1.76
	Propane	1.45	2.29	3.89	4.71	2.30
	Mixed C4	3.23	6.30	7.58	8.66	3.09
	Mixed C5	1.30	3.68	3.12	2.72	1.29
	C6+	0.22	1.62	0.00	0.00	0.40

**Table C4** Distribution and yield of gases obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HY mixed with 10%HBETA

Catalysts	Name	Non-catalyst	1PY10B	1PY10B10Z	1PY10B20Z	HZSM-5
	Metal	-	1% Pd			-
	Support	-	HY			-
	1 <sup>st</sup> Additive	-	10% HBETA			-
	2 <sup>nd</sup> Additive	-	-	10% HZSM-5	20% HZSM-5	-
Gas composition (wt%)	Methane	21.89	19.91	17.49	15.75	18.72
	Ethylene	10.25	7.33	8.20	8.33	9.63
	Ethane	17.86	18.23	21.21	20.24	15.94
	Propylene	11.36	10.17	9.50	9.05	11.07
	Propane	9.05	10.92	13.53	15.66	14.49
	Mixed C4	20.10	20.41	21.69	22.69	19.48
	Mixed C5	8.10	9.54	8.38	8.29	8.15
	C6+	1.39	3.49	0.00	0.00	2.52
Gas yield (wt%)	Methane	3.52	5.47	4.95	3.78	2.97
	Ethylene	1.65	2.01	2.32	2.00	1.53
	Ethane	2.87	5.01	6.00	4.86	2.53
	Propylene	1.83	2.79	2.69	2.17	1.76
	Propane	1.45	3.00	3.83	3.76	2.30
	Mixed C4	3.23	5.61	6.14	5.45	3.09
	Mixed C5	1.30	2.62	2.37	1.99	1.29
	C6+	0.22	0.96	0.00	0.00	0.40

## Appendix D Amount of Asphaltene in Pyrolysis Oils

**Table D1** The amount of asphaltene in pyrolysis oils

No.	Parameter studied	Detail	Asphaltene in oil (wt%)
1	<b>Pure component</b>	Non-catalyst	0.097
2		HBETA	0.092
3		HY	0.112
4		HZSM-5	0.074
5		Pd/HBETA	0.014
6		Pd/HY	0.056
7	<b>Additive (HY) in Pd/HBETA</b>	Pd/HBETA+10%HY	0.054
8		Pd/HBETA+20%HY	0.078
9	<b>Additive (HBETA) in Pd/HY</b>	Pd/HY+10%HBETA	0.092
10		Pd/HY+20%HBETA	0.054
11	<b>2nd Additive (HZSM-5) in Pd/HBETA+20%HY</b>	Pd/HBETA+20%HY+10%HZSM-5	0.090
12		Pd/HBETA+20%HY+20%HZSM-5	0.320
13	<b>2nd Additive (HZSM-5) in Pd/HY+10%HBETA</b>	Pd/HY+10%HBETA+10%HZSM-5	0.106
14		Pd/HY+10%HBETA+20%HZSM-5	0.086



## Appendix E Chemical Compositions of Maltenes

**Table E1** Chemical compositions of maltenes obtained from pyrolysis with varied percentage of HY in Pd/HBETA

	<b>Name</b>	<b>Non-catalyst</b>	<b>HBETA</b>	<b>Pd/HBETA</b>	<b>1PB10Y</b>	<b>1PB20Y</b>	<b>HY</b>
<b>Catalysts</b>	<b>Metal</b>	-	-	1% Pd			-
	<b>Support</b>	-	-	HBETA			-
	<b>Additive</b>	-	-	-	10% HY	20% HY	-
<b>Chemical composition (wt%)</b>	<b>Saturated Hydrocarbon</b>	69.79	71.72	78.55	76.52	58.12	73.68
	<b>Mono-Aromatics</b>	6.34	9.84	4.06	5.30	15.38	5.88
	<b>Di-Aromatics</b>	7.85	4.51	6.38	3.03	7.12	7.12
	<b>Poly-Aromatics</b>	6.34	1.64	2.90	7.95	6.55	4.95
	<b>Polar-Aromatics</b>	9.67	12.30	8.12	7.20	12.82	8.36
	<b>Total-Aromatics</b>	30.21	28.28	21.45	23.48	41.88	26.32

**Table E2** Chemical compositions of maltenes obtained from pyrolysis with varied percentage of HBETA in Pd/HY

	<b>Name</b>	<b>Non-catalyst</b>	<b>HY</b>	<b>Pd/HY</b>	<b>1PY10B</b>	<b>1PY20B</b>	<b>HBETA</b>
<b>Catalysts</b>	<b>Metal</b>	-	-	1% Pd			-
	<b>Support</b>	-	-	HY			-
	<b>Additive</b>	-	-	-	10% HBETA	20% HBETA	-
	<b>Saturated Hydrocarbon</b>	69.79	73.68	75.59	69.25	61.63	71.72
<b>Chemical composition (wt%)</b>	<b>Mono-Aromatics</b>	6.34	5.88	6.47	7.39	7.45	9.84
	<b>Di-Aromatics</b>	7.85	7.12	3.53	1.12	7.00	4.51
	<b>Poly-Aromatics</b>	6.34	4.95	9.41	8.90	7.00	1.64
	<b>Polar-Aromatics</b>	9.67	8.36	5.00	13.34	16.93	12.30
	<b>Total-Aromatics</b>	30.21	26.32	24.41	30.75	38.37	28.28

**Table E3** Chemical compositions of maltenes obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HBETA mixed with 20%HY

	<b>Name</b>	<b>Non-catalyst</b>	<b>1PB20Y</b>	<b>1PB20Y10Z</b>	<b>1PB20Y20Z</b>	<b>HZSM-5</b>
<b>Catalysts</b>	<b>Metal</b>	-	1% Pd			-
	<b>Support</b>	-	HBETA			-
	<b>1<sup>st</sup> Additive</b>	-	20% HY			-
	<b>2<sup>nd</sup> Additive</b>	-	-	10% HZSM-5	20% HZSM-5	-
	<b>Saturated Hydrocarbon</b>	69.79	58.12	50.00	58.17	56.33
<b>Chemical composition (wt%)</b>	<b>Mono-Aromatics</b>	6.34	15.38	13.99	12.03	11.62
	<b>Di-Aromatics</b>	7.85	7.12	6.99	7.16	7.14
	<b>Poly-Aromatics</b>	6.34	6.55	5.94	4.30	13.68
	<b>Polar-Aromatics</b>	9.67	12.82	23.08	18.34	11.23
	<b>Total-Aromatics</b>	30.21	41.88	50.00	41.83	43.67

**Table E4** Chemical compositions of maltenes obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HY mixed with 10%HBETA

	Name	Non-catalyst	1PY10B	1PY10B10Z	1PY10B20Z	HZSM-5
<b>Catalysts</b>	<b>Metal</b>	-	1% Pd			-
	<b>Support</b>	-	HY			-
	<b>1<sup>st</sup> Additive</b>	-	10% HBETA			-
	<b>2<sup>nd</sup> Additive</b>	-	-	10% HZSM-5	20% HZSM-5	-
	<b>Saturated Hydrocarbon</b>	69.79	69.25	55.34	56.39	56.33
<b>Chemical composition (wt%)</b>	<b>Mono-Aromatics</b>	6.34	7.39	13.70	15.56	11.62
	<b>Di-Aromatics</b>	7.85	1.12	6.85	8.61	7.14
	<b>Poly-Aromatics</b>	6.34	8.90	4.93	5.56	13.68
	<b>Polar-Aromatics</b>	9.67	13.34	19.18	13.89	11.23
	<b>Total-Aromatics</b>	30.21	30.75	44.66	43.61	43.67

## Appendix F True Boiling Point of Maltenes ✓

**Table F1** True boiling point of maltenes obtained from pyrolysis with varied percentages of HY in Pd/HBETA

% Off	Boiling point (°C)					
	Non-catalyst	HBETA	Pd/HBETA	1PB10Y	1PB20Y	HY
0	55.5	53.7	51.7	53.3	53.8	52.3
5	65.0	74.3	121.1	64.8	73.0	58.0
10	69.7	104.2	142.3	69.4	148.4	122.6
15	122.7	127.5	147.8	98.6	150.1	137.6
20	154.2	133.8	154.2	148.5	166.3	148.1
25	172.8	137.6	171.7	165.1	183.7	149.5
30	199.9	148.6	188.0	183.9	200.0	164.9
35	226.9	157.9	204.8	205.6	218.9	174.9
40	247.0	171.7	222.7	223.9	229.5	192.7
45	259.5	185.1	238.1	237.1	242.5	211.1
50	275.1	201.5	253.5	252.5	255.1	227.6
55	294.0	215.4	261.9	259.4	262.7	240.4
60	313.1	226.8	275.0	273.0	274.4	254.6
65	330.9	243.2	289.8	286.8	285.9	265.7
70	355.6	261.1	306.9	305.7	297.6	280.1
75	378.9	279.7	324.3	328.0	313.2	300.7
80	408.8	298.3	343.9	361.0	329.6	323.7
85	469.2	321.3	367.8	414.1	353.7	350.4
90	509.3	389.9	392.3	501.5	382.2	383.9
95	538.9	415.5	433.4	536.5	426.8	435.4
100	581.2	517.2	538.1	580.9	522.9	556.2

**Table F2** True boiling point of maltenes obtained from pyrolysis with varied percentages of HBETA in Pd/HY

% Off	Boiling point (°C)					
	Non-catalyst	HY	Pd/HY	1PY10B	1PY20B	HBETA
0	55.5	52.3	51.2	53.7	69.4	53.7
5	65.0	58.0	67.1	83.8	99.4	74.3
10	69.7	122.6	123.7	125.3	148.7	104.2
15	122.7	137.6	148.6	148.1	170.1	127.5
20	154.2	148.1	165.7	149.0	191.3	133.8
25	172.8	149.5	188.3	159.8	211.2	137.6
30	199.9	164.9	206.3	172.3	228.7	148.6
35	226.9	174.9	224.9	189.9	242.6	157.9
40	247.0	192.7	238.9	210.1	255.5	171.7
45	259.5	211.1	253.1	229.5	264.9	185.1
50	275.1	227.6	260.8	245.7	275.7	201.5
55	294.0	240.4	273.5	257.0	287.4	215.4
60	313.1	254.6	284.0	268.8	296.9	226.8
65	330.9	265.7	295.3	284.6	309.8	243.2
70	355.6	280.1	309.4	389.8	321.2	261.1
75	378.9	300.7	322.8	409.4	334.6	279.7
80	408.8	323.7	338.9	427.6	350.6	298.3
85	469.2	350.4	362.0	447.5	369.1	321.3
90	509.3	383.9	393.4	473.3	391.9	389.9
95	538.9	435.4	527.8	528.4	439.2	415.5
100	581.2	556.2	578.7	581.6	539.3	517.2

**Table F3** True boiling point of maltenes obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HBETA mixed with 20%HY

% Off	Boiling point (°C)				
	Non-catalyst	1PB20Y	1PB20Y10Z	1PB20Y20Z	HZSM-5
0	55.5	53.8	54.1	54.4	61.4
5	65.0	73.0	104.0	76.9	62.0
10	69.7	148.4	129.6	103.8	65.7
15	122.7	150.1	133.8	131.5	83.2
20	154.2	166.3	140.9	132.4	117.4
25	172.8	183.7	148.8	141.5	146.0
30	199.9	200.0	160.8	153.7	147.8
35	226.9	218.9	172.1	167.0	154.4
40	247.0	229.5	187.7	180.1	171.4
45	259.5	242.5	199.4	194.9	186.3
50	275.1	255.1	209.7	204.5	206.2
55	294.0	262.7	221.7	218.2	217.4
60	313.1	274.4	228.0	228.0	232.2
65	330.9	285.9	241.6	243.8	242.1
70	355.6	297.6	254.2	263.8	256.2
75	378.9	313.2	270.5	285.5	271.8
80	408.8	329.6	288.2	308.4	290.2
85	469.2	353.7	309.1	337.5	310.0
90	509.3	382.2	339.0	396.5	339.8
95	538.9	426.8	411.5	465.3	415.4
100	581.2	522.9	530.7	549.0	539.8

**Table F4** - True boiling point of maltenes obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HY mixed with 10%HBETA

% Off	Boiling point (°C)				
	Non-catalyst	1PY10B	1PY10B10Z	1PY10B20Z	HZSM-5
0	55.5	53.7	54.6	54.2	61.4
5	65.0	83.8	58.7	57.3	62.0
10	69.7	125.3	103.9	102.0	65.7
15	122.7	148.1	132.4	121.2	83.2
20	154.2	149.0	133.3	130.9	117.4
25	172.8	159.8	140.5	139.4	146.0
30	199.9	172.3	148.5	150.3	147.8
35	226.9	189.9	160.4	163.7	154.4
40	247.0	210.1	173.1	177.9	171.4
45	259.5	229.5	190.4	194.4	186.3
50	275.1	245.7	202.0	205.8	206.2
55	294.0	257.0	215.1	218.8	217.4
60	313.1	268.8	225.8	227.3	232.2
65	330.9	284.6	239.1	240.9	242.1
70	355.6	389.8	258.3	258.2	256.2
75	378.9	409.4	280.5	276.3	271.8
80	408.8	427.6	302.1	293.6	290.2
85	469.2	447.5	330.5	316.7	310.0
90	509.3	473.3	390.6	343.9	339.8
95	538.9	528.4	466.0	434.8	415.4
100	581.2	581.6	554.4	552.2	539.8



**Appendix G True Boiling Point of Maltenes, Saturated Hydrocarbons, Mono-, Di-, Poly-, and Polar-aromatics in Maltenes**

**Table G1** Pyrolysis conditions: Non-catalytic Pyrolysis

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	55.5	61.0	58.8	58.0	51.0	47.4
5	65.0	154.4	64.6	64.1	62.2	65.8
10	69.7	210.7	69.1	69.7	65.2	71.3
15	122.7	228.9	94.6	106.1	67.7	202.9
20	154.2	246.8	170.2	147.8	69.6	231.0
25	172.8	256.3	221.9	154.6	94.9	235.5
30	199.9	266.4	247.6	171.5	106.2	236.1
35	226.9	276.2	267.8	178.6	112.1	252.6
40	247.0	289.1	357.2	186.2	148.3	264.8
45	259.5	301.2	377.2	191.9	179.1	279.4
50	275.1	312.5	388.5	198.8	197.5	286.7
55	294.0	323.4	399.3	206.6	220.1	307.6
60	313.1	334.3	411.7	215.4	233.4	324.9
65	330.9	348.0	424.2	222.2	454.9	351.8
70	355.6	362.8	438.6	228.6	486.4	377.8
75	378.9	376.8	458.8	239.2	500.1	426.2
80	408.8	390.5	481.8	251.8	521.0	479.5
85	469.2	411.8	502.3	269.7	530.5	501.1
90	509.3	445.5	527.8	474.6	542.2	526.8
95	538.9	497.4	547.1	526.0	559.0	545.9
100	581.2	568.5	584.1	577.1	589.8	584.1

**Table G2** Pyrolysis conditions: HBETA catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	53.7	53.1	52.9	55.0	55.0	55.0
5	74.3	72.6	60.8	55.5	55.5	55.5
10	104.2	148.2	103.8	55.8	55.8	55.9
15	127.5	170.1	211.5	56.3	56.1	56.3
20	133.8	186.6	240.2	57.2	56.7	57.0
25	137.6	197.4	259.4	69.0	57.5	64.2
30	148.6	210.3	277.5	84.0	73.9	158.0
35	157.9	218.7	293.8	293.2	81.7	208.5
40	171.7	231.4	302.3	310.1	111.1	250.4
45	185.1	242.0	314.4	320.5	282.5	289.4
50	201.5	248.3	322.5	324.4	310.0	315.8
55	215.4	259.6	329.3	334.9	322.3	333.5
60	226.8	267.5	338.7	389.7	336.5	390.1
65	243.2	279.4	347.2	389.9	340.5	390.8
70	261.1	291.6	354.5	390.3	389.9	409.1
75	279.7	302.9	363.3	390.7	390.3	431.0
80	298.3	316.2	373.1	401.0	390.8	437.3
85	321.3	333.0	383.4	422.7	399.8	451.7
90	389.9	356.6	396.4	440.1	420.5	480.8
95	415.5	387.2	420.8	475.7	438.9	504.2
100	517.2	461.3	491.6	531.5	499.1	543.2

**Table G3** Pyrolysis conditions: HY catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	52.3	73.6	67.1	63.1	68.6	69.0
5	58.0	147.9	71.5	79.2	95.2	89.5
10	122.6	164.5	79.8	97.5	114.9	110.8
15	137.6	179.8	87.1	101.2	133.3	130.2
20	148.1	198.1	98.1	105.9	148.3	143.1
25	149.5	212.7	103.1	106.6	197.5	164.4
30	164.9	224.0	110.8	110.3	234.7	198.4
35	174.9	236.4	116.4	110.6	254.9	232.0
40	192.7	247.9	128.6	111.0	272.4	251.8
45	211.1	255.4	136.8	111.3	296.6	276.0
50	227.6	262.5	147.4	115.6	336.1	305.0
55	240.4	273.2	182.4	136.1	364.9	334.9
60	254.6	284.0	274.4	373.8	386.9	356.0
65	265.7	296.0	402.7	458.9	405.9	377.6
70	280.1	311.6	433.1	464.8	423.6	397.3
75	300.7	327.3	459.6	470.5	441.5	420.8
80	323.7	344.9	476.1	477.2	458.6	445.0
85	350.4	368.0	497.7	487.0	471.0	466.4
90	383.9	392.4	527.0	499.1	487.1	487.7
95	435.4	431.2	547.4	524.4	522.2	526.4
100	556.2	538.6	583.4	566.2	563.4	565.2

**Table G4** Pyrolysis conditions: 1%Pd/HBETA catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	51.7	80.0	67.5	58.8	67.5	67.3
5	121.1	153.1	72.9	96.8	71.3	85.5
10	142.3	173.3	79.0	101.7	85.0	111.6
15	147.8	191.0	85.5	105.5	97.5	142.7
20	154.2	205.2	96.9	106.9	100.2	176.6
25	171.7	221.2	106.6	109.7	103.1	215.5
30	188.0	232.3	122.5	110.0	106.3	234.6
35	204.8	247.7	140.7	110.4	110.2	253.5
40	222.7	255.3	170.8	113.9	110.7	279.8
45	238.1	265.1	219.6	127.5	111.5	313.0
50	253.5	275.3	253.9	239.1	127.3	343.9
55	261.9	288.4	277.1	343.9	152.5	364.8
60	275.0	303.1	309.1	391.9	273.3	385.2
65	289.8	316.6	342.7	419.2	352.2	407.5
70	306.9	333.5	373.3	440.6	395.2	430.2
75	324.3	354.3	401.4	460.4	429.0	454.1
80	343.9	375.3	437.3	477.6	459.4	476.0
85	367.8	397.7	483.1	498.1	487.8	498.4
90	392.3	427.5	526.9	528.6	525.6	529.4
95	433.4	464.5	553.8	551.6	550.6	554.0
100	538.1	536.4	590.6	585.4	587.2	588.9

**Table G5** Pyrolysis conditions: 1%Pd/HBETA+10%HY catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	53.3	97.5	69.1	69.0	55.7	69.1
5	64.8	201.1	71.8	237.0	62.4	235.2
10	69.4	222.5	236.6	237.4	64.8	237.1
15	98.6	234.4	237.3	237.9	66.7	237.6
20	148.5	245.3	237.8	255.4	68.6	239.7
25	165.1	254.6	294.5	280.3	69.7	286.9
30	183.9	258.6	328.3	328.1	71.5	327.5
35	205.6	268.0	336.8	329.4	96.5	329.1
40	223.9	274.8	357.3	366.8	102.0	345.1
45	237.1	282.5	373.5	373.5	110.9	373.1
50	252.5	292.8	373.8	373.8	112.2	373.7
55	259.4	303.1	374.1	374.1	198.0	373.9
60	273.0	313.2	374.7	374.5	228.7	374.3
65	286.8	325.8	404.6	428.2	465.4	384.6
70	305.7	336.5	436.5	462.9	495.0	449.3
75	328.0	351.9	471.3	485.2	512.9	485.1
80	361.0	370.4	490.8	501.1	526.3	503.5
85	414.1	381.9	511.1	526.2	535.0	524.9
90	501.5	405.6	528.4	540.1	545.9	535.7
95	536.5	448.4	543.3	558.4	561.5	552.9
100	580.9	549.6	579.9	589.0	589.5	587.9

- **Table G6** Pyrolysis conditions: 1%Pd/HBETA+20%HY catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	53.8	62.0	62.2	61.6	58.8	55.7
5	73.0	96.5	70.9	101.9	61.8	61.6
10	148.4	191.9	179.8	163.5	63.9	63.5
15	150.1	211.2	221.2	177.1	65.8	65.2
20	166.3	224.2	238.2	188.2	67.7	66.7
25	183.7	234.1	256.1	193.8	69.2	68.2
30	200.0	246.5	280.5	201.0	70.2	69.2
35	218.9	254.7	326.2	206.6	80.0	70.2
40	229.5	258.4	335.9	214.3	192.7	71.7
45	242.5	266.5	345.1	221.0	221.7	235.6
50	255.1	274.1	357.0	225.2	235.2	252.7
55	262.7	280.4	360.5	231.0	254.2	328.5
60	274.4	290.5	367.0	237.7	274.1	360.3
65	285.9	298.6	373.5	245.3	397.6	389.3
70	297.6	310.1	380.9	253.6	432.3	463.2
75	313.2	320.5	386.8	260.3	484.2	494.8
80	329.6	333.4	393.3	275.6	505.5	516.0
85	353.7	350.5	404.8	351.4	526.5	529.2
90	382.2	374.2	435.2	386.2	539.4	541.4
95	426.8	411.2	523.9	433.2	557.7	558.0
100	522.9	554.5	576.1	566.4	589.5	590.2

**Table G7** Pyrolysis conditions: 1%Pd/HY catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	51.2	60.8	59.7	47.2	59.5	46.4
5	67.1	70.9	64.8	59.9	68.2	60.8
10	123.7	188.2	69.5	61.4	107.0	62.7
15	148.6	209.2	172.7	62.7	111.3	64.3
20	165.7	224.1	228.5	63.9	112.5	65.8
25	188.3	235.9	257.5	65.2	126.2	67.3
30	206.3	248.7	346.8	66.5	127.9	69.0
35	224.9	256.4	360.6	67.5	129.1	70.1
40	238.9	262.7	367.9	68.8	134.9	71.6
45	253.1	273.0	377.1	70.1	142.5	236.0
50	260.8	279.1	383.1	72.4	154.6	356.2
55	273.5	289.5	387.2	95.7	172.1	492.5
60	284.0	296.9	391.0	492.7	183.3	503.6
65	295.3	308.5	400.0	506.6	194.8	517.6
70	309.4	317.5	408.5	522.7	208.4	525.8
75	322.8	328.6	426.6	529.2	223.5	531.7
80	338.9	341.8	485.1	536.5	237.4	538.5
85	362.0	360.3	512.5	545.0	258.2	546.6
90	393.4	383.7	532.1	555.6	446.0	556.5
95	527.8	504.6	551.4	569.3	527.1	570.0
100	578.7	571.5	586.0	591.0	577.9	591.8

**Table G8** Pyrolysis conditions: 1%Pd/HY+10%HBETA catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	52.1	96.8	68.6	56.9	101.8	68.4
5	96.8	148.6	86.3	58.6	124.7	128.6
10	127.1	171.5	106.5	63.3	143.4	166.1
15	147.9	186.8	131.9	93.3	212.4	207.8
20	149.5	198.9	168.5	93.9	233.3	234.2
25	165.1	212.8	221.3	345.9	245.1	235.2
30	178.8	223.4	256.8	373.3	258.8	252.0
35	196.9	233.4	306.3	377.8	274.7	269.9
40	214.0	245.1	335.1	382.8	307.0	288.1
45	228.2	253.2	351.3	391.3	340.9	314.0
50	240.8	258.6	360.9	401.2	360.0	339.7
55	253.7	267.9	371.9	407.2	375.4	355.1
60	262.2	275.2	382.9	416.0	392.7	373.1
65	274.0	286.3	391.3	424.5	405.2	389.8
70	288.9	296.0	404.8	433.7	419.7	415.8
75	307.2	310.3	434.5	444.8	432.7	445.2
80	327.8	325.5	491.8	456.7	447.3	480.9
85	357.5	344.2	516.8	469.1	464.2	501.7
90	397.0	375.7	532.7	494.2	479.7	527.2
95	491.4	432.4	551.7	530.9	509.3	546.5
100	571.5	548.1	589.3	590.7	567.0	588.3



**Table G9** Pyrolysis conditions: 1%Pd/HY+10%HBETA catalyst (repeated)

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	55.3	67.5	62.2	64.3	61.8	61.2
5	70.7	148.4	67.3	69.3	67.1	66.0
10	123.4	165.8	70.6	71.9	69.8	69.4
15	148.2	184.6	87.9	277.0	98.1	71.5
20	148.5	199.8	356.5	354.2	101.6	235.5
25	154.4	218.7	493.4	381.5	106.9	493.3
30	165.8	229.0	501.1	401.0	111.8	500.6
35	182.8	242.9	510.2	424.1	494.0	509.4
40	206.1	254.5	520.6	445.1	502.6	519.5
45	230.7	261.2	525.0	462.2	513.1	524.6
50	250.5	272.0	528.7	473.2	522.9	528.1
55	260.3	280.7	532.5	481.7	526.8	531.8
60	275.3	292.9	536.5	489.2	531.0	535.8
65	295.2	306.0	540.8	496.0	535.5	540.1
70	490.6	319.4	545.5	508.2	540.3	544.6
75	511.6	337.3	550.5	522.4	545.6	549.7
80	527.4	368.0	556.1	528.2	551.5	555.3
85	537.5	422.9	562.5	535.4	558.2	561.6
90	549.5	491.3	570.1	545.1	566.2	569.2
95	565.4	531.5	579.9	559.6	576.8	579.2
100	591.6	577.8	595.7	588.8	594.2	595.4

**Table G10** Pyrolysis conditions: 1%Pd/HY+20%HBETA catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	69.4	83.7	110.6	79.5	98.2	71.3
5	99.4	168.9	253.1	111.1	198.6	111.5
10	148.7	191.8	318.4	148.2	239.6	219.9
15	170.1	210.5	331.5	171.7	265.8	235.6
20	191.3	224.3	341.2	189.8	311.3	244.2
25	211.2	238.0	350.9	205.4	351.5	261.5
30	228.7	250.0	357.7	227.7	372.8	280.4
35	242.6	257.4	361.0	255.4	388.0	305.8
40	255.5	265.0	366.9	344.5	398.8	327.4
45	264.9	273.8	370.6	361.5	407.3	347.5
50	275.7	281.6	376.4	375.8	417.4	356.3
55	287.4	291.4	382.8	379.0	423.7	373.0
60	296.9	301.5	386.2	385.5	432.1	384.3
65	309.8	311.3	390.3	392.5	440.4	399.9
70	321.2	322.0	396.9	402.0	448.7	422.2
75	334.6	334.0	402.3	410.1	459.6	442.2
80	350.6	349.0	411.7	421.6	469.7	462.5
85	369.1	368.9	424.5	433.8	479.7	479.5
90	391.9	392.5	442.5	454.1	493.9	499.1
95	439.2	432.9	473.5	484.9	526.3	530.0
100	539.3	495.3	544.7	554.5	571.8	573.0

**Table G11** Pyrolysis conditions: 1%Pd/HBETA+20%HY+10%HZSM-5 catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	54.1	57.9	59.1	55.9	55.5	55.6
5	104.0	71.3	114.2	196.6	74.4	178.0
10	129.6	133.8	188.8	223.1	89.4	209.7
15	133.8	148.7	210.5	223.6	182.3	239.2
20	140.9	161.1	215.8	224.7	224.0	258.0
25	148.8	171.6	219.6	239.2	239.2	265.9
30	160.8	182.7	237.5	244.5	244.7	277.1
35	172.1	192.1	242.6	247.1	249.1	285.3
40	187.7	199.2	245.2	248.7	258.3	293.4
45	199.4	207.4	246.3	261.7	265.8	301.8
50	209.7	215.2	256.7	264.5	273.5	309.0
55	221.7	222.2	262.9	276.7	280.1	318.0
60	228.0	230.3	269.1	282.1	287.0	324.4
65	241.6	239.2	279.4	291.3	297.6	334.5
70	254.2	252.1	290.5	301.4	307.8	389.7
75	270.5	266.7	303.3	314.1	321.9	390.2
80	288.2	285.3	318.6	333.9	339.8	392.3
85	309.1	306.1	343.0	390.4	390.4	429.0
90	339.0	389.7	375.6	425.7	418.5	450.2
95	411.5	439.7	425.2	460.4	458.3	485.6
100	530.7	524.2	523.3	523.1	540.3	542.8

**Table G12** Pyrolysis conditions: 1%Pd/HBETA+20%HY+20%HZSM-5 catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	54.4	58.5	58.5	58.1	58.1	58.1
5	76.9	68.9	76.8	64.2	58.5	58.9
10	103.8	130.7	170.9	76.8	62.6	163.1
15	131.5	146.8	206.2	215.6	76.5	207.1
20	132.4	157.9	223.8	246.4	80.6	266.6
25	141.5	169.2	236.5	269.7	88.2	292.6
30	153.7	180.3	243.5	279.2	243.0	307.9
35	167.0	192.1	250.2	288.4	288.2	318.5
40	180.1	198.8	256.8	295.8	305.0	327.3
45	194.9	205.7	263.8	303.8	319.8	337.3
50	204.5	215.5	273.4	310.6	333.1	389.8
55	218.2	221.7	279.3	318.5	389.7	390.4
60	228.0	228.8	283.2	324.8	390.2	392.6
65	243.8	240.4	292.3	334.1	390.8	420.9
70	263.8	256.4	299.9	342.8	412.4	439.4
75	285.5	273.6	308.7	390.3	438.2	458.0
80	308.4	291.6	320.3	398.0	460.6	478.4
85	337.5	315.6	336.0	438.0	488.2	497.7
90	396.5	390.0	390.3	476.3	509.4	514.5
95	465.3	453.9	453.7	515.2	531.7	533.4
100	549.0	547.0	549.0	561.6	568.8	569.0

**Table G13** Pyrolysis conditions: 1%Pd/HY+10%HBETA+10%HZSM-5 catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	54.6	55.6	56.8	55.5	55.6	55.8
5	58.7	59.8	63.2	57.4	56.4	56.9
10	103.9	74.3	160.9	88.7	57.0	57.7
15	132.4	132.5	200.4	237.5	57.5	58.4
20	133.3	147.9	218.5	249.1	58.0	60.8
25	140.5	159.8	225.3	260.4	58.9	175.6
30	148.5	170.5	234.2	273.8	74.0	207.4
35	160.4	182.1	241.9	280.2	78.3	238.2
40	173.1	194.2	247.8	285.2	82.4	276.7
45	190.4	200.9	258.3	294.3	88.4	297.9
50	202.0	209.8	264.5	300.5	97.0	313.5
55	215.1	217.9	276.0	306.5	280.5	322.4
60	225.8	224.9	284.7	312.5	299.8	334.1
65	239.1	232.6	290.8	321.6	313.3	389.8
70	258.3	244.8	300.8	329.1	327.7	390.4
75	280.5	263.1	311.3	338.1	342.8	407.6
80	302.1	281.5	325.7	390.0	390.6	447.0
85	330.5	301.4	342.6	390.8	505.6	496.5
90	390.6	336.0	390.7	431.5	525.4	517.5
95	466.0	433.1	455.2	491.7	542.9	537.2
100	554.4	555.1	555.2	558.4	573.6	571.7

**Table G14** Pyrolysis conditions: 1%Pd/HY+10%HBETA+20%HZSM-5 catalyst

% Off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	54.2	55.8	55.8	55.9	58.1	55.3
5	57.3	66.7	68.7	75.1	59.5	56.1
10	102.0	129.9	153.9	208.6	75.2	56.7
15	121.2	139.5	194.0	240.2	80.2	57.3
20	130.9	152.7	210.5	257.3	88.2	57.9
25	139.4	167.1	221.3	272.8	262.9	59.8
30	150.3	176.3	231.0	279.5	283.3	156.3
35	163.7	189.3	238.1	290.5	297.5	206.8
40	177.9	196.9	245.2	298.7	308.6	317.0
45	194.4	205.2	255.7	306.8	318.4	328.8
50	205.8	214.0	262.3	315.0	328.0	496.7
55	218.8	220.7	273.4	323.7	337.5	504.5
60	227.3	226.8	281.8	334.1	389.9	511.1
65	240.9	236.0	289.6	343.5	390.4	519.1
70	258.2	246.2	299.0	390.3	392.6	525.1
75	276.3	261.5	310.0	391.0	425.8	530.4
80	293.6	276.7	326.8	419.2	453.5	536.4
85	316.7	293.0	389.8	438.9	488.5	543.2
90	343.9	318.8	400.1	457.1	511.1	551.5
95	434.8	390.6	452.4	483.0	532.8	562.2
100	552.2	534.7	536.1	543.7	567.9	579.8

## Appendix H Petroleum Fractions of Derived Oils

**Table H1** Petroleum fractions in derived oils obtained from pyrolysis with varied percentages of HY in Pd/HBETA

	Name	Non-catalyst	HBETA	Pd/HBETA	1PB10Y	1PB20Y	HY
<b>Catalysts</b>	<b>Metal</b>	-	-	1% Pd			-
	<b>Support</b>	-	-	HBETA			-
	<b>Additive</b>	-	-	-	10% HY	20% HY	-
<b>Petroleum Fraction (wt%)</b>	<b>Naphtha</b>	30.02	49.54	33.57	33.71	30.00	41.98
	<b>Kerosene</b>	11.18	17.36	15.29	15.48	17.98	16.40
	<b>Light gas oil</b>	15.37	13.47	19.12	19.30	22.79	16.45
	<b>Heavy gas oil</b>	16.52	8.18	17.47	12.36	17.09	13.10
	<b>Residues</b>	26.91	11.45	14.55	19.15	12.14	12.07

**Table H2** Petroleum fractions in derived oils obtained from pyrolysis with varied percentages of HBETA in Pd/HY

	Name	Non-catalyst	HY	Pd/HY	1PY10B	1PY20B	HBETA
<b>Catalysts</b>	<b>Metal</b>	-	-	1% Pd			-
	<b>Support</b>	-	-	HY			-
	<b>Additive</b>	-	-	-	10% HBETA	20% HBETA	-
	<b>Petroleum Fraction (wt%)</b>						
	<b>Naphtha</b>	30.02	41.98	28.25	37.30	22.19	49.54
	<b>Kerosene</b>	11.18	16.40	15.66	14.42	15.68	17.36
	<b>Light gas oil</b>	15.37	16.45	22.76	17.36	23.33	13.47
	<b>Heavy gas oil</b>	16.52	13.10	19.61	7.67	24.00	8.18
	<b>Residues</b>	26.91	12.07	13.73	23.25	14.80	11.45



**Table H3** Petroleum fractions in derived oils obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HBETA mixed with 20%HY

	Name	Non-catalyst	1PB20Y	1PB20Y10Z	1PB20Y20Z	HZSM-5
<b>Catalysts</b>	<b>Metal</b>	-	1% Pd			-
	<b>Support</b>	-	HBETA			-
	<b>1<sup>st</sup> Additive</b>	-	20% HY			-
	<b>2<sup>nd</sup> Additive</b>	-	-	10% HZSM-5	20% HZSM-5	-
	<b>Petroleum Fraction (wt%)</b>	<b>Naphtha</b>	30.02	30.00	45.29	47.66
	<b>Kerosene</b>	11.18	17.98	23.04	18.89	19.36
	<b>Light gas oil</b>	15.37	22.79	14.49	11.62	14.67
	<b>Heavy gas oil</b>	16.52	17.09	9.31	9.59	9.52
	<b>Residues</b>	26.91	12.14	7.86	12.25	8.00

**Table H4** Petroleum fractions in derived oils obtained from pyrolysis with varied percentages of HZSM-5 in Pd/HY mixed with 10%HBETA

	Name	Non-catalyst	1PY10B	1PY10B10Z	1PY10B20Z	HZSM-5
<b>Catalysts</b>	<b>Metal</b>	-	1% Pd			-
	<b>Support</b>	-	HY			-
	<b>1<sup>st</sup> Additive</b>	-	10% HBETA			-
	<b>2<sup>nd</sup> Additive</b>	-	-	10% HZSM-5	20% HZSM-5	-
<b>Petroleum Fraction (wt%)</b>	<b>Naphtha</b>	30.02	37.30	49.14	47.46	48.44
	<b>Kerosene</b>	11.18	14.42	18.70	20.17	19.36
	<b>Light gas oil</b>	15.37	17.36	11.68	13.76	14.67
	<b>Heavy gas oil</b>	16.52	7.67	8.77	10.05	9.52
	<b>Residues</b>	26.91	23.25	11.71	8.56	8.00

