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APPENDICES

APPENDIX A Temperature Profiles

Table A1 Temperature profiles: Batch 1 (no Cat):

1. Sample = 30.02 g , N₂ flow rate = 30 ml/min
2. Char = 14.53 g
3. Pyrolysis oils = 11.8 g
4. Pyrolysis Gas = 4.09 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	42.2	48.2	32	369.2	498.1	62	354	500.1	92	350	500
4	62.9	80.7	34	368.5	498.5	64	350	498.8	94	350	500
6	94.9	122.7	36	365.8	499.8	66	354	492.5	96	350	500
8	133.8	175.8	38	372.8	498.2	68	353.2	495	98	350	500
10	177.2	229.3	40	366	500.2	70	356.8	497.9	100	350	500
12	225.9	290	42	363.9	499	72	356.7	503.6	102	350	500
14	271.7	350	44	362.7	498	74	354.1	501.8	104	350	500
16	282	411.3	46	369.1	499.9	76	354.4	499.3	106	350	500
18	309	438.9	48	362.3	498.8	78	347.9	502.8	108	350	500
20	334.3	476.1	50	360	499.6	80	352.8	499.9	110	350	500
22	337.9	506.8	52	360.6	502.3	82	350	500	112	350	500
24	363	495.2	54	359.9	498.3	84	350	500	114	350	500
26	366.3	501.1	56	360.5	499	86	350	500	116	350	500
28	368.1	493.5	58	360.4	500.8	88	350	500	118	350	500
30	373.4	502	60	354.4	498.7	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

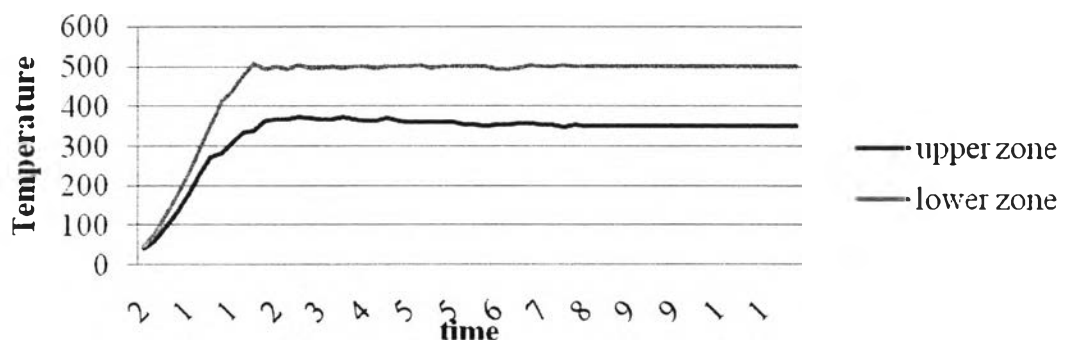


Figure A1 Temperature profile Bacth 1 (no cat)

Table A2 Temperature profiles: Batch 2 (HMOR):

1. Sample = 30.02 g , Catalyst = 7.52g, N₂ flow rate = 30 ml/min
2. Char = 14.24 g
3. Pyrolysis oils = 10.25 g
4. Pyrolysis Gas = 5.53 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.7	27.8	32	342.7	502.2	62	350	500	92	350	500
4	34.6	45.1	34	344.9	505.4	64	350	500	94	350	500
6	52.2	73.6	36	346.6	496.2	66	350	500	96	350	500
8	76.8	114	38	347.8	496.7	68	350	500	98	350	500
10	108.4	164.2	40	347.9	498.7	70	350	500	100	350	500
12	145.4	219.6	42	348	499.5	72	350	500	102	350	500
14	186.2	276.4	44	347.9	498.8	74	350	500	104	350	500
16	232	335.9	46	347.3	501.1	76	350	500	106	350	500
18	282	402.9	48	355.8	500.8	78	350	500	108	350	500
20	329.3	433.8	50	360.7	499.1	80	350	500	110	350	500
22	324.9	476.9	52	360.3	500	82	350	500	112	350	500
24	325.7	508	54	359.1	501.3	84	350	500	114	350	500
26	332.1	493.6	56	357.2	499	86	350	500	116	350	500
28	336.8	503.1	58	356.3	500.2	88	350	500	118	350	500
30	340.3	498.7	60	354.9	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

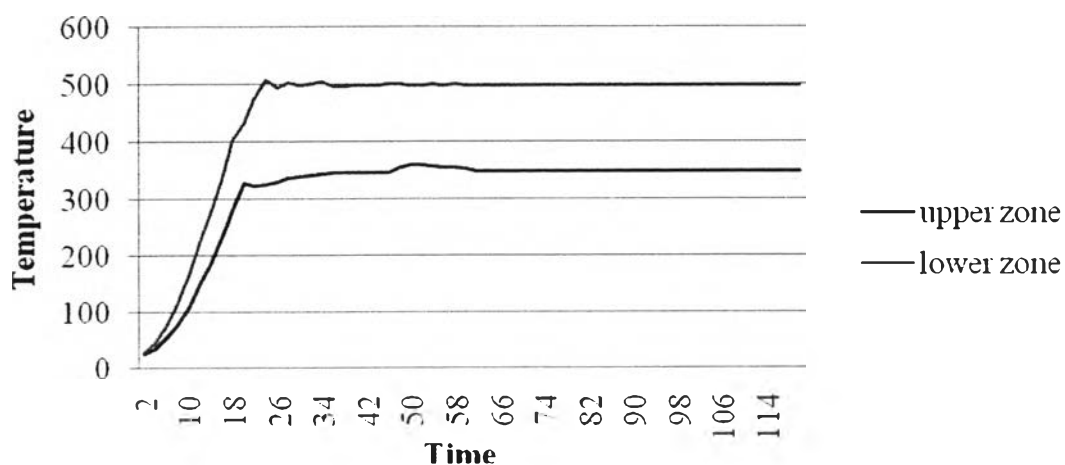
**Figure A2** Temperature profiles: Batch 2 (HMOR)

Table A3 Temperature profiles: Batch 3 (Ru/HMOR):

1. Sample = 30.03 g , Catalyst = 7.52g, N₂ flow rate = 30 ml/min
2. Char = 14.36g
3. Pyrolysis oils = 8.61 g
4. Pyrolysis Gas = 7.06 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	31.4	43.2	32	348.3	502.2	62	353.9	500	92	350	500
4	40.1	60.7	34	350.7	506	64	356.7	500	94	350	500
6	57.4	88.8	36	352.3	496.7	66	356.1	500	96	350	500
8	89.3	130.1	38	352.6	496.6	68	354.8	500	98	350	500
10	118.2	176.2	40	351.7	499.1	70	350	500	100	350	500
12	157	231.3	42	351.8	501.9	72	350	500	102	350	500
14	205	297.4	44	350.9	498.6	74	350	500	104	350	500
16	250.7	350.8	46	350.3	500.5	76	350	500	106	350	500
18	312.7	416.7	48	349.4	500	78	350	500	108	350	500
20	327.2	451.4	50	353.7	498.6	80	350	500	110	350	500
22	327.8	491.9	52	351.8	500	82	350	500	112	350	500
24	330.9	504.2	54	357.1	500	84	350	500	114	350	500
26	335.9	505.5	56	356	500	86	350	500	116	350	500
28	340.9	497	58	350.8	500	88	350	500	118	350	500
30	344.2	505.9	60	348.9	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

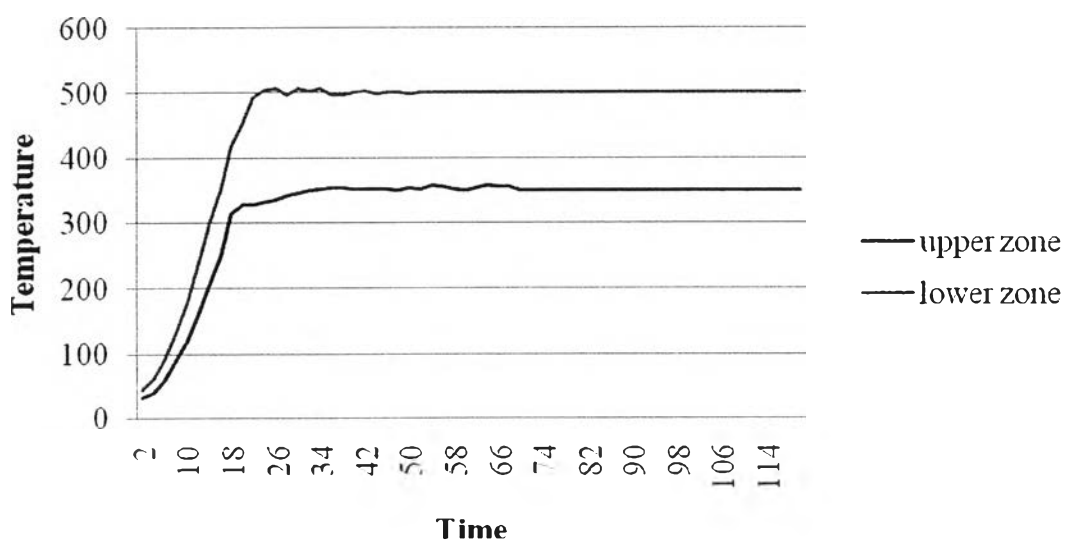
**Figure A3** Temperature profiles: Batch 3 (Ru/HMOR)

Table A4 Temperature profiles: Batch 4 (Kaolin):

1. Sample = 30 g , Catalyst = 7.54g, N₂ flow rate = 30 ml/min
2. Char = 14.46 g
3. Pyrolysis oils = 10.59 g
4. Pyrolysis Gas = 4.99 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	27.4	28.4	32	341.8	498.2	62	350	498.7	92	350	500
4	33	44.8	34	354.7	505	64	350	500.9	94	350	500
6	44.6	72.8	36	365.8	497.6	66	350	500.2	96	350	500
8	62.1	111.6	38	368.5	495.5	68	350	499.9	98	350	500
10	87.2	161.4	40	369	500.3	70	350	500	100	350	500
12	119	215.3	42	369.6	498.7	72	350	500	102	350	500
14	157.8	273.8	44	368	499.1	74	350	500	104	350	500
16	203.2	334.2	46	367.1	498	76	350	500	106	350	500
18	250.4	396.9	48	366	500.9	78	350	500	108	350	500
20	306.6	439.5	50	367	500	80	350	500	110	350	500
22	321.9	480.2	52	364.8	501.2	82	350	500	112	350	500
24	327.9	509.6	54	363.2	497.9	84	350	500	114	350	500
26	334.3	499.3	56	361	500.9	86	350	500	116	350	500
28	336.4	496.5	58	358.3	501	88	350	500	118	350	500
30	339.3	504.3	60	348.9	501	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

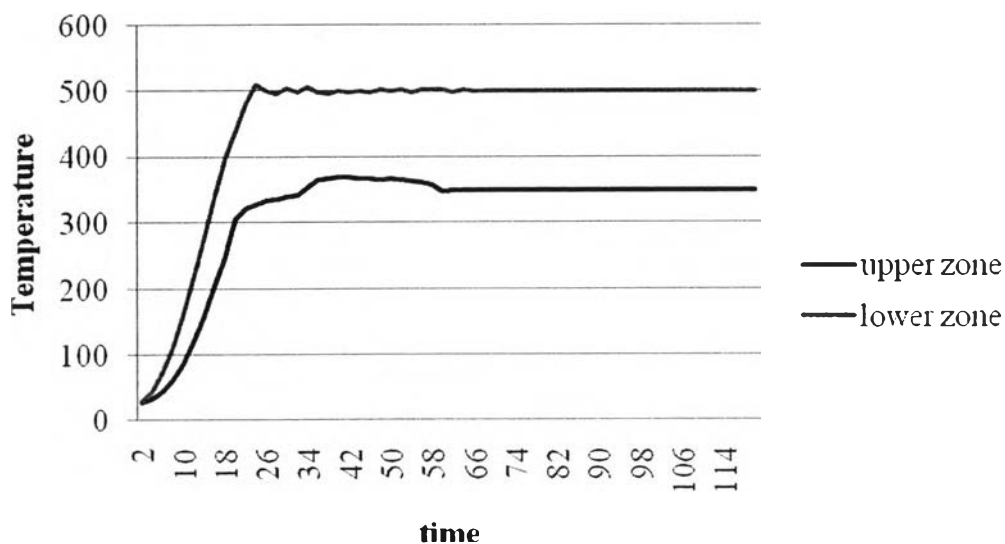
**Figure A4** Temperature profiles: Batch 4 (Kaolin)

Table A5 Temperature profiles: Batch 5 (Alumina):

1. Sample = 26 g , Catalyst = 6.50g, N₂ flow rate = 30 ml/min
2. Char = 12.73 g
3. Pyrolysis oils = 8.54 g
4. Pyrolysis Gas = 4.73 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	29	29	32	358	501	62	350	498.7	92	350	500
4	39	49	34	358	503	64	350	500.9	94	350	500
6	54	75	36	356	493	66	350	500.2	96	350	500
8	74	110	38	352	497	68	350	499.9	98	350	500
10	111	174	40	349	503	70	350	500	100	350	500
12	141	220	42	346	505	72	350	500	102	350	500
14	178	275	44	343	494	74	350	500	104	350	500
16	224	345	46	339	501	76	350	500	106	350	500
18	273	425	48	338	498	78	350	500	108	350	500
20	322	459	50	334	505	80	350	500	110	350	500
22	328	513	52	331	493	82	350	500	112	350	500
24	328	512	54	328	504	84	350	500	114	350	500
26	335	501	56	326	498	86	350	500	116	350	500
28	344	501	58	323	501	88	350	500	118	350	500
30	357	500	60	320	493	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

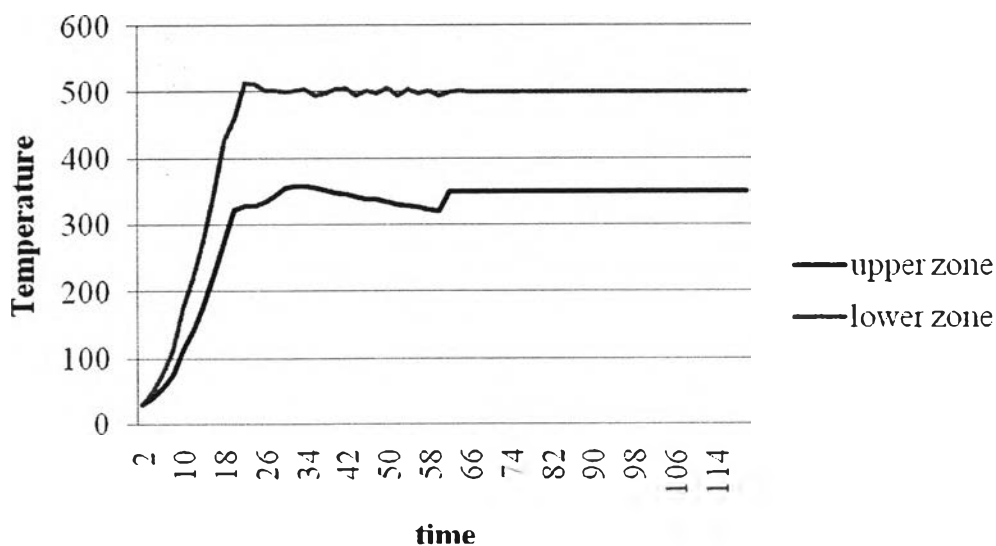
**Figure A5** Temperature profiles: Batch 5 (Alumina)

Table A6 Temperature profiles: Batch 6 (5-7RMOR):

1. Sample = 30.02 g , Catalyst = 7.54g , N₂ flow rate = 30 ml/min
2. Char = 14.15 g
3. Pyrolysis oils = 11.35 g
4. Pyrolysis Gas = 4.52 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	30.1	42.5	32	351.4	483.7	62	350	500	92	350	500
4	35.7	58.4	34	350.1	507.3	64	350	500	94	350	500
6	46.6	85.5	36	355.7	501.7	66	350	500	96	350	500
8	64.6	125.9	38	363.1	505.9	68	350	500	98	350	500
10	91.6	175.4	40	365.5	497.3	70	350	500	100	350	500
12	127.3	236.3	42	366.4	496.1	72	350	500	102	350	500
14	166.3	294.6	44	366.3	498.7	74	350	500	104	350	500
16	219.3	354.8	46	365.8	500.3	76	350	500	106	350	500
18	271.1	417.1	48	363.8	500.3	78	350	500	108	350	500
20	320	450.4	50	362.6	499	80	350	500	110	350	500
22	33.6	497.8	52	359.9	499.5	82	350	500	112	350	500
24	337.2	506.8	54	359.6	500.2	84	350	500	114	350	500
26	345.1	495.7	56	358.1	499.3	86	350	500	116	350	500
28	351.4	503.4	58	358.1	498.1	88	350	500	118	350	500
30	350.1	491.2	60	354.2	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

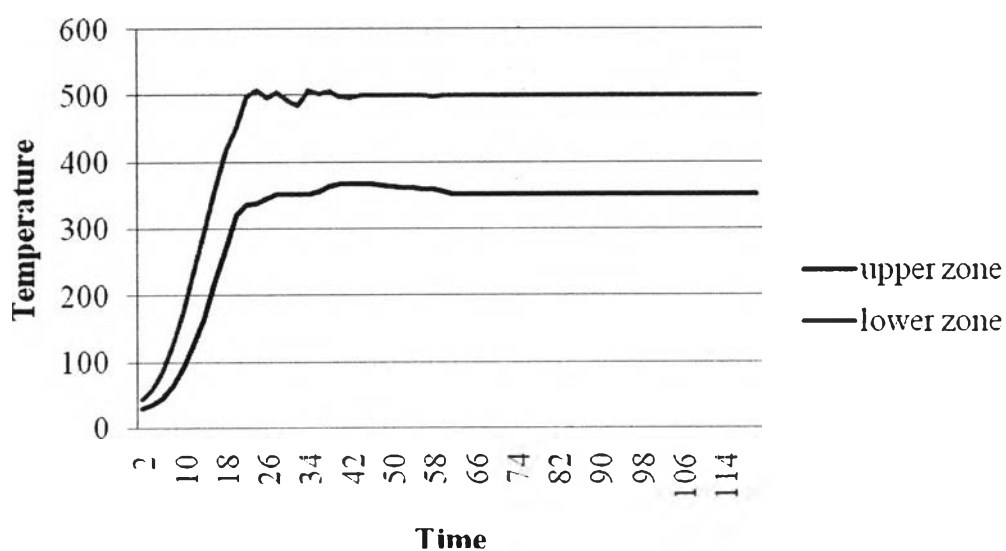
**Figure A6** Temperature profiles: Batch 6 (5-7RMOR)

Table A7 Temperature profiles: Batch 7 (10-7RMOR):

1. Sample = 30.02 g , Catalyst = 7.51g, N₂ flow rate = 30 ml/min
2. Char = 14.13 g
3. Pyrolysis oils = 10.29 g
4. Pyrolysis Gas =5.61 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.1	26.8	32	347.9	497.6	62	353.2	500	92	350	500
4	30.8	44.4	34	349.5	502.3	64	350	500	94	350	500
6	43.8	75.5	36	357.4	496.6	66	350	500	96	350	500
8	66.2	122.2	38	357.4	499.8	68	350	500	98	350	500
10	94.9	173.6	40	357.7	501.7	70	350	500	100	350	500
12	132.9	232.2	42	357.4	501.4	72	350	500	102	350	500
14	173.9	296.1	44	357.2	498.7	74	350	500	104	350	500
16	217.4	352.3	46	356.2	499.1	76	350	500	106	350	500
18	265.8	415.7	48	354.8	500	78	350	500	108	350	500
20	314.8	453.8	50	353.7	499	80	350	500	110	350	500
22	321.4	490.7	52	352.2	499.8	82	350	500	112	350	500
24	330.8	508.4	54	350.7	499.5	84	350	500	114	350	500
26	336.3	505.6	56	349.2	501.2	86	350	500	116	350	500
28	341	495.8	58	349.9	499.2	88	350	500	118	350	500
30	344.3	504.1	60	357.4	500.7	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

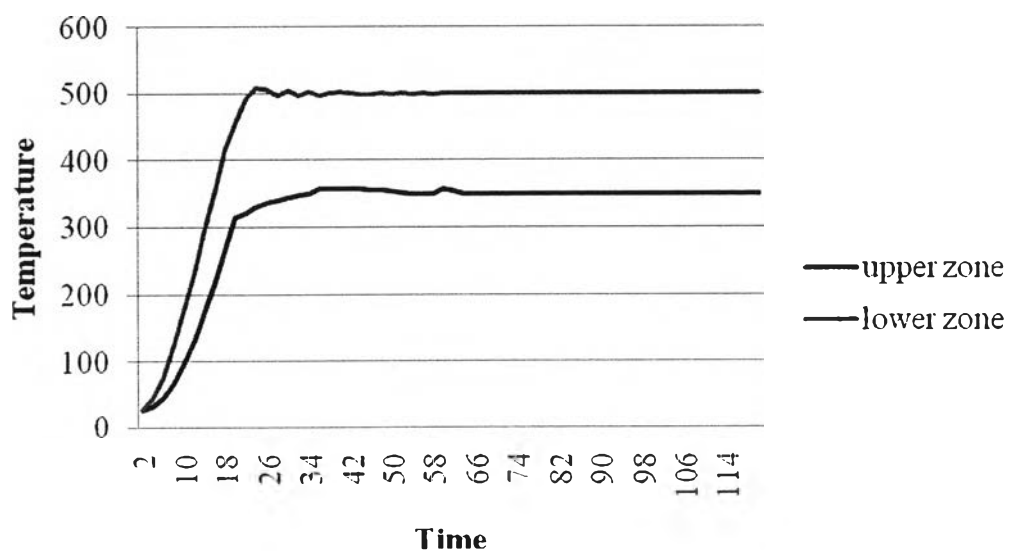
**Figure A7** Temperature profiles: Batch 7 (10-7RMOR)

Table A8 Temperature profiles: Batch 8 (15-7RMOR):

1. Sample = 30.02 g , Catalyst = 7.50g , N₂ flow rate = 30 ml/min
2. Char = 14.18 g
3. Pyrolysis oils = 10.38 g
4. Pyrolysis Gas = 5.46 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	24.2	41.7	32	359.8	499.9	62	353.2	500	92	350	500
4	37	61.8	34	363.1	500.2	64	351.9	500	94	350	500
6	49.1	89.6	36	365.4	502.9	66	350	500	96	350	500
8	69.5	133.2	38	370.5	494.1	68	350	500	98	350	500
10	98.2	186.7	40	369.8	497.8	70	350	500	100	350	500
12	133.2	242.9	42	368.3	499.4	72	350	500	102	350	500
14	175.8	301.5	44	368.3	500.8	74	350	500	104	350	500
16	223.8	372.8	46	366.4	500.3	76	350	500	106	350	500
18	292.8	413.5	48	364.5	499.5	78	350	500	108	350	500
20	314.8	461.5	50	362.5	499.6	80	350	500	110	350	500
22	316.2	507.1	52	460.2	500.7	82	350	500	112	350	500
24	331.2	497.4	54	357.8	500.6	84	350	500	114	350	500
26	336.6	503.9	56	355.6	499.7	86	350	500	116	350	500
28	350.1	493.7	58	353.3	500.2	88	350	500	118	350	500
30	355.8	506.3	60	351.2	500.9	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

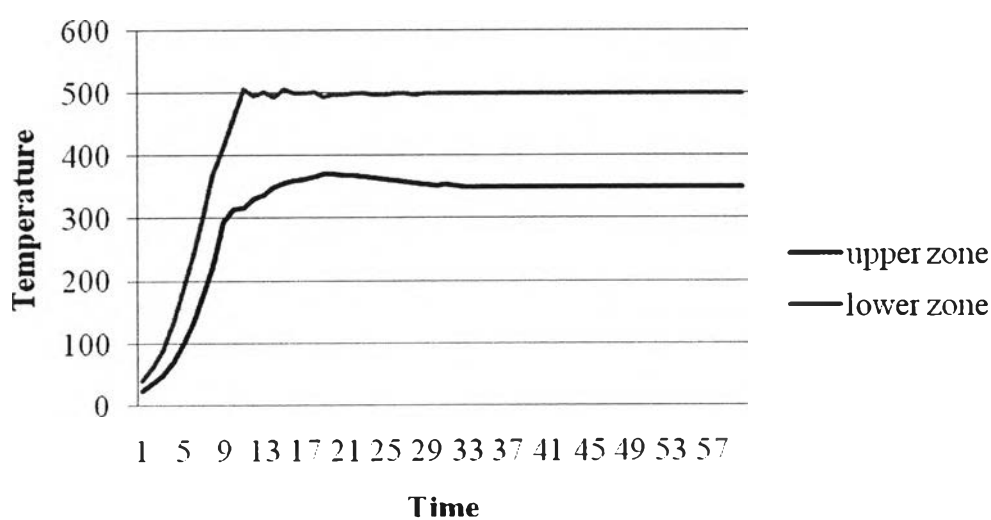
**Figure A8** Temperature profiles: Batch 8 (15-7RMOR)

Table A9 Temperature profiles: Batch 9 (20-7RMOR):

1. Sample = 30.02 g , Catalyst = 7.52g, N₂ flow rate = 30 ml/min
2. Char = 14.12 g
3. Pyrolysis oils = 10.52 g
4. Pyrolysis Gas = 5.38 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	48.8	59.4	32	361	495	62	350	500	92	350	500
4	66.1	87.4	34	362	498.1	64	350	500	94	350	500
6	93.9	130.5	36	365.7	499.2	66	350	500	96	350	500
8	129.6	183.5	38	367.5	500.7	68	350	500	98	350	500
10	173.5	242.5	40	366.9	499.8	70	350	500	100	350	500
12	216.4	298.4	42	364.8	499.6	72	350	500	102	350	500
14	262.4	361.1	44	363.9	500.7	74	350	500	104	350	500
16	315.5	412.9	46	361.4	499.4	76	350	500	106	350	500
18	328.8	452.8	48	359.3	499.3	78	350	500	108	350	500
20	321.5	498.2	50	351	500.6	80	350	500	110	350	500
22	324.9	501.6	52	355.2	500.3	82	350	500	112	350	500
24	328	504.5	54	353.2	499	84	350	500	114	350	500
26	342.9	498.5	56	350.8	500.3	86	350	500	116	350	500
28	352.4	505.8	58	348.8	500.6	88	350	500	118	350	500
30	358.6	496.8	60	356.4	499.7	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

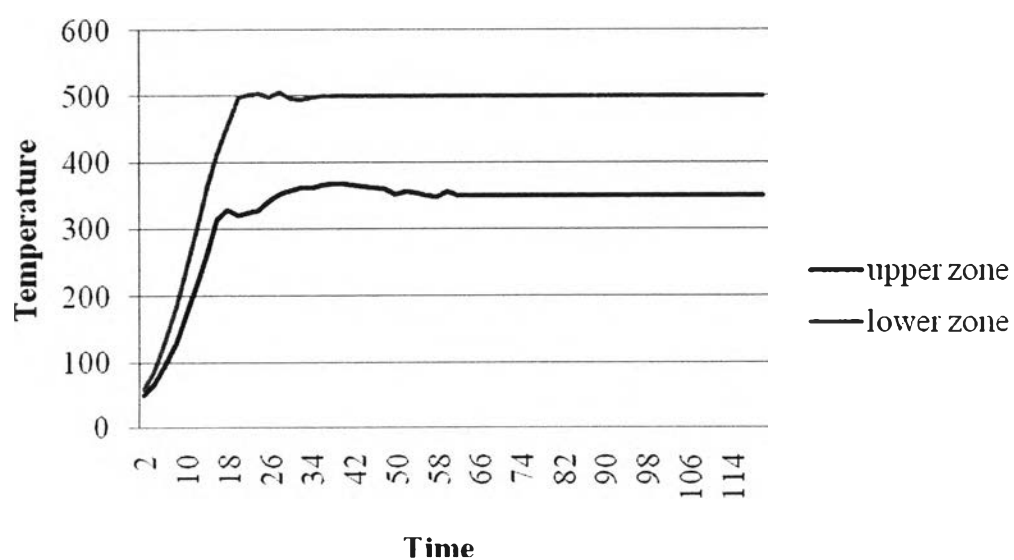
**Figure A9** Temperature profiles: Batch 9 (20-7RMOR)

Table A10 Temperature profiles: Batch 10 (non-cat 10):

1. Sample = 10.03 g , N₂ flow rate = 30 ml/min
2. Char = 4.8 g
3. Pyrolysis oils = 3.94 g
4. Pyrolysis Gas = 1.37 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	42.2	48.2	32	369.2	498.1	62	354	500.1	92	350	500
4	62.9	80.7	34	368.5	498.5	64	350	498.8	94	350	500
6	94.9	122.7	36	365.8	499.8	66	354	492.5	96	350	500
8	133.8	175.8	38	372.8	498.2	68	353.2	495	98	350	500
10	177.2	229.3	40	366	500.2	70	356.8	497.9	100	350	500
12	225.9	290	42	363.9	499	72	356.7	503.6	102	350	500
14	271.7	350	44	362.7	498	74	354.1	501.8	104	350	500
16	282	411.3	46	369.1	499.9	76	354.4	499.3	106	350	500
18	309	438.9	48	362.3	498.8	78	347.9	502.8	108	350	500
20	334.3	476.1	50	360	499.6	80	352.8	499.9	110	350	500
22	337.9	506.8	52	360.6	502.3	82	350	500	112	350	500
24	363	495.2	54	359.9	498.3	84	350	500	114	350	500
26	366.3	501.1	56	360.5	499	86	350	500	116	350	500
28	368.1	493.5	58	360.4	500.8	88	350	500	118	350	500
30	373.4	502	60	354.4	498.7	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

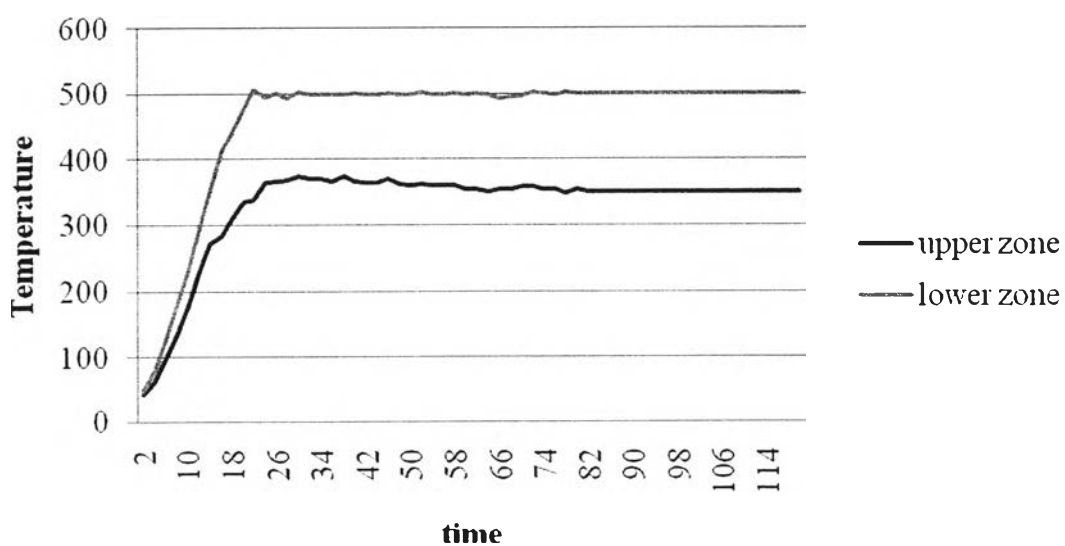
**Table A10** Temperature profiles: Batch 10 (non-cat 10)

Table A11 Temperature profiles :Batch 11 (MCM-48):

1. Sample = 10.04 g , Catalyst = 2.51g, N₂ flow rate = 30 ml/min
2. Char = 4.8 g
3. Pyrolysis oils = 2.95 g
4. Pyrolysis Gas = 2.29 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	31.6	44.2	32	348.4	464.6	62	358	501.3	92	350	500
4	38.1	67.3	34	349.3	453.6	64	356.6	499.1	94	350	500
6	51.8	105.8	36	349.2	442.3	66	355.5	497.9	96	350	500
8	71.9	155.8	38	349.1	458.1	68	354.3	499.7	98	350	500
10	99.1	212.8	40	348.7	493.8	70	352.8	499.6	100	350	500
12	133.1	275.2	42	348.5	504.6	72	350	500	102	350	500
14	175.4	336.7	44	349.8	504.5	74	350	500	104	350	500
16	217.9	383.3	46	350	495	76	350	500	106	350	500
18	264.3	428	48	349.9	498.8	78	350	500	108	350	500
20	300.4	477.5	50	350.8	501.8	80	350	500	110	350	500
22	315.4	510.8	52	349.3	506.8	82	350	500	112	350	500
24	328.4	497.4	54	348.8	498.8	84	350	500	114	350	500
26	339.3	501.5	56	352.1	493.4	86	350	500	116	350	500
28	339.7	490.4	58	356.9	500.1	88	350	500	118	350	500
30	344.3	479.6	60	358.3	497.9	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

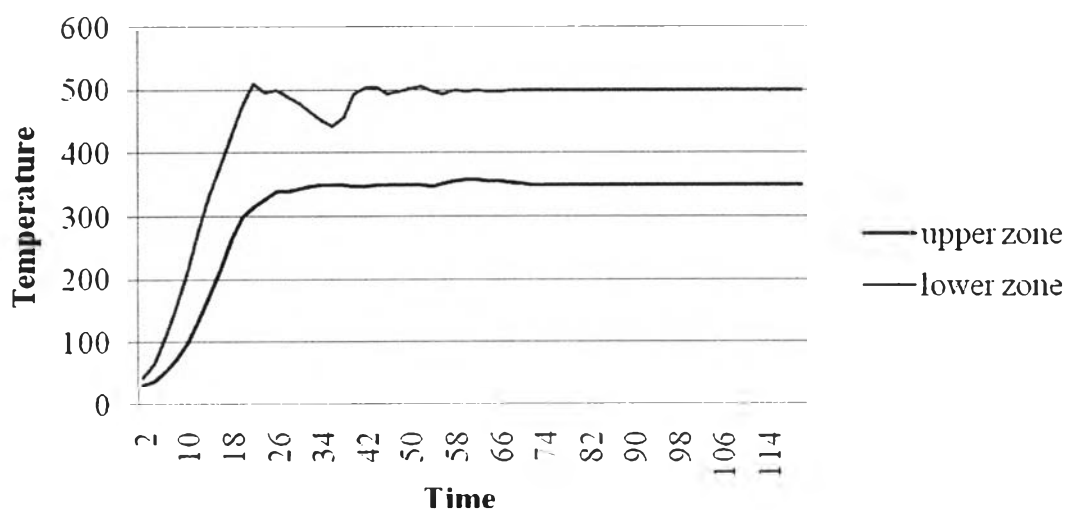
**Figure A11** Temperature profiles :Batch 11 (MCM-48)

Table A12 Temperature profiles :Batch 12 (Ru/MCM-48):

1. Sample = 10.02 g , Catalyst = 2.52g, N₂ flow rate = 30 ml/min
2. Char = 4.76 g
3. Pyrolysis oils = 2.74 g
4. Pyrolysis Gas = 2.52 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	27.9	29.4	32	361.5	502.3	62	353.9	498.7	92	350	500
4	35	45.3	34	364.4	492.8	64	356.7	500.9	94	350	500
6	49.3	73.5	36	364.7	496.5	66	356.1	500.2	96	350	500
8	70.5	113.5	38	363.4	499.5	68	354.8	499.9	98	350	500
10	97.6	163.5	40	364	498	70	350	500	100	350	500
12	132.5	222.5	42	363.1	500.1	72	350	500	102	350	500
14	175.4	285.7	44	361.8	499.6	74	350	500	104	350	500
16	218	344.2	46	361.2	500.4	76	350	500	106	350	500
18	262	418.5	48	359.9	498	78	350	500	108	350	500
20	298.2	455.3	50	357.6	499.6	80	350	500	110	350	500
22	322.3	505.4	52	355.9	500.1	82	350	500	112	350	500
24	330.5	507.4	54	354.6	502.3	84	350	500	114	350	500
26	336.1	497.5	56	352.6	497.7	86	350	500	116	350	500
28	327.6	505.1	58	350.8	499.9	88	350	500	118	350	500
30	336.2	505.4	60	348.9	501.7	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

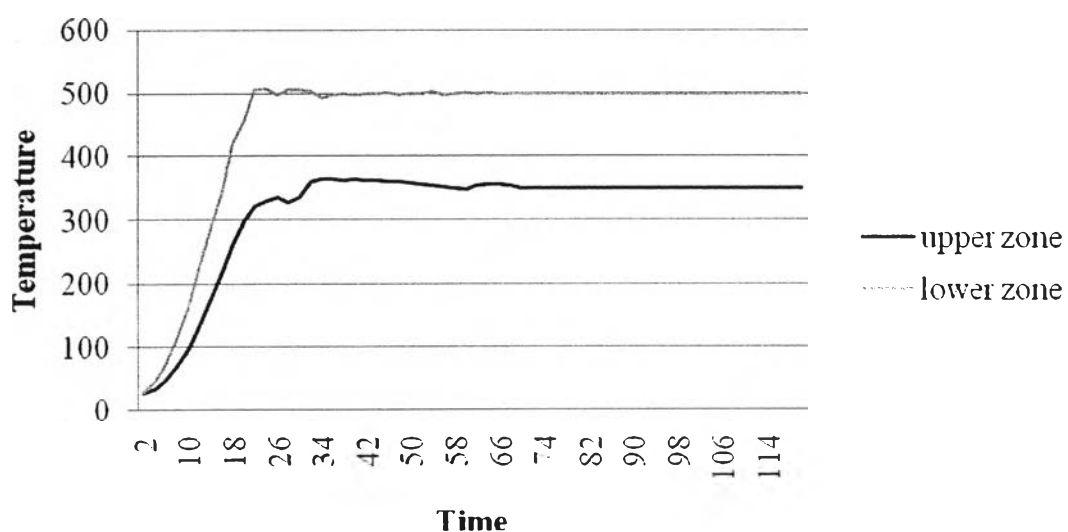
**Figure A12** Temperature profiles :Batch 12 (Ru/MCM-48)

Table A13 Temperature profiles :Batch 13 (5-7RM48):

1. Sample = 10.02 g , Catalyst = 2.51g, N₂ flow rate = 30 ml/min
2. Char = 4.53 g
3. Pyrolysis oils = 3.77 g
4. Pyrolysis Gas = 1.72 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.3	25.7	32	378.7	495.2	62	353.2	500	92	350	500
4	30	43.6	34	374.1	499.2	64	351.9	500	94	350	500
6	42	78	36	378.9	499.4	66	350	500	96	350	500
8	61.5	125.5	38	377.7	499.9	68	350	500	98	350	500
10	87.6	180	40	376.7	499.4	70	350	500	100	350	500
12	122.4	243.1	42	375.4	500.1	72	350	500	102	350	500
14	163.1	306.4	44	373.6	500.1	74	350	500	104	350	500
16	209.9	364.7	46	370.7	499.8	76	350	500	106	350	500
18	255.7	432.2	48	368.1	499.3	78	350	500	108	350	500
20	303.7	457.9	50	364.1	500.7	80	350	500	110	350	500
22	329	505.2	52	361.4	500.2	82	350	500	112	350	500
24	354.9	500.1	54	359.4	501.5	84	350	500	114	350	500
26	368.6	505	56	357.3	499.9	86	350	500	116	350	500
28	374.1	498.9	58	355.4	499.3	88	350	500	118	350	500
30	377.5	503.3	60	354.2	499.2	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

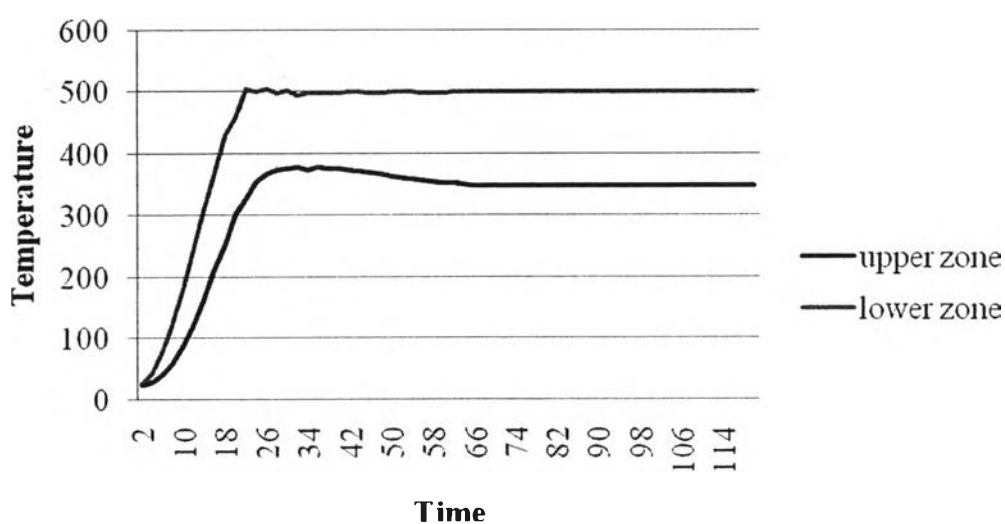
**Figure A13** Temperature profiles :Batch 13 (5-7RM48)

Table A14 Temperature profiles :Batch 14 (10-7RM48):

1. Sample = 10.02 g , Catalyst = 2.5g, N₂ flow rate = 30 ml/min
2. Char = 4.54 g
3. Pyrolysis oils = 3.08 g
4. Pyrolysis Gas = 2.42 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	33.4	48.1	32	363	504.6	62	353.2	500	92	350	500
4	41.9	73.5	34	366.2	495.5	64	351.9	500	94	350	500
6	57	113	36	367.3	497.7	66	350	500	96	350	500
8	80.8	165.4	38	367.2	500.7	68	350	500	98	350	500
10	113.2	226	40	366.1	499.1	70	350	500	100	350	500
12	154	291.6	42	366.2	500.4	72	350	500	102	350	500
14	200.2	355.4	44	364.7	499.8	74	350	500	104	350	500
16	251.3	406.4	46	363.8	500.6	76	350	500	106	350	500
18	304.9	450.2	48	361.7	499	78	350	500	108	350	500
20	322.6	497.7	50	361.3	501	80	350	500	110	350	500
22	332.6	505.1	52	361.4	500	82	350	500	112	350	500
24	342.6	501	54	359.4	500	84	350	500	114	350	500
26	341.7	498.3	56	357.3	500	86	350	500	116	350	500
28	343.2	500.3	58	355.4	500	88	350	500	118	350	500
30	350.1	498.7	60	354.2	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

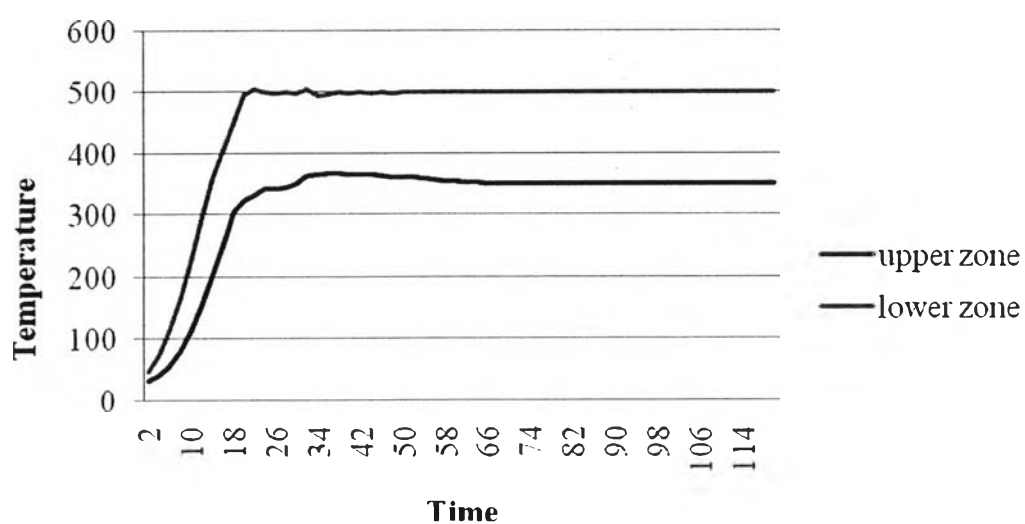
**Figure A14** Temperature profiles :Batch 14 (10-7RM48)

Table A15 Temperature profiles :Batch 15 (15-7RM48):

1. Sample = 10.02 g , Catalyst = 2.52g, N₂ flow rate = 30 ml/min
2. Char = 4.67 g
3. Pyrolysis oils = 2.58 g
4. Pyrolysis Gas = 2.77 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	31.7	38.6	32	361.8	495.1	62	353.2	500	92	350	500
4	40.4	60.4	34	361.1	499.5	64	351.9	500	94	350	500
6	57.6	101.6	36	359.3	499.5	66	350	500	96	350	500
8	77.1	142.3	38	357.7	501.7	68	350	500	98	350	500
10	106.3	199.2	40	357	499.7	70	350	500	100	350	500
12	143.9	260.4	42	357	501.6	72	350	500	102	350	500
14	187.8	321.8	44	357	499.7	74	350	500	104	350	500
16	231.9	378.4	46	356.2	500.3	76	350	500	106	350	500
18	282.9	433	48	355.9	500.9	78	350	500	108	350	500
20	327.7	476.4	50	354.8	500.3	80	350	500	110	350	500
22	333.7	510.5	52	353.6	499.6	82	350	500	112	350	500
24	337.1	501.4	54	352.2	500	84	350	500	114	350	500
26	360	507.3	56	351.4	500.9	86	350	500	116	350	500
28	362.7	501.2	58	350.4	500	88	350	500	118	350	500
30	363.6	504.8	60	341.7	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

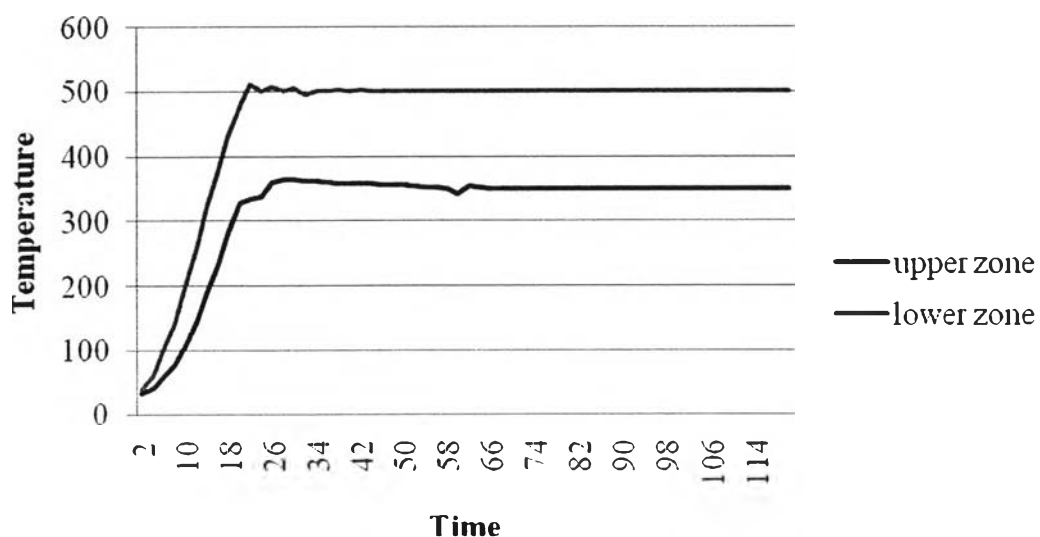
**Figure A15** Temperature profiles :Batch 15 (15-7RM48)

Table A16 Temperature profiles :Batch 16 (20-7RM48):

1. Sample = 10.02 g , Catalyst = 2.54g, N₂ flow rate = 30 ml/min
2. Char = 4.64 g
3. Pyrolysis oils = 2.74 g
4. Pyrolysis Gas = 2.64 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.1	28.3	32	341.3	489.3	62	349.5	500	92	350	500
4	31.3	49.7	34	339.7	506.2	64	353.1	500	94	350	500
6	44.4	85	36	361.5	498.3	66	350	500	96	350	500
8	64.6	132.3	38	360.6	495.7	68	350	500	98	350	500
10	93.3	187.8	40	364.1	498.8	70	350	500	100	350	500
12	130.2	251.4	42	359.6	499.9	72	350	500	102	350	500
14	170.5	313.9	44	359.1	500.3	74	350	500	104	350	500
16	214	373.9	46	358.8	500.1	76	350	500	106	350	500
18	262.3	430.3	48	357.2	500.5	78	350	500	108	350	500
20	304.5	455.9	50	356.8	499.9	80	350	500	110	350	500
22	308.2	502.8	52	356.7	500.4	82	350	500	112	350	500
24	316.2	502.7	54	355.9	499.9	84	350	500	114	350	500
26	336.5	502.6	56	354.8	500.3	86	350	500	116	350	500
28	338.3	487.9	58	353.7	499.4	88	350	500	118	350	500
30	340.5	476.6	60	352	500.3	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

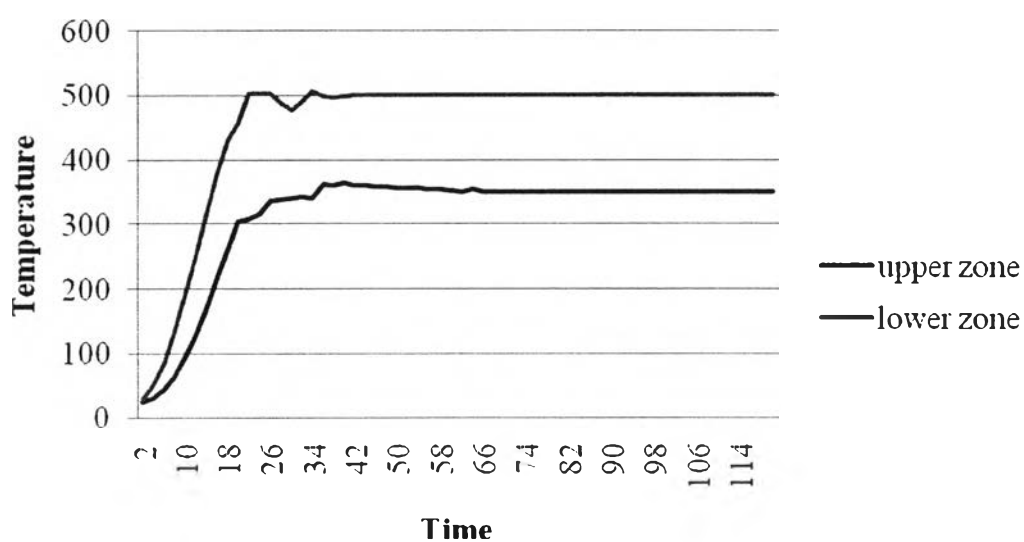
**Figure A16** Temperature profiles :Batch 16 (20-7RM48)

Table A17 Temperature profiles :Batch 17 (Bentonite):

1. Sample = 30.02 g , Catalyst = 7.52g, N₂ flow rate = 30 ml/min
2. Char = 14.31 g
3. Pyrolysis oils = 9.83 g
4. Pyrolysis Gas = 5.88 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.1	28.2	32	348.4	481	62	364.5	500	92	350	500
4	30.8	45.7	34	351.8	458.4	64	362.3	500	94	350	500
6	43	74.5	36	352.4	460.7	66	357.7	500	96	350	500
8	81.9	115.3	38	349.6	490.7	68	350	500	98	350	500
10	88.9	164.9	40	344	503.3	70	350	500	100	350	500
12	126.6	227.3	42	345.6	504.7	72	350	500	102	350	500
14	164.8	288.4	44	348.7	496.5	74	350	500	104	350	500
16	204.8	348.9	46	342.8	494.3	76	350	500	106	350	500
18	248.5	406.1	48	361.9	498.9	78	350	500	108	350	500
20	305.7	444.3	50	366.2	499.5	80	350	500	110	350	500
22	330.6	489	52	369.7	499.7	82	350	500	112	350	500
24	335.5	510.4	54	371.7	498.9	84	350	500	114	350	500
26	337.3	497.6	56	372.8	498.5	86	350	500	116	350	500
28	339.8	505.7	58	370.9	501.2	88	350	500	118	350	500
30	344.8	493.3	60	367.9	499	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

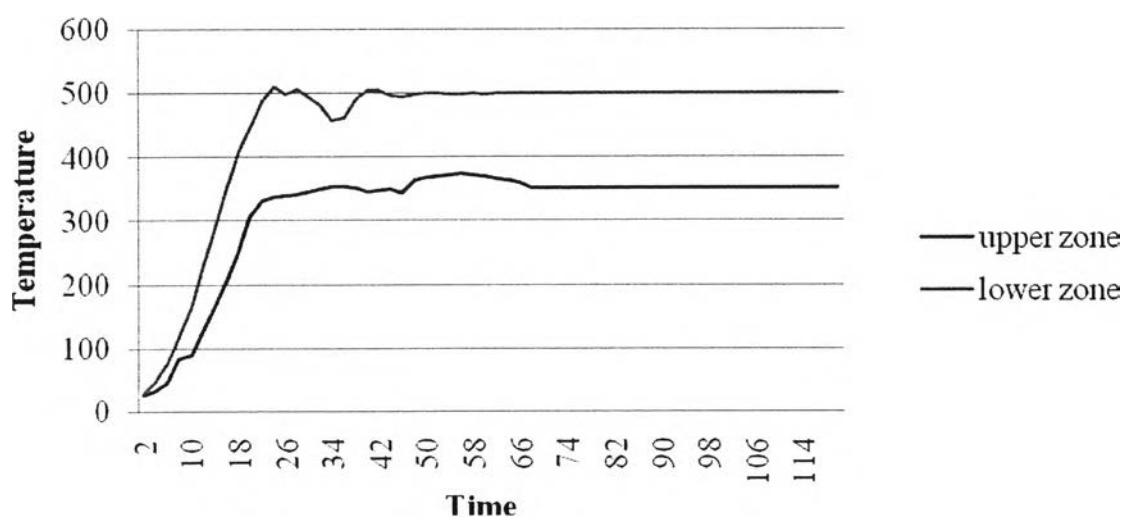
**Figure A17** Temperature profiles :Batch 17 (Bentonite)

Table A18 Temperature profiles :Batch 18(Montmorillonite):

1. Sample = 30.02 g , Catalyst = 7.53g, N₂ flow rate = 30 ml/min
2. Char = 14.18 g
3. Pyrolysis oils = 10.75 g
4. Pyrolysis Gas = 5.09 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	25.5	27.2	32	353.5	494	62	350	500	92	350	500
4	30.1	41	34	354.9	503.7	64	350	500	94	350	500
6	40.9	67.2	36	357.4	500.7	66	350	500	96	350	500
8	59.8	107.4	38	358.1	497	68	350	500	98	350	500
10	82.4	153.2	40	357	499	70	350	500	100	350	500
12	113.2	206.5	42	356.6	500.5	72	350	500	102	350	500
14	156.8	273.5	44	356.6	499	74	350	500	104	350	500
16	203.2	335.2	46	356.6	500.8	76	350	500	106	350	500
18	249.1	396.3	48	355.2	499	78	350	500	108	350	500
20	316.5	435.8	50	354	500.5	80	350	500	110	350	500
22	332	479.7	52	352.2	500	82	350	500	112	350	500
24	339	510.7	54	350.7	500	84	350	500	114	350	500
26	343.7	499.7	56	350	500	86	350	500	116	350	500
28	347.3	505.4	58	350	500	88	350	500	118	350	500
30	352.3	494.8	60	350	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

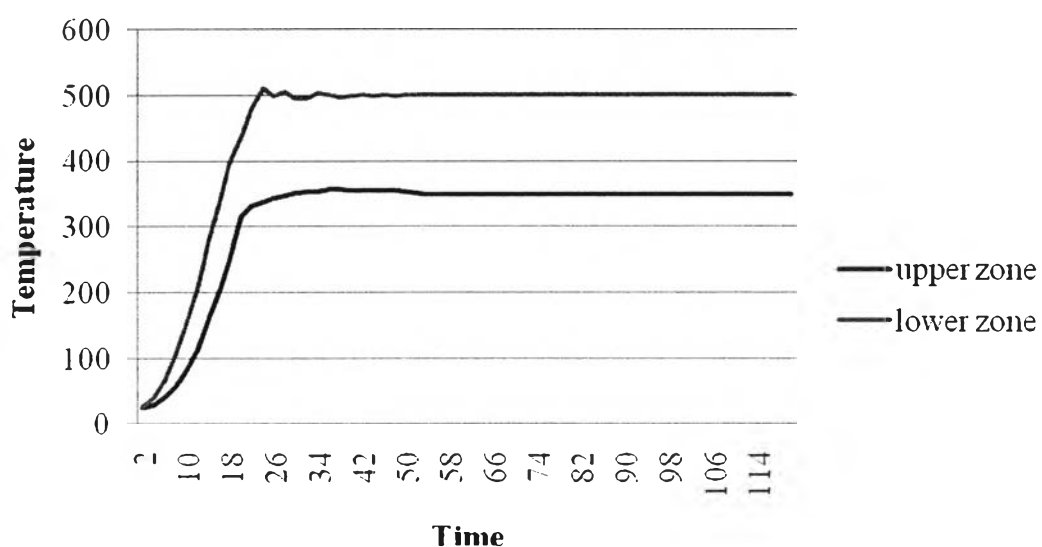
**Figure A18** Temperature profiles :Batch 18 (Montmorillonite)

Table A19 Temperature profiles :Batch 19 (Talc):

1. Sample = 30.02 g , Catalyst = 7.51g, N₂ flow rate = 30 ml/min
2. Char = 14.68 g
3. Pyrolysis oils = 9.28 g
4. Pyrolysis Gas = 6.06 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	26.9	29.7	32	347.2	508.2	62	352.4	500	92	350	500
4	34.1	49.4	34	348.2	497.9	64	350	500	94	350	500
6	49	82.2	36	350.4	503.6	66	350	500	96	350	500
8	69.1	124.1	38	352.4	494.6	68	350	500	98	350	500
10	96.9	176.4	40	352	497.1	70	350	500	100	350	500
12	132.6	233.4	42	353.7	500.3	72	350	500	102	350	500
14	176.6	301.6	44	354.4	499.8	74	350	500	104	350	500
16	22.6	350.6	46	353.3	501.2	76	350	500	106	350	500
18	268	412.7	48	352.6	498.9	78	350	500	108	350	500
20	324	456.9	50	353.3	500.1	80	350	500	110	350	500
22	321	507.4	52	353	499.4	82	350	500	112	350	500
24	332.9	500.6	54	352.2	501.1	84	350	500	114	350	500
26	340.4	503.3	56	348.9	500	86	350	500	116	350	500
28	341.2	490.1	58	354.5	499	88	350	500	118	350	500
30	350.5	484.7	60	355.3	499.5	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

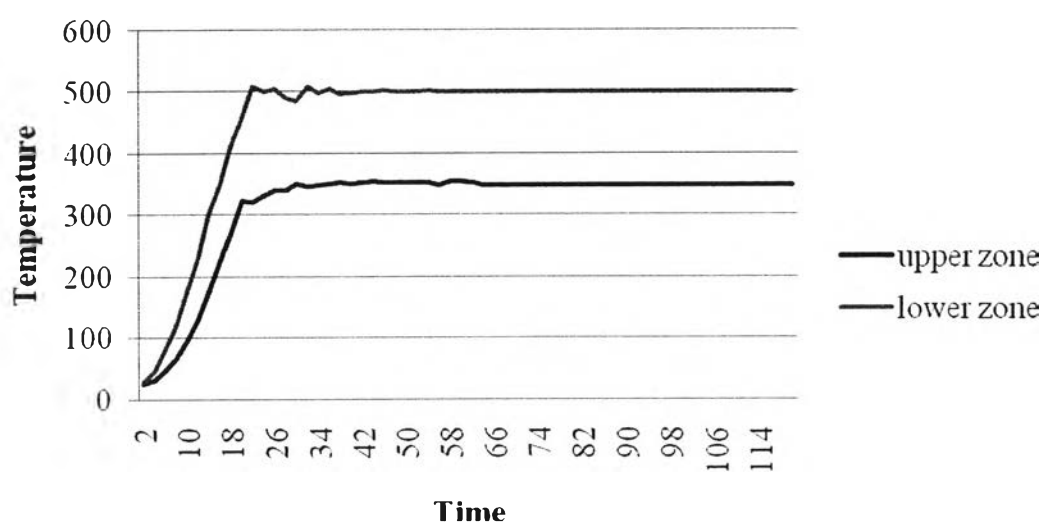
**Figure A19** Temperature profiles :Batch 19 (Talc)

Table A20 Temperature profiles :Batch 20 (5-7RM-ben):

1. Sample = 30.02 g , Catalyst = 7.53g, N₂ flow rate = 30 ml/min
2. Char = 14.25 g
3. Pyrolysis oils = 10.28 g
4. Pyrolysis Gas = 5.5 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	30.8	42.7	32	361.3	502.8	62	350	500	92	350	500
4	38	63	34	362.3	505.8	64	350	500	94	350	500
6	51.8	96.8	36	364.1	499.4	66	350	500	96	350	500
8	72.7	141.4	38	363.5	499.7	68	350	500	98	350	500
10	101.8	194.7	40	364	499	70	350	500	100	350	500
12	138.4	253.3	42	365.5	499.5	72	350	500	102	350	500
14	180.3	313	44	363.8	499.6	74	350	500	104	350	500
16	227.4	370.3	46	362.1	499.9	76	350	500	106	350	500
18	286.4	434.4	48	359.7	499.7	78	350	500	108	350	500
20	327.5	462.6	50	357.7	499.6	80	350	500	110	350	500
22	336	505.2	52	355.3	500	82	350	500	112	350	500
24	349.9	501.3	54	352.1	500	84	350	500	114	350	500
26	352	504.3	56	350	500	86	350	500	116	350	500
28	356.6	496.4	58	350	500	88	350	500	118	350	500
30	359.7	504.5	60	350	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

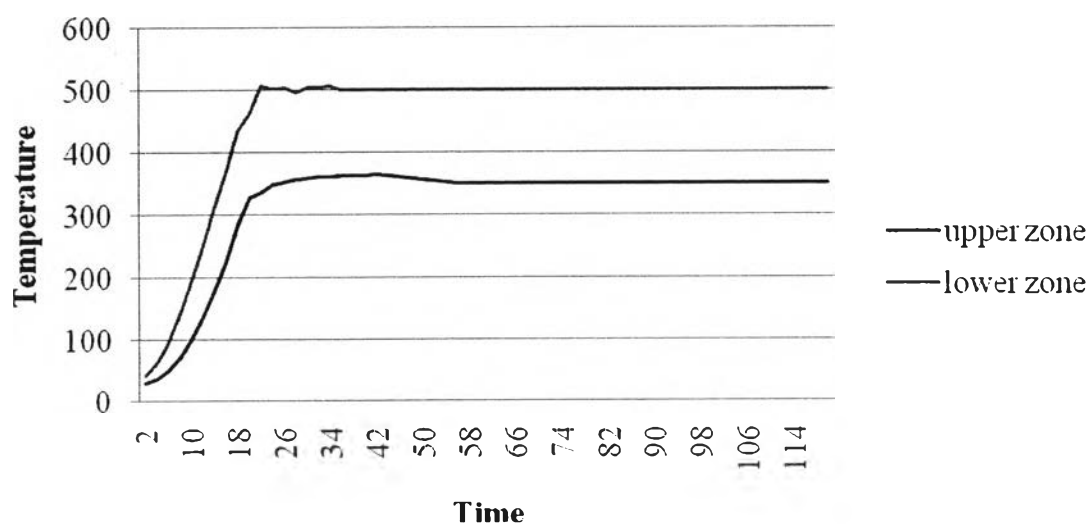
**Table A20** Temperature profiles :Batch 20 (5-7RM-ben)

Table A21 Temperature profiles :Batch 21 (5-7RM-mont):

1. Sample = 30.02 g , Catalyst = 7.54g, N₂ flow rate = 30 ml/min
2. Char = 14.15 g
3. Pyrolysis oils = 11.35 g
4. Pyrolysis Gas = 4.52 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	26.7	30.8	32	363.3	503.7	62	357.8	500	92	350	500
4	33.5	49.9	34	366.5	502.9	64	354.4	500	94	350	500
6	47	79.4	36	368.2	500.9	66	351.9	500	96	350	500
8	66.7	119.6	38	369.5	502.7	68	350	500	98	350	500
10	97.8	174.3	40	370.9	494.6	70	350	500	100	350	500
12	129.2	223.7	42	371.6	499.4	72	350	500	102	350	500
14	169.3	286.8	44	370.6	500.4	74	350	500	104	350	500
16	216.6	343.3	46	371.4	499.9	76	350	500	106	350	500
18	271.3	415.3	48	370	499.6	78	350	500	108	350	500
20	330.1	452.7	50	370.1	500.6	80	350	500	110	350	500
22	336.2	493	52	367.8	499.9	82	350	500	112	350	500
24	339.5	506.6	54	365.9	500.8	84	350	500	114	350	500
26	338.5	496.5	56	363.9	500.4	86	350	500	116	350	500
28	348	502.1	58	362.1	500.4	88	350	500	118	350	500
30	358.5	493.6	60	360.5	500.6	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

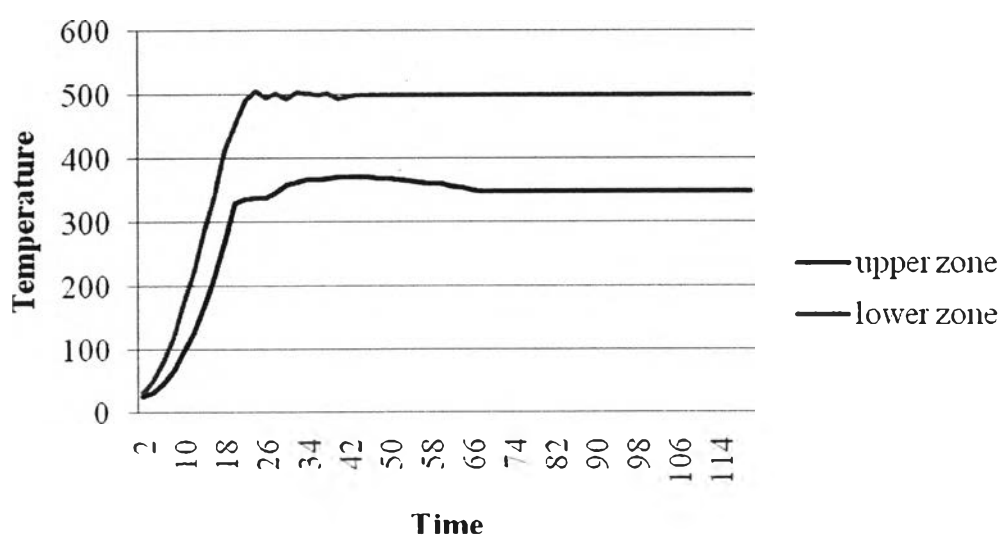
**Figure A21** Temperature profiles :Batch 21 (5-7RM-mont)

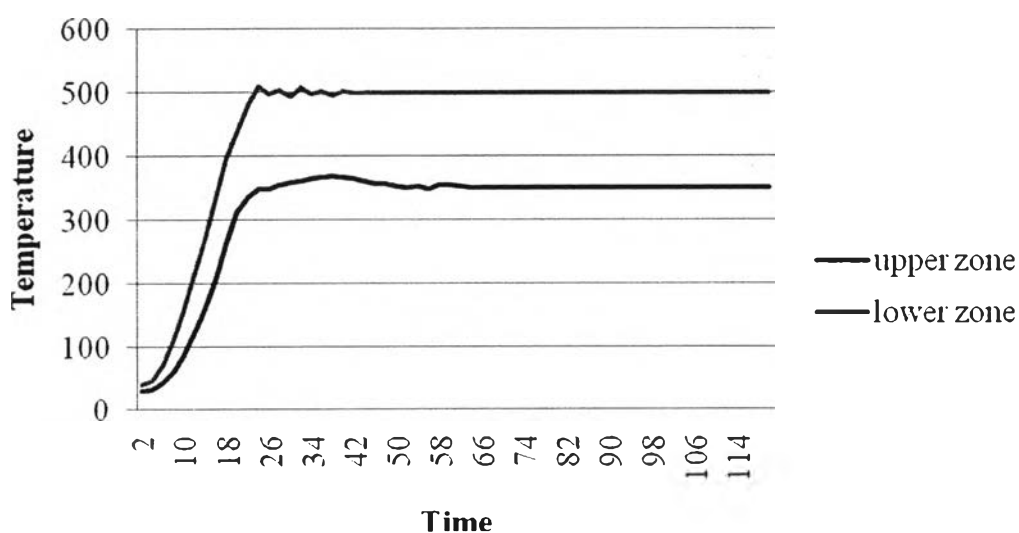
Table A22 Temperature profiles :Batch 22 (5-7RM-talc):

1. Sample = 30.02 g , Catalyst = 7.50g, N₂ flow rate = 30 ml/min
2. Char = 14.22 g
3. Pyrolysis oils = 10.23 g
4. Pyrolysis Gas = 5.57 g

Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2	Time (min)	T1	T2
2	29.2	40.6	32	360.3	506.6	62	352.4	500	92	350	500
4	31.8	47.2	34	365.6	497.7	64	354.4	500	94	350	500
6	42.9	73	36	366.7	501.4	66	351.9	500	96	350	500
8	60.3	111.5	38	369	494.9	68	350	500	98	350	500
10	85.9	157.9	40	366.1	500.8	70	350	500	100	350	500
12	121	213	42	364.5	499.6	72	350	500	102	350	500
14	162.8	273.2	44	361.7	499.8	74	350	500	104	350	500
16	207.5	334	46	357.4	500	76	350	500	106	350	500
18	261.6	395.8	48	355.8	500	78	350	500	108	350	500
20	312.7	437	50	353.2	500	80	350	500	110	350	500
22	337.2	480.2	52	350.9	500	82	350	500	112	350	500
24	349.2	509.4	54	352.2	500	84	350	500	114	350	500
26	348.5	497	56	348.9	500	86	350	500	116	350	500
28	354.5	502.8	58	354.5	500	88	350	500	118	350	500
30	359.3	492.9	60	355.3	500	90	350	500	120	350	500

* T1 is the catalytic temperature

* T2 is the pyrolysis temperature

**Figure A22** Temperature profiles :Batch 22 (5-7RM-talc)

Appendix B Yields of Pyrolysis Products

Table B1 Weight percentage of pyrolysis products obtained from individual catalysts

Catalyst Products	No Cat.	HMOR	MCM-48	Kaolin	α-alumina
Gas	13.66	18.42	22.86	16.57	18.35
Liquid	39.28	34.14	28.14	35.23	32.69
Solid	47.86	47.44	49.00	48.13	48.96

Table B2 Weight percentage of pyrolysis products obtained from the Ru/MCM-48 based extrudates

Catalyst Products	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
Gas	17.17	24.15	27.64	26.35	25.15
Liquid	37.62	30.74	25.75	27.35	27.34
Solid	45.21	45.31	46.61	46.31	47.51

Table B3 Weight percentage of pyrolysis products obtained from the Ru/HMOR-based extrudates

Catalyst Products	5- 7RMOR	10- 7RMOR	15- 7RMOR	20- 7RMOR	Ru/HMOR
Gas	15.06	18.65	18.19	17.92	23.51
Liquid	37.81	34.28	34.58	35.04	28.67
Solid	47.14	47.07	47.24	47.04	47.82

Table B4 Weight percentage of pyrolysis products from using various matrixes

Catalyst Products	Bentonite	Montmorillonite	Talc
Gas	18.59	16.96	19.52
Liquid	33.74	35.81	31.58
Solid	47.67	47.24	48.90

Catalyst Products	5-7RM-ben	5-7RM-mon	5-7RM-tal
Gas	18.32	15.06	18.55
Liquid	34.24	37.81	34.08
Solid	47.47	47.14	47.37

Appendix C The Pyrolytic Gas Compositions

Table C1 Weight percentage of gas product obtained from individual catalysts

Gas composition	Catalysts				
	No Cat.	HMOR	MCM-48	Kaolin	α-alumina
Methane	22.7	21.9	19.6	24.4	21.8
Ethylene	9.4	6.1	9.3	8.9	8.9
Ethane	17.4	18.7	17.0	19.6	16.9
Propylene	10.9	8.8	10.8	8.5	10.8
Propane	8.5	17.4	8.2	10.1	8.3
Mixed C4	19.5	17.6	22.1	20.3	19.0
Mixed C5	10.5	8.9	11.8	8.0	13.9
>C5	1.2	0.2	1.2	0.2	0.3

Table C2 Weight Percentage of gas products Obtained from the 0.7% Ru/MCM-48 based extrudates

gas composition	Catalysts				
	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
Methane	17.40	17.68	20.75	20.36	17.42
Ethylene	8.86	9.16	9.73	9.52	8.64
Ethane	15.70	16.10	16.61	17.94	15.71
Propylene	10.04	10.24	11.27	11.04	9.91
Propane	7.89	7.85	9.38	8.57	7.65
Mixed C4	22.68	22.20	21.56	20.54	19.85
Mixed C5	15.69	15.00	9.97	10.85	19.98
>C5	1.74	1.77	0.74	1.19	0.83

Table C3 Weight percentage of gas products obtained from the 0.7% Ru/HMOR-based extrudates

gas composition	Catalysts				
	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
Methane	21.75	22.18	22.05	22.30	21.94
Ethylene	9.26	8.40	8.28	7.89	6.75
Ethane	20.34	20.76	19.18	19.74	18.62
Propylene	11.02	10.53	10.30	10.19	8.24
Propane	10.54	11.42	10.46	11.09	14.50
Mixed C4	18.58	21.05	21.90	21.47	21.81
Mixed C5	7.82	5.31	7.30	6.86	7.87
>C5	0.29	0.11	0.22	0.15	0.28

Table C4 Weight percentage of gas products from the using various matrixes

Gas composition	Catalysts		
	Bentonite	Montmorillonite	Talc
Methane	21.97	21.73	22.58
Ethylene	8.68	8.78	8.98
Ethane	19.68	19.47	18.97
Propylene	10.84	10.79	10.68
Propane	10.18	10.16	9.42
Mixed C4	20.89	21.30	20.88
Mixed C5	7.56	7.49	8.27
>C5	0.20	0.28	0.23

Gas composition	Catalysts		
	5-7RM-ben	5-7RM-mon	5-7RM-tal
Methane	21.91	21.23	21.56
Ethylene	8.84	8.48	8.46
Ethane	19.31	18.81	18.77
Propylene	10.57	10.58	10.18
Propane	10.08	10.10	9.63
Mixed C4	21.37	22.03	22.29
Mixed C5	7.64	8.41	8.70
>C5	0.28	0.36	0.41

APPENDIX D Amount of Asphaltene in Pyrolysis Oils

Table D1 Amount of asphaltene in pyrolysis oils

No.	Case	Nomenclature	Ratio asphaltene to pyrolytic oil
1	Raw materials	No cat	0.706
2		HMOR	0.0716
3		MCM-48	0.1977
4		Kaolin	0.1769
5		α -alumina	0.1733
6	0.7% Ru/MCM-48 based extrudates	5-7RM48	0.1198
7		10-7RM48	0.1718
8		15-7RM48	0.1582
9		20-7RM48	0.0815
10		100-7RM48	0.2762
11	0.7% Ru/HMOR based extrudates	5-7RMOR	0.0160
12		10-7RMOR	0.0437
13		15-7RMOR	0.1016
14		20-7RMOR	0.1032
15		100-RMOR	0.0259
16	Clays	Bentonite	0.0140
17		Montmorillonite	0.0100
18		Talc	0.0219
19	0.7% Ru/HMOR based extrudates with various matrixes	5-7RM-ben	0.0398
20		5-7RM-mon	0.0317
21		5-7RM-tal	0.0577

APPENDIX E Chemical Compositions of Maltenes

Table E1 Molecular compositions of maltenes obtained from each component

Catalyst component \ Chemical composition	No Cat.	HMOR	MCM-48	Kaolin	α -alumina
Saturated HC.	54.50	63.75	44.26	50.96	57.25
Mono-aromatic	14.50	12.17	19.67	22.60	15.78
Di-aromatic	9.00	7.06	16.39	16.42	11.20
Poly-aromatic	11.00	7.30	9.84	5.12	8.14
Polar-aromatic	11.00	6.81	9.84	4.90	7.38

Table E2 Molecular compositions of maltenes obtained from the Ru/MCM-48 based extrudates

Catalyst	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
Chemical composition					
Saturated HC.	50.00	51.49	55.37	56.60	60.53
Mono-aromatic	18.46	18.66	18.18	18.87	14.04
Di-aromatic	13.85	11.94	14.88	12.26	8.77
Poly-aromatic	9.23	7.46	4.96	5.66	4.39
Polar-aromatic	8.46	5.97	6.61	6.60	4.39

Table E3 Molecular compositions of maltenes obtained from the Ru/HMOR-based extrudates

Catalyst	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
Chemical composition					
Saturated HC.	60.13	62.91	63.16	63.79	63.00
Mono-aromatic	22.59	20.86	19.74	16.94	14.67
Di-aromatic	8.64	7.28	6.25	9.30	5.67
Poly-aromatic	5.32	3.97	4.93	4.98	6.67
Polar-aromatic	3.32	3.64	4.28	3.65	5.00

Table E4 Molecular compositions of maltenes from using various matrixes

Catalyst	Bentonite	Montmorillonire	Talc
Chemical composition			
Saturated HC.	52.00	56.95	51.23
Mono-aromatic	22.33	18.87	24.63
Di-aromatic	15.00	11.59	10.34
Poly-aromatic	3.33	4.30	3.45
Polar-aromatic	7.33	4.97	4.43

Catalyst	5-7RM- ben	5-7RM- mon	5-7RM- tal
Chemical composition			
Saturated HC.	60.00	57.19	59.20
Mono-aromatic	14.00	21.07	14.72
Di-aromatic	11.50	8.70	7.36
Poly-aromatic	9.00	4.68	4.01
Polar-aromatic	4.50	4.68	10.70

APPENDIX F True boiling Point Curve of Maltenes

Table F1 True boiling point curve of maltenes obtained from each component

% Off	Boiling point (°C)				
	No cat	HMOR	MCM-48	Kaolin	α -alumina
0	116.9	39.6	148.4	112.4	22.0
5	151.6	120.2	165.2	148	111.8
10	170.5	147.7	174	150.2	150.1
15	187.2	149.8	187.9	166.3	155.0
20	198.8	164.3	195.3	171.7	157.4
25	208.8	170	204.2	185.2	161.8
30	216.4	184.3	210	192.5	169.4
35	224.2	192.5	214.9	202.7	171.1
40	232.3	203.8	220.6	208.4	176.0
45	240.6	212.1	225.4	214.8	185.1
50	250.9	219.8	231.5	221.7	191.3
55	260.9	227.4	237	227.8	201.3
60	271.5	235.8	244.5	235.7	209.0
65	279.9	246.2	252.1	245.3	219.0
70	290.5	256.2	260	256.2	230.3
75	302.9	268.9	269.7	269.4	245.3
80	319	279.8	278.5	280.4	263.8
85	336.4	296.1	290.2	295.8	283.8
90	362.4	321.7	305.7	320.1	310.7
95	395.2	363.7	340.2	361.1	350.6
100	460.9	452.3	435.7	453.8	428.0

Table F2 True boiling point curve of maltenes obtained from the Ru/MCM-48 based extrudates

% Off	Boiling point (°C)				
	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
0	117.2	112.8	115.4	114.5	114.5
5	165.1	149.4	150.1	148.9	149.6
10	181.1	165.3	167.2	164.1	166
15	192.6	173.3	172.4	169.4	172
20	204.2	189	186.1	181.1	186.4
25	212.4	200.4	192.4	189	193.6
30	219.5	208.3	201.7	195.6	203.9
35	225.5	215.4	207	203.8	210.9
40	232.9	222.7	212.4	209.2	216.5
45	241	229.7	216.9	214.3	222.7
50	249.6	237.1	222.3	220.2	229.2
55	257.4	246	227.7	225	236.1
60	265.9	255.1	233.7	231.4	244.7
65	272.9	264.2	241.5	237.6	253.4
70	280.4	272.7	250.5	245.6	261.9
75	288.3	281.4	259.8	254.5	271.1
80	296.9	290.7	270.8	264.2	278.7
85	307.4	301.1	281.5	274.5	288.9
90	325.4	316.7	297.2	288.5	301.5
95	363.6	345.2	333.6	314.8	324
100	460.7	447.2	452.3	419.9	420.8

Table F3 True boiling point curve of maltenes obtained from the Ru/HMOR-based extrudates

% Off	Boiling point (°C)				
	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
0	23.1	23.1	44.3	22.9	23.1
5	112.9	112.9	120	121.9	114.1
10	147.8	148.1	148.6	149.1	147.7
15	149.4	149.6	150.6	152.7	149.5
20	158.6	161.6	165.1	167.6	164
25	169.3	169.8	171.8	177.6	169.7
30	183.1	183.7	186.6	192.2	184.5
35	193	193.5	198	204.7	193.2
40	204.8	205.1	208.6	214.4	204.8
45	214.1	214.1	217.6	223.1	213.7
50	222.4	222	225.7	232.2	222.1
55	231	229.9	235.2	241.5	230.8
60	240.5	238.5	245.7	252.9	240.4
65	251.9	248.9	256.5	263.9	251.8
70	262.7	259.2	268	274.9	262.7
75	273.1	270.5	277.7	285.6	273.2
80	283.9	280.7	289.1	299	284.8
85	296.2	294.2	302.7	316.8	299.8
90	314	314.7	324	342.7	326.4
95	353.1	365	361.8	382.8	371
100	460.3	470.6	450.6	467.4	461.4

Table F4 True boiling point curve of maltenes from using various matrixes

% Off	Boiling point (°C)					
	Bentonite	Mont	Talc	5-7RM- ben	5-7RM- mon	5-7RM- tal
0	23.3	23.5	22.9	22.3	86.3	22.7
5	113.3	113.8	74.4	41.7	147.1	73.4
10	147.9	148.3	114.7	115.2	150.4	147.6
15	149.1	150.3	148.1	149.2	160.3	151.3
20	153.7	165.4	148.9	152.9	170.8	165.7
25	168.6	172.4	150.6	167	183.7	173.7
30	176.1	186.9	161.8	176.8	194.9	188.6
35	188.4	197.2	168.6	191.9	206.4	200.8
40	199.1	208	172.8	205	215.7	211.4
45	208.3	216	185.3	215.4	224.1	221.1
50	216	224.2	193.6	225	233.3	229.8
55	224	233.1	204.5	235.1	242.3	239.7
60	232.9	241.9	214	246.2	253.6	251.8
65	242.5	252.7	224.7	258.7	264.3	263.8
70	254	262.9	237.8	271.6	275.4	276.6
75	266	273.7	257.1	284.4	286.4	289.7
80	278.4	285.5	280.1	301.1	300.2	307.9
85	294	301.8	305.3	327.3	319.3	333.9
90	319.4	332.3	341.2	369.4	348.2	372
95	372.6	389.4	404.1	435.8	391.5	426.6
100	534.2	538.4	548.3	557.7	480.1	556.4

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

Table G1 Batch 1 (no Cat)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	116.9	156.7	167.6	122.2	119.6	117.1
5	151.6	193.7	205.9	309.3	224.6	129.4
10	170.5	206.4	218.1	327.3	273.1	140.9
15	187.2	214.4	228.7	336.8	288.7	243.9
20	198.8	220.7	237.1	344.1	301	260.1
25	208.8	225.7	247.1	350.5	312.4	270.2
30	216.4	232.4	255.8	356.2	322.4	276.4
35	224.2	238.4	265	361.3	332	283
40	232.3	245.4	272.8	366.3	341.7	290.6
45	240.6	252.8	278.1	371.1	349.9	299.4
50	250.9	259.8	285.5	375.8	359.3	306.8
55	260.9	267.7	292.5	380.7	368.6	314.5
60	271.5	274	300.5	385.9	377.6	323.3
65	279.9	281.1	309.1	391.4	386.2	332
70	290.5	289	318.8	397.5	391.7	340.3
75	302.9	299.1	328.8	403.9	401	349.4
80	319	312	339.5	409.9	409.5	360.1
85	336.4	328.7	356.2	416.8	418.4	371.2
90	362.4	353	375.5	427.5	432	382.8
95	395.2	387.6	402.7	444	453.3	397.1
100	460.9	446.2	459.1	480.8	498	428

Table G2 Batch 2 (MCM-48)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	148.4	168.6	177.7	119.4	131.9	111.4
5	165.2	192.1	214.3	136.6	274.3	130.5
10	174	204.2	223.7	262.7	279	142.1
15	187.9	212.6	230.7	277.3	282.7	289.6
20	195.3	218.9	234.7	285.4	287.3	306.7
25	204.2	223.2	240.5	291.7	290.4	315.1
30	210	229.4	246	297.1	293.4	322.8
35	214.9	235.4	249.4	301.8	296.7	329.9
40	220.6	240.6	254.2	306.1	300.3	335.6
45	225.4	247	259.1	310.2	304.2	340.7
50	231.5	253.1	262.7	314.2	308.5	345.7
55	237	258.1	266.7	318.6	313.6	350.9
60	244.5	264.7	272.2	323.4	319.6	356.5
65	252.1	270.2	276.8	328.9	326.7	362
70	260	275.1	282.2	334.7	335.1	367.6
75	269.7	282.3	288.3	341	344.7	373.8
80	278.5	290.3	295.6	348	355.6	380
85	290.2	299.9	304.6	356.8	369	386.9
90	305.7	318	320.7	367.5	385.3	394.8
95	340.2	353.4	352.5	381.8	409	400.6
100	435.7	444.6	430.4	401.5	463.7	436.8

Table G3 Batch 3 (Ru/HMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	114.5	148.4	183.1	131.8	108.9	121.6
5	149.6	153.8	209.4	198.1	119.8	203.5
10	166	169.4	220.5	214	121.8	232.5
15	172	178.9	229.8	226.6	123.8	243.8
20	186.4	187.3	237.1	238.2	126.5	252.4
25	193.6	193.8	246.3	250.3	128.2	260.5
30	203.9	203.3	253	264.9	130	268.5
35	210.9	208.5	259.1	279.9	131.8	274
40	216.5	214.7	264.9	291.1	133.5	279.4
45	222.7	220.6	270.4	297.4	135	285.7
50	229.2	225.5	273.5	303.5	136.7	292.7
55	236.1	232.4	277.3	309.2	138.3	300.5
60	244.7	239	283	314.8	139.7	307.8
65	253.4	247	287.6	320.3	141.2	315.4
70	261.9	255.5	292.2	326.6	142.8	324.3
75	271.1	264.2	298	333.8	144.5	333.7
80	278.7	272.9	303.8	342.2	146.5	342.5
85	288.9	282.7	311.5	352.2	150.3	352.7
90	301.5	295.9	323.4	365.2	154.1	365.2
95	324	319.1	343.7	383.8	585.9	381.4
100	420.8	403.2	432	439.4	593.8	588.7

Table G4 Batch 4 (Kaolin)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	112.4	59.5	168.1	38.8	34.9	24.4
5	148	148.1	211.7	74.3	264.5	209
10	150.2	153.7	226.3	76.9	283.3	231.6
15	166.3	169.1	233.6	81.9	290.5	245.4
20	171.7	180.8	244.7	150	296.5	258.1
25	185.2	188.1	249.4	177.5	304.3	270.7
30	192.5	195.4	255.3	209.8	310	282.8
35	202.7	203.6	262.6	244.5	316	291.9
40	208.4	208.4	268.1	267.4	322.8	300
45	214.8	214.3	272.6	273	330.3	303.1
50	221.7	219.9	276.4	277.9	338.2	307.9
55	227.8	224.3	282.2	287.5	345.6	312.4
60	235.7	231.1	287.5	294.5	353.3	315.1
65	245.3	238.1	292.4	302.5	361.5	321.2
70	256.2	246.8	301.2	311.2	370.1	333.1
75	269.4	257.3	311.5	322	379.1	346.6
80	280.4	269.9	324.4	333	389.2	363.2
85	295.8	282	338.5	351.1	401.3	381.9
90	320.1	299.8	361.9	376.2	415.9	403.6
95	361.1	336.2	390.1	407.9	438.7	435.9
100	453.8	427.9	461.5	472.4	497.8	493.6

Table G5 Batch 5 (Alumina)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	22.0	55.4	35.8	24.2	26.9	23.5
5	111.8	156.5	72.3	72.6	70.1	155.3
10	150.1	169.8	75.1	74.6	70.5	155.7
15	155.0	173.8	80.9	78.5	70.9	156.1
20	157.4	183.8	170.4	171.7	71.3	156.4
25	161.8	189.5	191.9	232.0	71.8	157.1
30	169.4	196.4	209.2	246.2	72.5	162.6
35	171.1	201.7	211.9	254.9	73.5	182.4
40	176.0	206.9	219.6	264.7	75.4	192.6
45	185.1	212.7	228.5	272.5	113.1	194.7
50	191.3	218.0	231.9	279.1	226.1	201.9
55	201.3	223.0	240.2	287.4	269.6	203.0
60	209.0	230.6	247.7	293.2	287.9	209.4
65	219.0	238.1	255.1	302.4	301.6	213.5
70	230.3	248.3	264.3	311.5	311.8	223.2
75	245.3	259.0	274.5	321.9	322.6	236.5
80	263.8	271.4	285.0	333.3	335.8	245.5
85	283.8	286.3	298.9	347.2	347.6	269.3
90	310.7	309.7	319.9	365.3	366.3	297.0
95	350.6	346.6	352.1	390.2	386.9	345.6
100	428.0	433.3	347.5	457.8	456.9	453.6

Table G6 Batch 6 (5-7RM48)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	117.2	75.9	78.4	41.7	126.3	121.7
5	165.1	192.1	191	251	281.8	230.4
10	181.1	206.1	203.9	258.6	289.4	255.9
15	192.6	216.1	212.5	268.6	295	267.4
20	204.2	221.9	219.1	272.9	299.3	274.4
25	212.4	229.6	225.8	276.5	303.8	280.9
30	219.5	236.7	231	281.9	308	287.9
35	225.5	243.2	236.9	286	312.4	294.9
40	232.9	251.5	244.6	290.1	317.3	301.7
45	241	257.1	250.3	293.2	322.7	308
50	249.6	264.6	256.5	297.8	328.6	314.6
55	257.4	269.7	262.7	301.7	335.2	321.6
60	265.9	274.7	269.2	304.2	342.3	328.9
65	272.9	281.3	274.1	308.4	349.9	336.2
70	280.4	287.1	280.2	314.8	358.6	343.7
75	288.3	295.4	286.2	320.6	368.3	352.1
80	296.9	302.1	292.8	329.2	378.9	361.8
85	307.4	313.5	301.6	339.2	391.2	372.6
90	325.4	329.3	315.1	359.8	407	385.5
95	363.6	359.6	338.8	394	432.3	397.9
100	460.7	445.2	431.2	470.6	475.6	442.7

Table G7 Batch7 (10-7RM48)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	112.8	75.9	78.4	41.7	126.3	121.7
5	149.4	192.1	191	251	281.8	230.4
10	165.3	206.1	203.9	258.6	289.4	255.9
15	173.3	216.1	212.5	268.6	295	267.4
20	189	221.9	219.1	272.9	299.3	274.4
25	200.4	229.6	225.8	276.5	303.8	280.9
30	208.3	236.7	231	281.9	308	287.9
35	215.4	243.2	236.9	286	312.4	294.9
40	222.7	251.5	244.6	290.1	317.3	301.7
45	229.7	257.1	250.3	293.2	322.7	308
50	237.1	264.6	256.5	297.8	328.6	314.6
55	246	269.7	262.7	301.7	335.2	321.6
60	255.1	274.7	269.2	304.2	342.3	328.9
65	264.2	281.3	274.1	308.4	349.9	336.2
70	272.7	287.1	280.2	314.8	358.6	343.7
75	281.4	295.4	286.2	320.6	368.3	352.1
80	290.7	302.1	292.8	329.2	378.9	361.8
85	301.1	313.5	301.6	339.2	391.2	372.6
90	316.7	329.3	315.1	359.8	407	385.5
95	345.2	359.6	338.8	394	432.3	397.9
100	447.2	445.2	431.2	470.6	475.6	442.7

Table G8 Batch8 (15-7RM48)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	115.4	165	184.5	139	126.3	121.7
5	150.1	186.5	205.4	225	281.8	230.4
10	167.2	193.8	213.3	236.1	289.4	255.9
15	172.4	202.8	220.9	244.9	295	267.4
20	186.1	206.6	227.8	253.6	299.3	274.4
25	192.4	210.8	231.8	261.8	303.8	280.9
30	201.7	214.7	236.8	269.4	308	287.9
35	207	218.8	244.3	276.8	312.4	294.9
40	212.4	221.5	246.9	283.5	317.3	301.7
45	216.9	224.1	252.1	290.2	322.7	308
50	222.3	229	257	297.5	328.6	314.6
55	227.7	233.9	261.9	305.2	335.2	321.6
60	233.7	238.8	265.8	313.7	342.3	328.9
65	241.5	244.1	272.1	323	349.9	336.2
70	250.5	252.3	276.7	333.1	358.6	343.7
75	259.8	259.3	282.6	344.1	368.3	352.1
80	270.8	269.5	289.6	356.7	378.9	361.8
85	281.5	278.5	299.1	370.8	391.2	372.6
90	297.2	292.2	320.3	386.6	407	385.5
95	333.6	318.6	363.6	409.6	432.3	397.9
100	452.3	432.2	454.2	461.6	475.6	442.7

Table G9 Batch9 (20-7RM48)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	114.5	148.5	181.1	140.4	126.6	122.8
5	148.9	171.1	210.9	213.6	276	240.2
10	164.1	185.7	214.8	229	294	258.9
15	169.4	192.2	227.2	243.3	301	270.8
20	181.1	201.1	230.3	258.6	306.5	278.9
25	189	205.4	234.2	265.8	311.7	287.2
30	195.6	210.4	242.2	273.9	316.7	295.9
35	203.8	214.1	245.4	277.6	322.1	304.3
40	209.2	218.5	248.6	281.4	327.6	311.9
45	214.3	221.9	254	286.4	333.2	319.7
50	220.2	226.5	258.7	291.3	338.9	327.8
55	225	232	262.2	296.2	344.8	335.6
60	231.4	237.5	265.7	302.1	351	343.4
65	237.6	243.4	272.1	308.8	357.8	351.4
70	245.6	251.5	275.8	317.1	365.1	359.9
75	254.5	258.6	280.9	327.5	372.9	368.4
80	264.2	268.2	286.8	339.8	381.5	377.3
85	274.5	276.8	293.3	353.6	391.2	386.5
90	288.5	290.3	306.2	370.3	403.4	396.1
95	314.8	315.1	338	391.7	426.9	407.1
100	419.9	415.2	429.8	447.4	469.3	447

Table G10 Batch 10 (HMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	39.6	148.2	31.6	23.3	23.1	24.2
5	120.2	168.2	74.8	31.1	24.8	183
10	147.7	182.4	80	36.2	28.2	213.1
15	149.8	192.1	172.2	40.2	32.6	225.8
20	164.3	202.2	209.4	43.6	34.5	236.2
25	170	208.6	231.5	60.8	36.2	245.1
30	184.3	214.9	252.2	71.7	37.9	253.4
35	192.5	221.5	271.5	79.6	39.6	261.6
40	203.8	227.3	288.2	83.7	41.5	269.4
45	212.1	233.6	306.4	384.8	43	277.1
50	219.8	240.6	323.7	393.7	44	286
55	227.4	248.7	337.6	400.5	45.1	295.6
60	235.8	256	350.5	406.6	46.2	305.6
65	246.2	264.5	360.7	413.4	70.7	316.6
70	256.2	272.6	370.7	419.7	71.3	329.7
75	268.9	281.1	380.7	425.7	337.8	344.1
80	279.8	292.4	392.3	431.4	359.7	359.9
85	296.1	308.2	404.5	438.3	372.8	376.7
90	321.7	331.8	417.5	445.9	388.6	394.2
95	363.7	369.5	439.5	456.2	427.7	421
100	452.3	448.6	494.1	474.6	449.2	467.7

Table G11 Batch 11 (Ru/HMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	23.1	115.1	83.2	71.2	23.1	22.5
5	114.1	166.7	214.6	259.4	267.5	24.8
10	147.7	181.1	229.1	280.9	303	27.8
15	149.5	191.3	239.2	291.7	323.5	31.6
20	164	201.2	250.4	299.5	337.9	35.6
25	169.7	207.8	257.1	307.6	347.6	40.2
30	184.5	214	265.7	314.7	355.6	57.6
35	193.2	220.2	271.1	322.4	362.2	81.8
40	204.8	225.4	275	330.1	368.5	227.1
45	213.7	231.9	279.1	337	374	251.9
50	222.1	237.8	285.1	345.1	379.6	271.3
55	230.8	245.4	290.3	353.4	385.3	290.2
60	240.4	252.9	295.9	361.4	391.1	309.9
65	251.8	260.1	303.4	369.5	397.4	331.6
70	262.7	268.2	312.2	377.7	404.2	356
75	273.2	275.6	322.5	386.7	411.4	382.4
80	284.8	284.9	334	396.9	420.1	409
85	299.8	297.4	349.9	407.6	431.1	434.2
90	326.4	317.4	371.3	421.5	445.2	474.3
95	371	357.5	400.1	442.9	467.1	528.1
100	461.4	444.9	470.2	498.2	511.5	576.5

Table G12 Batch 12 (5-7RMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	23.1	23.5	23.9	23.5	22.9	22.7
5	112.9	54.8	77.5	78.4	33.5	30.7
10	147.8	84.3	163	240.7	72.8	57.8
15	149.4	150.8	181.4	255.6	73.8	182.9
20	158.6	168.6	195.9	265.3	74.3	212.2
25	169.3	179	210.9	271	74.9	227.5
30	183.1	190.1	217.3	275.7	76.6	241.5
35	193	200.9	228.1	279.7	167.7	254.6
40	204.8	208.9	234.2	285.2	275.8	266.9
45	214.1	217.2	243.9	289.2	289.1	278.7
50	222.4	224.4	250.6	292.4	296.1	290
55	231	232.2	258	297.1	303.7	301.2
60	240.5	240.7	265.4	302.1	310.7	313.3
65	251.9	251.2	273.2	306.5	319.9	326.5
70	262.7	261.9	279.1	313.7	332	341.9
75	273.1	273.3	287	323	348.4	359.8
80	283.9	284.9	295.6	334.9	369.4	380.6
85	296.2	300.5	308.2	354.6	394.3	404.8
90	314	324.4	329.8	385.2	423.3	433.2
95	353.1	381.2	379	433.2	473.1	485.7
100	460.3	555.3	547	553.3	566.4	569.9

Table G13 Batch 13 (10-7RMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	23.1	26.7	24.4	23.5	22.9	23.1
5	112.9	72.5	160	43.4	30.7	33.5
10	148.1	77	206.6	218.2	44.9	76.9
15	149.6	80	214.9	248	176.9	202.8
20	161.6	88.9	224.6	256.3	246.5	220.4
25	169.8	171	230.7	264.9	274.7	234.5
30	183.7	189.1	235.6	269.8	284.9	246.8
35	193.5	202	244.1	274	291.2	258.6
40	205.1	208.2	248.2	277.6	297	268.8
45	214.1	216.6	254.3	283.5	303.6	279.1
50	222	222.3	259.8	288	310.2	289.1
55	229.9	228.7	264.7	291.6	317.9	299.2
60	238.5	236.4	270.6	296.3	327.5	310.3
65	248.9	243.8	275.1	302.7	338.8	322.5
70	259.2	253.9	280.4	309.5	352.8	337
75	270.5	263.6	286.8	319.9	369	354
80	280.7	272.7	294.4	333.4	387.3	374
85	294.2	284.3	305.8	352.1	409.6	397.3
90	314.7	299.3	327.1	380.5	437.4	425.2
95	365	330.6	374.9	426.3	490.2	476.7
100	470.6	524.3	545.2	555.9	570.4	567

Table G14 Batch 14 (15-7RMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	44.3	23.5	39.6	22.9	22.5	22.9
5	120	70.3	169.8	31.6	24.2	29.9
10	148.6	154.2	193.6	71.6	26.7	41.9
15	150.6	179.3	214.1	228.8	29.7	129.7
20	165.1	193.7	231.8	276.8	33	203.4
25	171.8	205.4	249.9	289.2	37.1	220.2
30	186.6	214.1	259.5	295.1	41.3	234.5
35	198	221.3	269.4	301.8	63.1	248.6
40	208.6	228.1	273.6	308	75.4	262.9
45	217.6	235.9	278.4	313.5	117.6	275.8
50	225.7	244.2	285.6	320.8	191.3	289.7
55	235.2	253.9	290.9	329.3	265.1	303.2
60	245.7	262.1	296.5	338.9	317.6	317.8
65	256.5	271.3	301.6	350.5	352.8	334.8
70	268	279.6	307.4	362.5	382.3	353.4
75	277.7	289.2	316.6	376.4	408.4	372.9
80	289.1	301.1	326.9	392.4	429.7	393.5
85	302.7	318.5	339.5	410.5	463.5	415.6
90	324	345.9	362.6	434	505.5	444.6
95	361.8	399.4	395.7	478	543.9	494.5
100	450.6	552.2	491.4	568	578.6	570.6

Table G15 Batch 15 (20-7RMOR)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	22.9	25.4	86	30.1	23.1	22.7
5	121.9	84	171.3	217.3	33.3	28.6
10	149.1	164.6	191.4	236.5	78.1	38.3
15	152.7	173.1	206.3	246.5	264.8	77.6
20	167.6	187.9	212.2	255.6	283.5	208.3
25	177.6	199.1	219.7	264.2	293.9	232.1
30	192.2	206.7	226.4	271.2	302.1	248.9
35	204.7	214.3	232.4	273.9	308.3	263.9
40	214.4	220.9	242	279.7	315.4	277.1
45	223.1	226	248.4	286.1	322	289.9
50	232.2	234.6	255.9	291	329.7	302.4
55	241.5	242.2	263.4	297.6	337.9	315.6
60	252.9	252.4	270.6	304.3	348.5	329.9
65	263.9	261.7	276.6	314	359.8	345.2
70	274.9	271.8	283.3	323.3	371.9	362.1
75	285.6	281.2	291.5	333	384.3	379.9
80	299	292.9	303.4	347.7	398.6	398.8
85	316.8	307.9	320.2	366.9	413.8	418.1
90	342.7	332.6	341.5	386.2	435.3	445.3
95	382.8	381	378.3	417	477.5	495.5
100	467.4	523.6	461.3	504.5	567.1	571.1

Table G16 Batch 16 (Bentonite)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	23.3	22.5	23.7	22.5	22.5	21
5	113.3	148.8	166.7	27.1	24.2	24.4
10	147.9	168.9	204.1	36.4	27.8	30.1
15	149.1	182.6	215.2	80	32.4	38.1
20	153.7	191.2	225	226.2	38.3	75.3
25	168.6	199.4	232.3	265.9	74	190.3
30	176.1	205.7	238.9	279.1	135.8	221.2
35	188.4	212	247.1	287.3	218.5	238
40	199.1	217.2	253.6	294.1	273.6	253.4
45	208.3	222.6	260	300.8	308.1	268.4
50	216	228.1	265.9	308.3	329.2	283
55	224	234.5	272.5	316.6	346.3	297.6
60	232.9	241.4	277.2	326.5	361.9	312.8
65	242.5	250	283.9	337.4	377.1	330.2
70	254	258.4	290.8	349.9	392.6	349.9
75	266	268.7	298.6	365.2	409.5	372.4
80	278.4	278.1	310.2	383.2	427.3	397.2
85	294	291.1	327.3	406.7	452.5	424.9
90	319.4	311.8	352.5	437.7	486.2	465
95	372.6	356.8	398.4	497.5	529.9	521.3
100	534.2	521.7	543.6	572.6	576.9	575.4

Table G17 Batch 17 (Montmorillonite)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	23.5	23.1	23.1	22.7	22.5	22.7
5	113.8	71.3	75.1	30.5	23.5	34.7
10	148.3	151.7	184.2	74.6	25.6	174.7
15	150.3	169	198.2	235.5	28.2	196.4
20	165.4	179.8	209.9	267.4	31.6	205.1
25	172.4	190.3	218.8	277.9	35.2	214.5
30	186.9	200	227.8	287.7	39.4	224.9
35	197.2	208.8	236.3	294.6	55.5	235.4
40	208	216.3	246.3	301.5	86	246.2
45	216	223.4	254.7	309.7	171.3	258.8
50	224.2	230.7	261.7	318.1	236.4	270.7
55	233.1	238.4	269.8	327.6	297.3	284.9
60	241.9	247.2	276	337.6	330.1	299
65	252.7	256.9	283.1	349	361.5	315.3
70	262.9	267.2	291.6	362.3	390.3	334.6
75	273.7	277.6	302.2	377.1	415.2	356
80	285.5	290	318.1	394.5	444	378.9
85	301.8	308.2	339.1	414.2	479.5	403.8
90	332.3	340.2	370.9	441.9	517.8	432.4
95	389.4	404.5	420.7	489.8	548.5	480.3
100	538.4	557.4	556.4	570.3	579.1	567.3

Table G18 Batch 18 (Talc)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	22.9	23.3	66.3	23.1	22.7	22.9
5	74.4	39.6	179.2	32.6	26.5	31.1
10	114.7	140.4	192.7	75	32.6	62
15	148.1	173.9	207.9	241.6	40.4	178.5
20	148.9	188.2	213.1	266.9	75.1	204.5
25	150.6	197.6	222.2	276.6	183.4	217.8
30	161.8	205.4	229	284.9	283.9	231.1
35	168.6	211.2	236.8	291.1	302	243.6
40	172.8	218	246.2	296.2	312.1	257.3
45	185.3	224.1	256.5	302.9	321.5	270.6
50	193.6	230.2	266	308.9	331.3	284
55	204.5	238	272.3	316.6	342.1	296.5
60	214	247	279	324.8	354.2	309.9
65	224.7	258.7	286.7	333.3	367.8	324.4
70	237.8	271.9	294.4	343.5	381.9	341
75	257.1	284.7	304.3	357.4	397.8	359.8
80	280.1	301.4	317.6	374.1	414.3	381.3
85	305.3	324	331.8	394.5	434.8	406.2
90	341.2	362.4	356.6	419.3	466.8	436.1
95	404.1	419.3	393	464.2	518.2	490.1
100	548.3	560	477.5	566.2	575	569.9

Table G19 Batch 19 (5-7RM-ben)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	22.3	25.4	24.4	22.3	22.3	22.3
5	41.7	82.6	171.9	24.4	23.3	23.3
10	115.2	160.5	202.2	28	24.4	26.9
15	149.2	172.5	214.4	32.8	26.1	32.2
20	152.9	187.4	223.4	38.8	28.8	39.2
25	167	196.4	231.2	238.8	32	75.9
30	176.8	205.4	237.6	282.3	35.8	181.8
35	191.9	212.6	246.4	292.3	40.2	223.9
40	205	219.1	253.1	300.1	57.6	243.5
45	215.4	224.4	259	308	79	260.3
50	225	231.2	265.4	316.6	142.5	275.1
55	235.1	237.7	271.7	326.2	290.9	290.7
60	246.2	245.6	276.1	336.3	322.2	306.1
65	258.7	254.2	282.4	347.1	356.9	323.5
70	271.6	262.6	289.2	359.1	376.3	343
75	284.4	271.9	296.9	372.8	393.2	364.3
80	301.1	280.4	308.3	387.9	410.3	386.9
85	327.3	292.1	324.7	406.1	428.7	411.7
90	369.4	310.2	346.7	428.1	452.4	440.6
95	435.8	349	383.4	467	486	477.5
100	557.7	470.5	494.3	566.7	566.6	560.1

Table G20 Batch 20 (5-7RM-mon)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	86.3	27.3	26.3	36.2	22.3	22.7
5	147.1	148.2	150.4	185.4	34.5	30.5
10	150.4	152.3	169.5	199.1	227.3	165.2
15	160.3	168.6	184.3	210.7	267.7	202.5
20	170.8	175.6	193.4	221.8	301.8	215.7
25	183.7	186.9	205.3	237.1	317.9	228.7
30	194.9	194.2	214.3	270	331.3	241.8
35	206.4	204.4	223.1	285.7	342.3	254.9
40	215.7	210.5	232.4	293.6	351.8	267.6
45	224.1	217.7	243.4	302.1	359.9	280.2
50	233.3	223.9	254.1	308.7	367.1	292
55	242.3	231.8	264.3	316.1	374.3	303.8
60	253.6	239.5	273.1	323.5	381.1	316.5
65	264.3	249.7	280.3	332.4	388	330.5
70	275.4	259.6	289.6	344.2	395.2	345.2
75	286.4	271.1	299.8	355.8	402.9	361.8
80	300.2	281.6	312.4	369.6	411.3	379.7
85	319.3	295.7	329.2	384.3	421.2	399.7
90	348.2	317.1	351.4	403.1	434.6	423.2
95	391.5	360.9	387.2	426.8	458.4	456.7
100	480.1	469.4	480.6	487.4	545	549.9

Table G21 Batch 21 (5-7RM-talc)

%off	Boiling point (°C)					
	Maltene	Saturated Hydrocarbons	Mono-aromatics	Di-aromatics	Poly-aromatics	Polar-aromatics
0	22.7	22.5	22.5	22.9	22.7	22.5
5	73.4	70.9	42.8	41.3	46.2	26.7
10	147.6	104.9	192.7	256.5	263.8	35.4
15	151.3	177.9	215	272.9	292.1	75
20	165.7	194.9	226.4	279.9	306.8	207.5
25	173.7	207	234.9	289.1	317.4	244.4
30	188.6	214.8	244.6	295.4	327.8	266.6
35	200.8	221.6	251.9	303.1	337.7	283.6
40	211.4	226.9	259.1	309	344.9	297.8
45	221.1	234.2	266.6	316.9	352.3	311.5
50	229.8	241.2	273.9	323.9	359.5	325.7
55	239.7	249.8	279.3	331.6	366.7	341.2
60	251.8	257.8	286.8	339.9	373.9	356.9
65	263.8	267	295	351.2	381.2	373.6
70	276.6	275.1	306	363.7	389.1	390.1
75	289.7	284.5	320.4	376.7	397.6	408.1
80	307.9	297.2	335.8	391.4	407.6	426.2
85	333.9	315.5	357.8	408.2	419.1	448.4
90	372	343.8	384.5	429.3	436.4	477.1
95	426.6	391.6	428.9	465.3	470	519.9
100	556.4	529.4	556.2	561.1	561.3	574.6

APPENDIX H Carbon Number Distribution

Table H1 Carbon number distribution of maltenes obtained from each component

Catalyst No. carbon.	No Cat	MCM-48	HMOR	Kaolin	α-alumina
6	0.027	0.018	0.669	0.159	0.002
7	0.221	0.123	1.850	0.780	0.340
8	1.039	0.644	4.106	2.660	4.080
9	3.041	2.471	7.255	6.272	12.448
10	6.043	6.604	10.303	10.535	18.034
11	8.936	12.147	12.087	13.370	17.637
12	10.665	15.934	12.168	13.753	14.103
13	10.967	16.025	10.947	12.244	10.210
14	10.207	13.417	9.118	9.942	7.065
15	8.903	10.036	7.232	7.642	4.809
16	7.456	7.054	5.574	5.703	3.271
17	6.095	4.815	4.234	4.200	2.241
18	4.916	3.254	3.200	3.083	1.553
19	3.942	2.204	2.419	2.270	1.091
20	3.158	1.504	1.838	1.682	0.778
21	2.535	1.038	1.405	1.258	0.562
22	2.043	0.726	1.083	0.949	0.412
23	1.655	0.515	0.842	0.724	0.306
24	1.349	0.369	0.660	0.557	0.230
25	1.106	0.269	0.522	0.433	0.175
26	0.912	0.198	0.417	0.340	0.135
27	0.757	0.147	0.335	0.269	0.105
28	0.631	0.110	0.271	0.215	0.082
29	0.530	0.084	0.221	0.172	0.065
30	0.446	0.064	0.181	0.139	0.052
31	0.378	0.049	0.149	0.113	0.041
32	0.321	0.038	0.123	0.093	0.033
33	0.273	0.030	0.103	0.076	0.027
34	0.233	0.023	0.086	0.063	0.022
35	0.200	0.018	0.072	0.052	0.018
36	0.171	0.015	0.060	0.043	0.015
37	0.147	0.012	0.050	0.036	0.012
38	0.126	0.009	0.042	0.030	0.010
39	0.108	0.007	0.036	0.025	0.008
40	0.092	0.006	0.030	0.021	0.007
41	0.079	0.005	0.025	0.017	0.006
42	0.067	0.004	0.021	0.014	0.005
43	0.056	0.003	0.017	0.012	0.004
44	0.047	0.002	0.014	0.010	0.003
45	0.038	0.002	0.012	0.008	0.002
46	0.031	0.001	0.009	0.006	0.002
47	0.023	0.001	0.007	0.004	0.001
48	0.016	0.001	0.005	0.003	0.001
49	0.009	0.000	0.003	0.002	0.001
50	0.002	0.000	0.001	0.000	0.000

Table H2 Carbon number distribution of maltenes obtained from the Ru/MCM-48 based extrudates

Catalyst No. carbon.	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
5	0.092	0.500	0.007	0.061	0.249
6	0.246	0.958	0.048	0.217	0.589
7	0.607	1.739	0.257	0.699	1.294
8	1.372	2.971	1.112	1.978	2.616
9	2.807	4.744	3.637	4.761	4.797
10	5.103	6.990	8.551	9.325	7.804
11	8.080	9.353	14.164	14.250	10.998
12	10.960	11.198	17.011	16.757	13.199
13	12.678	11.902	15.874	15.587	13.485
14	12.657	11.273	12.482	12.157	11.960
15	11.185	9.665	8.865	8.474	9.512
16	9.031	7.674	5.972	5.559	7.028
17	6.864	5.780	3.935	3.552	4.971
18	5.033	4.215	2.582	2.257	3.440
19	3.622	3.024	1.704	1.443	2.364
20	2.589	2.156	1.138	0.934	1.628
21	1.853	1.540	0.770	0.614	1.129
22	1.332	1.106	0.529	0.410	0.791
23	0.966	0.801	0.368	0.278	0.561
24	0.707	0.585	0.260	0.192	0.402
25	0.522	0.432	0.187	0.134	0.292
26	0.390	0.322	0.135	0.095	0.214
27	0.293	0.242	0.099	0.068	0.159
28	0.223	0.184	0.074	0.049	0.119
29	0.171	0.141	0.055	0.036	0.090
30	0.132	0.108	0.042	0.027	0.069
31	0.103	0.084	0.032	0.020	0.053
32	0.080	0.066	0.024	0.015	0.041
33	0.063	0.052	0.019	0.011	0.032
34	0.050	0.041	0.015	0.009	0.025
35	0.040	0.032	0.011	0.007	0.019
36	0.032	0.026	0.009	0.005	0.015
37	0.025	0.021	0.007	0.004	0.012
38	0.020	0.017	0.006	0.003	0.010
39	0.016	0.013	0.004	0.002	0.008
40	0.013	0.011	0.003	0.002	0.006
41	0.011	0.009	0.003	0.001	0.005
42	0.008	0.007	0.002	0.001	0.004
43	0.007	0.006	0.002	0.001	0.003
44	0.005	0.004	0.001	0.001	0.002
45	0.004	0.003	0.001	0.001	0.002
46	0.003	0.003	0.001	0.000	0.001
47	0.002	0.002	0.001	0.000	0.001
48	0.002	0.001	0.000	0.000	0.001
49	0.001	0.001	0.000	0.000	0.000
50	0.000	0.000	0.000	0.000	0.000

Table H3 Carbon number distribution of maltenes obtained from the Ru/HMOR extrudates

No. carbon. \ Catalyst	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
5	0.588	0.523	0.513	0.393	0.272
6	1.278	1.168	1.163	0.960	0.820
7	2.510	2.362	2.355	2.052	2.054
8	4.399	4.271	4.202	3.794	4.218
9	6.791	6.797	6.533	6.031	7.067
10	9.156	9.401	8.821	8.254	9.749
11	10.792	11.269	10.399	9.837	11.342
12	11.244	11.815	10.869	10.408	11.497
13	10.563	11.055	10.291	10.008	10.511
14	9.162	9.472	9.037	8.955	8.940
15	7.506	7.625	7.523	7.614	7.252
16	5.924	5.897	6.046	6.257	5.716
17	4.573	4.455	4.756	5.035	4.435
18	3.489	3.327	3.699	4.004	3.419
19	2.653	2.478	2.865	3.168	2.633
20	2.019	1.849	2.220	2.506	2.034
21	1.543	1.387	1.726	1.987	1.580
22	1.187	1.049	1.350	1.582	1.236
23	0.920	0.800	1.063	1.267	0.974
24	0.719	0.615	0.842	1.021	0.773
25	0.566	0.477	0.673	0.828	0.619
26	0.450	0.374	0.541	0.676	0.499
27	0.360	0.295	0.438	0.555	0.406
28	0.290	0.234	0.357	0.459	0.332
29	0.235	0.188	0.293	0.381	0.273
30	0.192	0.151	0.242	0.318	0.226
31	0.157	0.123	0.200	0.267	0.188
32	0.129	0.100	0.167	0.225	0.157
33	0.107	0.082	0.139	0.190	0.131
34	0.089	0.067	0.117	0.161	0.110
35	0.074	0.055	0.098	0.137	0.093
36	0.062	0.046	0.083	0.116	0.079
37	0.052	0.038	0.070	0.099	0.066
38	0.043	0.031	0.059	0.084	0.056
39	0.036	0.026	0.050	0.072	0.048
40	0.030	0.022	0.042	0.061	0.040
41	0.025	0.018	0.035	0.052	0.034
42	0.021	0.015	0.029	0.044	0.028
43	0.017	0.012	0.025	0.037	0.024
44	0.014	0.010	0.020	0.030	0.020
45	0.011	0.008	0.016	0.025	0.016
46	0.009	0.006	0.013	0.020	0.013
47	0.007	0.005	0.010	0.015	0.010
48	0.005	0.003	0.007	0.010	0.007
49	0.003	0.002	0.004	0.006	0.004
50	0.001	0.000	0.001	0.001	0.001

Table H4 Carbon number distribution of maltenes from using various matrixes

No. carbon. \ Catalyst	Bentonite	Mont	Talc	5-7RM-ben	5-7RM-mon	5-7RM-tal
5	0.196	0.402	0.005	0.578	0.076	0.048
6	0.720	0.982	0.282	1.379	0.376	0.343
7	2.079	2.131	2.454	2.809	1.317	1.414
8	4.643	4.051	7.495	4.857	3.307	3.688
9	8.029	6.639	12.381	7.143	6.155	6.698
10	10.996	9.306	14.324	9.044	8.919	9.282
11	12.409	11.189	13.515	10.062	10.632	10.610
12	12.081	11.724	11.365	10.082	10.977	10.627
13	10.598	10.973	8.971	9.329	10.247	9.748
14	8.680	9.434	6.853	8.151	8.939	8.449
15	6.816	7.647	5.158	6.848	7.468	7.069
16	5.227	5.970	3.867	5.611	6.077	5.792
17	3.965	4.561	2.905	4.530	4.872	4.694
18	2.999	3.448	2.197	3.630	3.881	3.787
19	2.273	2.600	1.675	2.902	3.087	3.054
20	1.732	1.964	1.288	2.323	2.460	2.470
21	1.330	1.492	1.001	1.866	1.968	2.006
22	1.030	1.141	0.786	1.506	1.584	1.639
23	0.804	0.880	0.623	1.223	1.283	1.346
24	0.634	0.684	0.498	0.999	1.046	1.113
25	0.503	0.536	0.402	0.822	0.858	0.926
26	0.403	0.424	0.327	0.680	0.709	0.776
27	0.326	0.338	0.268	0.566	0.589	0.653
28	0.265	0.271	0.221	0.474	0.492	0.553
29	0.217	0.219	0.184	0.398	0.414	0.471
30	0.178	0.178	0.154	0.337	0.350	0.402
31	0.148	0.145	0.129	0.286	0.296	0.345
32	0.123	0.119	0.109	0.244	0.252	0.297
33	0.102	0.099	0.092	0.208	0.215	0.257
34	0.086	0.082	0.078	0.178	0.184	0.222
35	0.072	0.068	0.066	0.153	0.158	0.192
36	0.061	0.056	0.057	0.131	0.136	0.167
37	0.051	0.047	0.048	0.113	0.117	0.145
38	0.043	0.039	0.041	0.097	0.100	0.126
39	0.036	0.033	0.035	0.084	0.086	0.109
40	0.031	0.027	0.030	0.072	0.074	0.094
41	0.026	0.023	0.025	0.061	0.063	0.081
42	0.022	0.019	0.022	0.052	0.054	0.070
43	0.018	0.016	0.018	0.044	0.045	0.059
44	0.015	0.013	0.015	0.037	0.038	0.050
45	0.012	0.010	0.012	0.030	0.031	0.041
46	0.009	0.008	0.010	0.024	0.025	0.033
47	0.007	0.006	0.007	0.018	0.019	0.025
48	0.005	0.004	0.005	0.013	0.013	0.018
49	0.003	0.002	0.003	0.007	0.007	0.010
50	0.001	0.000	0.001	0.001	0.001	0.002

Table H5 Carbon number distribution of saturated hydrocarbons obtained from each component

No. carbon. \ Catalyst	No Cat	MCM-48	HMOR	Kaolin	α -alumina
5	0.000	0.001	0.000	0.013	0.000
6	0.000	0.008	0.000	0.078	0.002
7	0.000	0.041	0.015	0.384	0.340
8	0.001	0.190	0.230	1.511	4.080
9	0.089	0.752	1.575	4.484	12.448
10	1.345	2.430	5.384	9.603	18.034
11	5.654	6.125	10.650	14.707	17.637
12	11.211	11.511	14.237	16.708	14.103
13	14.351	15.926	14.683	15.102	10.210
14	14.290	16.746	12.886	11.721	7.065
15	12.341	14.277	10.284	8.316	4.809
16	9.848	10.599	7.786	5.635	3.271
17	7.534	7.267	5.740	3.748	2.241
18	5.648	4.791	4.186	2.486	1.553
19	4.203	3.114	3.050	1.660	1.091
20	3.128	2.024	2.232	1.121	0.778
21	2.338	1.327	1.645	0.767	0.562
22	1.760	0.880	1.224	0.532	0.412
23	1.336	0.592	0.920	0.375	0.306
24	1.024	0.403	0.698	0.268	0.230
25	0.791	0.279	0.535	0.194	0.175
26	0.617	0.195	0.414	0.142	0.135
27	0.485	0.139	0.323	0.105	0.105
28	0.384	0.100	0.255	0.078	0.082
29	0.306	0.072	0.202	0.059	0.065
30	0.246	0.053	0.161	0.045	0.052
31	0.199	0.039	0.130	0.035	0.041
32	0.161	0.029	0.105	0.027	0.033
33	0.132	0.022	0.085	0.021	0.027
34	0.108	0.016	0.069	0.016	0.022
35	0.089	0.012	0.057	0.013	0.018
36	0.073	0.010	0.046	0.010	0.015
37	0.060	0.007	0.038	0.008	0.012
38	0.050	0.006	0.031	0.006	0.010
39	0.041	0.004	0.026	0.005	0.008
40	0.034	0.003	0.021	0.004	0.007
41	0.028	0.003	0.018	0.003	0.006
42	0.023	0.002	0.014	0.003	0.005
43	0.019	0.002	0.012	0.002	0.004
44	0.016	0.001	0.010	0.002	0.003
45	0.012	0.001	0.008	0.001	0.002
46	0.010	0.001	0.006	0.001	0.002
47	0.007	0.001	0.004	0.001	0.001
48	0.005	0.000	0.003	0.000	0.001
49	0.003	0.000	0.002	0.000	0.001
50	0.001	0.000	0.000	0.000	0.000

Table H7 Carbon number distribution of saturated hydrocarbons obtained from the Ru/HMOR extrudates

No. carbon. \ Catalyst	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
5	0.414	1.032	0.083	0.005	0.000
6	0.897	1.632	0.242	0.038	0.004
7	1.804	2.492	0.635	0.236	0.039
8	3.332	3.683	1.497	1.047	0.307
9	5.571	5.264	3.112	3.233	1.560
10	8.284	7.252	5.602	6.984	5.025
11	10.784	9.541	8.591	10.964	10.405
12	12.212	11.754	11.156	13.293	14.773
13	12.113	13.150	12.374	13.322	15.779
14	10.735	12.888	11.988	11.724	13.902
15	8.731	10.816	10.454	9.499	10.876
16	6.696	7.833	8.461	7.328	7.957
17	4.953	5.076	6.524	5.505	5.628
18	3.594	3.078	4.890	4.087	3.927
19	2.589	1.813	3.613	3.025	2.736
20	1.866	1.061	2.657	2.246	1.917
21	1.351	0.626	1.956	1.678	1.355
22	0.986	0.375	1.448	1.263	0.968
23	0.726	0.229	1.079	0.960	0.700
24	0.540	0.142	0.811	0.736	0.512
25	0.406	0.090	0.615	0.570	0.379
26	0.308	0.057	0.471	0.445	0.284
27	0.236	0.038	0.363	0.350	0.214
28	0.182	0.025	0.282	0.278	0.164
29	0.142	0.017	0.221	0.222	0.126
30	0.111	0.011	0.175	0.179	0.098
31	0.088	0.008	0.139	0.145	0.076
32	0.070	0.005	0.111	0.118	0.060
33	0.056	0.004	0.089	0.096	0.047
34	0.045	0.003	0.071	0.079	0.038
35	0.036	0.002	0.058	0.065	0.030
36	0.029	0.001	0.047	0.054	0.024
37	0.023	0.001	0.038	0.044	0.019
38	0.019	0.001	0.031	0.037	0.016
39	0.016	0.001	0.025	0.030	0.013
40	0.013	0.000	0.021	0.025	0.010
41	0.010	0.000	0.017	0.021	0.008
42	0.008	0.000	0.014	0.017	0.007
43	0.007	0.000	0.011	0.014	0.005
44	0.005	0.000	0.009	0.011	0.004
45	0.004	0.000	0.007	0.009	0.003
46	0.003	0.000	0.006	0.007	0.003
47	0.002	0.000	0.004	0.005	0.002
48	0.002	0.000	0.003	0.004	0.001
49	0.001	0.000	0.002	0.002	0.001
50	0.000	0.000	0.000	0.000	0.000

Table H8 Carbon number distribution of saturated hydrocarbons from using various matrixes

No. carbon.	Catalyst					
	Bentonite	Mont	Talc	5-7RM-ben	5-7RM-mon	5-7RM-tal
5	0.001	0.034	0.00	0.057	0.009	0.008
6	0.008	0.160	0.00	0.190	0.079	0.043
7	0.081	0.612	0.02	0.565	0.489	0.195
8	0.554	1.868	0.42	1.499	1.988	0.725
9	2.478	4.429	2.85	3.462	5.312	2.160
10	7.020	8.076	7.85	6.753	9.709	5.021
11	12.845	11.483	12.45	10.797	13.021	8.966
12	16.332	13.193	14.20	13.942	13.878	12.436
13	15.917	12.849	13.35	14.693	12.643	13.883
14	13.048	11.129	11.22	13.089	10.422	13.106
15	9.662	8.927	8.87	10.323	8.094	11.003
16	6.780	6.837	6.79	7.532	6.084	8.568
17	4.644	5.105	5.12	5.261	4.503	6.385
18	3.160	3.769	3.84	3.601	3.318	4.651
19	2.157	2.776	2.88	2.452	2.450	3.357
20	1.485	2.052	2.18	1.675	1.820	2.422
21	1.035	1.526	1.66	1.155	1.363	1.756
22	0.730	1.144	1.28	0.804	1.030	1.283
23	0.522	0.866	0.99	0.567	0.786	0.946
24	0.378	0.662	0.77	0.405	0.606	0.704
25	0.277	0.510	0.61	0.293	0.472	0.529
26	0.206	0.397	0.49	0.214	0.370	0.402
27	0.154	0.312	0.39	0.158	0.293	0.308
28	0.117	0.247	0.32	0.118	0.234	0.238
29	0.089	0.196	0.26	0.089	0.188	0.185
30	0.069	0.158	0.21	0.068	0.152	0.146
31	0.053	0.127	0.17	0.052	0.124	0.115
32	0.042	0.103	0.14	0.040	0.101	0.091
33	0.033	0.084	0.12	0.031	0.083	0.073
34	0.026	0.069	0.10	0.024	0.069	0.058
35	0.020	0.056	0.08	0.019	0.057	0.047
36	0.016	0.046	0.07	0.015	0.047	0.038
37	0.013	0.038	0.06	0.012	0.039	0.031
38	0.010	0.032	0.05	0.009	0.033	0.025
39	0.008	0.026	0.04	0.007	0.027	0.020
40	0.007	0.022	0.03	0.006	0.023	0.017
41	0.005	0.018	0.03	0.005	0.019	0.014
42	0.004	0.015	0.02	0.004	0.016	0.011
43	0.003	0.012	0.02	0.003	0.013	0.009
44	0.003	0.010	0.02	0.002	0.010	0.007
45	0.002	0.008	0.01	0.002	0.008	0.006
46	0.002	0.006	0.01	0.001	0.007	0.004
47	0.001	0.005	0.01	0.001	0.005	0.003
48	0.001	0.003	0.01	0.001	0.003	0.002
49	0.000	0.002	0.00	0.000	0.002	0.001
50	0.000	0.000	0.00	0.000	0.000	0.000

Table H9 Carbon number distribution of mono-aromatic hydrocarbons obtained from each component

No. carbon. \ Catalyst	No Cat	MCM-48	HMOR	Kaolin	α -alumina
5	0.001	0.000	1.758	0.000	0.000
6	0.008	0.000	2.016	0.000	0.002
7	0.038	0.000	2.282	0.000	0.340
8	0.154	0.000	2.552	0.000	4.080
9	0.520	0.005	2.821	0.010	12.448
10	1.434	0.096	3.087	0.135	18.034
11	3.193	1.007	3.346	0.998	17.637
12	5.733	5.308	3.596	4.054	14.103
13	8.416	13.936	3.836	9.544	10.210
14	10.364	20.309	4.063	14.477	7.065
15	11.068	19.530	4.279	16.001	4.809
16	10.608	14.629	4.481	14.373	3.271
17	9.408	9.614	4.671	11.387	2.241
18	7.915	5.957	4.847	8.406	1.553
19	6.435	3.618	5.005	5.984	1.091
20	5.127	2.199	5.139	4.195	0.778
21	4.039	1.351	5.236	2.932	0.562
22	3.168	0.842	5.275	2.057	0.412
23	2.484	0.534	5.223	1.454	0.306
24	1.952	0.345	5.038	1.037	0.230
25	1.540	0.226	4.685	0.748	0.175
26	1.221	0.151	4.149	0.545	0.135
27	0.974	0.102	3.469	0.401	0.105
28	0.781	0.070	2.729	0.298	0.082
29	0.629	0.048	2.028	0.223	0.065
30	0.510	0.034	1.438	0.169	0.052
31	0.415	0.024	0.986	0.129	0.041
32	0.339	0.017	0.661	0.099	0.033
33	0.278	0.012	0.438	0.076	0.027
34	0.229	0.009	0.289	0.059	0.022
35	0.189	0.007	0.190	0.046	0.018
36	0.157	0.005	0.126	0.036	0.015
37	0.130	0.004	0.084	0.028	0.012
38	0.108	0.003	0.056	0.022	0.010
39	0.090	0.002	0.038	0.018	0.008
40	0.074	0.001	0.026	0.014	0.007
41	0.062	0.001	0.018	0.011	0.006
42	0.051	0.001	0.012	0.009	0.005
43	0.042	0.001	0.009	0.007	0.004
44	0.034	0.000	0.006	0.006	0.003
45	0.027	0.000	0.004	0.004	0.002
46	0.021	0.000	0.003	0.003	0.002
47	0.016	0.000	0.002	0.002	0.001
48	0.011	0.000	0.001	0.002	0.001
49	0.006	0.000	0.001	0.001	0.001
50	0.001	0.000	0.000	0.000	0.000

Table H10 Carbon number distribution of mono-aromatic hydrocarbons obtained from the Ru/MCM-48 extrudates

No. carbon. \ Catalyst	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
5	0.004	0.004	0.001	0.000	0.080
6	0.017	0.017	0.003	0.003	0.170
7	0.069	0.069	0.018	0.014	0.344
8	0.251	0.251	0.086	0.062	0.662
9	0.805	0.805	0.361	0.252	1.216
10	2.237	2.237	1.316	0.910	2.138
11	5.202	5.202	3.970	2.871	3.605
12	9.717	9.717	9.306	7.489	5.816
13	14.152	14.152	15.877	14.858	8.898
14	16.086	16.086	19.243	20.668	12.597
15	14.793	14.793	17.271	19.874	15.741
16	11.646	11.646	12.517	14.238	16.278
17	8.306	8.306	8.004	8.520	13.318
18	5.609	5.609	4.820	4.682	8.758
19	3.694	3.694	2.844	2.504	4.958
20	2.417	2.417	1.679	1.342	2.603
21	1.587	1.587	1.003	0.730	1.335
22	1.052	1.052	0.609	0.406	0.687
23	0.706	0.706	0.376	0.231	0.359
24	0.480	0.480	0.237	0.134	0.192
25	0.331	0.331	0.152	0.080	0.105
26	0.231	0.231	0.099	0.048	0.058
27	0.163	0.163	0.065	0.030	0.033
28	0.117	0.117	0.044	0.019	0.019
29	0.084	0.084	0.030	0.012	0.011
30	0.062	0.062	0.020	0.008	0.007
31	0.045	0.045	0.014	0.005	0.004
32	0.034	0.034	0.010	0.003	0.003
33	0.025	0.025	0.007	0.002	0.002
34	0.019	0.019	0.005	0.001	0.001
35	0.014	0.014	0.004	0.001	0.001
36	0.011	0.011	0.003	0.001	0.000
37	0.008	0.008	0.002	0.000	0.000
38	0.006	0.006	0.001	0.000	0.000
39	0.005	0.005	0.001	0.000	0.000
40	0.004	0.004	0.001	0.000	0.000
41	0.003	0.003	0.001	0.000	0.000
42	0.002	0.002	0.000	0.000	0.000
43	0.002	0.002	0.000	0.000	0.000
44	0.001	0.001	0.000	0.000	0.000
45	0.001	0.001	0.000	0.000	0.000
46	0.001	0.001	0.000	0.000	0.000
47	0.001	0.001	0.000	0.000	0.000
48	0.000	0.000	0.000	0.000	0.000
49	0.000	0.000	0.000	0.000	0.000
50	0.000	0.000	0.000	0.000	0.000

Table H11 Carbon number distribution of mono-aromatic hydrocarbons obtained from the Ru/HMOR extrudates

Catalyst No. carbon.	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
5	0.320	0.005	0.120	0.002	0.000
6	0.601	0.020	0.230	0.014	0.000
7	1.078	0.070	0.421	0.075	0.000
8	1.848	0.223	0.737	0.333	0.002
9	3.027	0.650	1.239	1.187	0.024
10	4.721	1.718	2.005	3.269	0.176
11	6.947	4.047	3.126	6.824	0.899
12	9.490	8.173	4.689	10.825	3.105
13	11.766	13.444	6.733	13.445	7.228
14	12.932	17.212	9.144	13.732	11.781
15	12.419	17.008	11.502	12.171	14.390
16	10.462	13.505	13.016	9.819	14.232
17	7.910	9.225	12.883	7.478	12.217
18	5.543	5.785	11.014	5.517	9.602
19	3.712	3.490	8.242	4.009	7.172
20	2.432	2.084	5.582	2.901	5.216
21	1.584	1.250	3.553	2.104	3.750
22	1.035	0.760	2.193	1.535	2.690
23	0.683	0.469	1.340	1.129	1.937
24	0.455	0.295	0.821	0.838	1.404
25	0.308	0.188	0.507	0.628	1.025
26	0.211	0.122	0.317	0.475	0.756
27	0.146	0.081	0.201	0.363	0.562
28	0.102	0.054	0.129	0.280	0.421
29	0.072	0.036	0.084	0.217	0.319
30	0.052	0.025	0.055	0.170	0.243
31	0.037	0.017	0.037	0.134	0.186
32	0.027	0.012	0.025	0.106	0.144
33	0.020	0.009	0.017	0.084	0.112
34	0.015	0.006	0.012	0.067	0.087
35	0.011	0.004	0.008	0.054	0.069
36	0.008	0.003	0.006	0.043	0.054
37	0.006	0.002	0.004	0.035	0.043
38	0.005	0.002	0.003	0.028	0.034
39	0.004	0.001	0.002	0.023	0.027
40	0.003	0.001	0.001	0.019	0.021
41	0.002	0.001	0.001	0.015	0.017
42	0.002	0.001	0.001	0.012	0.014
43	0.001	0.000	0.001	0.010	0.011
44	0.001	0.000	0.000	0.008	0.009
45	0.001	0.000	0.000	0.006	0.007
46	0.001	0.000	0.000	0.005	0.005
47	0.000	0.000	0.000	0.004	0.004
48	0.000	0.000	0.000	0.002	0.003
49	0.000	0.000	0.000	0.001	0.001
50	0.000	0.000	0.000	0.000	0.000

Table H12 Carbon number distribution of mono-aromatic hydrocarbons from using various mtrixes

No. carbon. \ Catalyst	Bentonite	Mont	Talc	5-7RM-ben	5-7RM-mon	5-7RM-tal
5	0.004	0.008	0.002	0.010	0.111	0.000
6	0.019	0.038	0.014	0.035	0.320	0.000
7	0.070	0.154	0.083	0.112	0.817	0.006
8	0.235	0.524	0.378	0.332	1.820	0.057
9	0.709	1.486	1.302	0.889	3.495	0.358
10	1.875	3.432	3.337	2.132	5.742	1.462
11	4.231	6.376	6.428	4.481	8.075	3.968
12	7.898	9.549	9.594	8.010	9.827	7.526
13	11.903	11.762	11.608	11.845	10.551	10.688
14	14.429	12.322	11.968	14.320	10.240	12.221
15	14.392	11.414	11.009	14.335	9.208	11.998
16	12.321	9.694	9.378	12.302	7.842	10.638
17	9.489	7.777	7.607	9.459	6.440	8.840
18	6.846	6.027	5.994	6.786	5.170	7.062
19	4.767	4.582	4.649	4.687	4.097	5.518
20	3.269	3.455	3.582	3.182	3.229	4.265
21	2.235	2.600	2.757	2.153	2.541	3.285
22	1.534	1.962	2.128	1.462	2.005	2.532
23	1.062	1.489	1.651	1.001	1.588	1.960
24	0.743	1.137	1.288	0.693	1.264	1.525
25	0.525	0.875	1.013	0.485	1.013	1.195
26	0.375	0.679	0.801	0.344	0.816	0.942
27	0.271	0.531	0.639	0.246	0.662	0.748
28	0.198	0.418	0.512	0.178	0.540	0.598
29	0.146	0.331	0.414	0.130	0.443	0.481
30	0.109	0.264	0.336	0.096	0.365	0.389
31	0.081	0.212	0.274	0.071	0.302	0.316
32	0.061	0.171	0.225	0.053	0.252	0.258
33	0.047	0.139	0.185	0.040	0.210	0.212
34	0.036	0.113	0.153	0.031	0.176	0.174
35	0.027	0.092	0.127	0.023	0.148	0.144
36	0.021	0.075	0.105	0.018	0.124	0.119
37	0.016	0.062	0.088	0.014	0.105	0.099
38	0.013	0.051	0.073	0.011	0.088	0.082
39	0.010	0.042	0.061	0.008	0.074	0.068
40	0.008	0.034	0.051	0.006	0.062	0.057
41	0.006	0.028	0.042	0.005	0.052	0.047
42	0.005	0.023	0.035	0.004	0.044	0.039
43	0.004	0.019	0.029	0.003	0.037	0.032
44	0.003	0.015	0.024	0.002	0.030	0.026
45	0.002	0.012	0.019	0.002	0.024	0.021
46	0.002	0.010	0.015	0.001	0.019	0.016
47	0.001	0.007	0.011	0.001	0.015	0.012
48	0.001	0.005	0.008	0.001	0.010	0.008
49	0.000	0.003	0.004	0.000	0.006	0.005
50	0.000	0.001	0.001	0.000	0.001	0.001

Table H13 Carbon number distribution of di-aromatic hydrocarbons obtained from each component

No. carbon. \ Catalyst	No Cat	MCM-48	HMOR	Kaolin	α-alumina
5	0.000	0.000	0.011	1.576	0.000
6	0.000	0.000	0.020	1.976	0.002
7	0.000	0.000	0.035	2.430	0.340
8	0.000	0.000	0.058	2.938	4.080
9	0.001	0.001	0.094	3.493	12.448
10	0.002	0.006	0.147	4.092	18.034
11	0.008	0.036	0.222	4.727	17.637
12	0.023	0.175	0.326	5.390	14.103
13	0.063	0.709	0.465	6.068	10.210
14	0.163	2.295	0.648	6.742	7.065
15	0.389	5.709	0.884	7.376	4.809
16	0.860	10.593	1.181	7.905	3.271
17	1.746	14.696	1.549	8.217	2.241
18	3.221	15.835	1.998	8.156	1.553
19	5.327	14.073	2.541	7.574	1.091
20	7.802	10.977	3.188	6.456	0.778
21	10.046	7.907	3.952	5.004	0.562
22	11.388	5.453	4.841	3.553	0.412
23	11.489	3.684	5.855	2.357	0.306
24	10.504	2.473	6.971	1.498	0.230
25	8.890	1.663	8.119	0.931	0.175
26	7.112	1.125	9.139	0.574	0.135
27	5.473	0.768	9.759	0.355	0.105
28	4.106	0.529	9.641	0.221	0.082
29	3.035	0.368	8.599	0.139	0.065
30	2.224	0.258	6.835	0.088	0.052
31	1.625	0.183	4.873	0.057	0.041
32	1.186	0.130	3.188	0.037	0.033
33	0.867	0.094	1.969	0.024	0.027
34	0.636	0.068	1.178	0.016	0.022
35	0.468	0.050	0.695	0.011	0.018
36	0.346	0.036	0.409	0.007	0.015
37	0.257	0.027	0.241	0.005	0.012
38	0.191	0.020	0.144	0.003	0.010
39	0.143	0.015	0.087	0.002	0.008
40	0.108	0.011	0.053	0.002	0.007
41	0.081	0.008	0.033	0.001	0.006
42	0.061	0.006	0.021	0.001	0.005
43	0.047	0.005	0.013	0.001	0.004
44	0.035	0.004	0.009	0.000	0.003
45	0.026	0.003	0.006	0.000	0.002
46	0.020	0.002	0.004	0.000	0.002
47	0.014	0.001	0.002	0.000	0.001
48	0.009	0.001	0.001	0.000	0.001
49	0.005	0.001	0.001	0.000	0.001
50	0.001	0.000	0.000	0.000	0.000

Table H14 Carbon number distribution of di-aromatic hydrocarbons obtained from the Ru/MCM-48 extrudates

No. carbon. \ Catalyst	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
5	0.000	0.000	0.000	0.000	0.540
6	0.000	0.000	0.000	0.000	0.781
7	0.000	0.000	0.000	0.002	1.098
8	0.000	0.000	0.000	0.011	1.505
9	0.000	0.000	0.002	0.055	2.013
10	0.000	0.000	0.092	0.225	2.632
11	0.007	0.007	0.848	0.784	3.371
12	0.103	0.103	3.138	2.256	4.234
13	0.949	0.949	6.530	5.182	5.223
14	4.814	4.814	9.455	9.284	6.327
15	12.924	12.924	10.902	12.966	7.516
16	19.711	19.711	10.897	14.496	8.710
17	19.765	19.765	9.963	13.584	9.736
18	15.226	15.226	8.620	11.224	10.285
19	10.157	10.157	7.214	8.550	9.970
20	6.326	6.326	5.922	6.209	8.607
21	3.839	3.839	4.812	4.399	6.522
22	2.321	2.321	3.893	3.085	4.393
23	1.414	1.414	3.148	2.161	2.718
24	0.872	0.872	2.551	1.520	1.601
25	0.546	0.546	2.074	1.077	0.924
26	0.347	0.347	1.693	0.770	0.531
27	0.224	0.224	1.389	0.555	0.307
28	0.147	0.147	1.145	0.404	0.180
29	0.097	0.097	0.948	0.297	0.106
30	0.065	0.065	0.788	0.220	0.064
31	0.044	0.044	0.658	0.164	0.039
32	0.030	0.030	0.551	0.123	0.024
33	0.021	0.021	0.463	0.093	0.015
34	0.015	0.015	0.390	0.071	0.009
35	0.010	0.010	0.330	0.054	0.006
36	0.007	0.007	0.279	0.042	0.004
37	0.005	0.005	0.236	0.032	0.003
38	0.004	0.004	0.200	0.025	0.002
39	0.003	0.003	0.169	0.019	0.001
40	0.002	0.002	0.143	0.015	0.001
41	0.001	0.001	0.121	0.012	0.000
42	0.001	0.001	0.101	0.009	0.000
43	0.001	0.001	0.085	0.007	0.000
44	0.001	0.001	0.070	0.006	0.000
45	0.000	0.000	0.057	0.004	0.000
46	0.000	0.000	0.045	0.003	0.000
47	0.000	0.000	0.034	0.002	0.000
48	0.000	0.000	0.024	0.002	0.000
49	0.000	0.000	0.013	0.001	0.000
50	0.000	0.000	0.003	0.000	0.000

Table H15 Carbon number distribution of di-aromatic hydrocarbons obtained from the Ru/HMOR extrudates

No. carbon. \ Catalyst	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
5	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.002	0.000	0.001
9	0.000	0.000	0.013	0.000	0.005
10	0.001	0.000	0.073	0.005	0.027
11	0.026	0.022	0.308	0.209	0.112
12	0.339	0.504	0.977	1.867	0.374
13	2.297	3.643	2.361	6.111	1.007
14	7.908	10.690	4.448	10.881	2.196
15	15.087	16.784	6.761	13.453	3.932
16	18.433	17.776	8.629	13.404	5.901
17	16.770	14.974	9.617	11.769	7.624
18	12.809	11.135	9.687	9.609	8.721
19	8.903	7.772	9.073	7.533	9.073
20	5.913	5.273	8.077	5.784	8.787
21	3.859	3.546	6.946	4.400	8.077
22	2.513	2.389	5.841	3.341	7.152
23	1.647	1.622	4.843	2.543	6.172
24	1.090	1.112	3.984	1.945	5.234
25	0.730	0.771	3.263	1.497	4.388
26	0.496	0.541	2.670	1.160	3.654
27	0.340	0.384	2.186	0.905	3.032
28	0.237	0.276	1.792	0.711	2.511
29	0.166	0.200	1.473	0.563	2.079
30	0.118	0.146	1.214	0.448	1.723
31	0.085	0.108	1.004	0.358	1.429
32	0.061	0.080	0.832	0.288	1.187
33	0.045	0.060	0.691	0.233	0.988
34	0.033	0.045	0.575	0.189	0.823
35	0.024	0.034	0.480	0.154	0.687
36	0.018	0.026	0.401	0.126	0.573
37	0.013	0.020	0.335	0.103	0.479
38	0.010	0.015	0.281	0.084	0.401
39	0.008	0.012	0.235	0.069	0.335
40	0.006	0.009	0.196	0.057	0.279
41	0.004	0.007	0.164	0.047	0.233
42	0.003	0.006	0.136	0.038	0.193
43	0.003	0.004	0.113	0.031	0.160
44	0.002	0.003	0.092	0.025	0.130
45	0.001	0.003	0.074	0.020	0.105
46	0.001	0.002	0.058	0.016	0.082
47	0.001	0.001	0.044	0.012	0.062
48	0.001	0.001	0.030	0.008	0.043
49	0.000	0.001	0.017	0.004	0.024
50	0.000	0.000	0.003	0.001	0.005

Table H16 Carbon number distribution of di-aromatic hydrocarbons from using various matrixes

No. carbon.	Catalyst					
	Bentonite	Mont	Talc	5-7RM-ben	5-7RM-mon	5-7RM-tal
5	0.009	0.000	0.000	0.094	0.545	0.000
6	0.027	0.000	0.000	0.173	0.783	0.000
7	0.074	0.000	0.000	0.306	1.095	0.000
8	0.185	0.003	0.000	0.515	1.492	0.000
9	0.426	0.030	0.001	0.833	1.983	0.000
10	0.896	0.175	0.023	1.291	2.572	0.001
11	1.705	0.678	0.209	1.918	3.259	0.032
12	2.925	1.841	1.040	2.727	4.032	0.398
13	4.501	3.698	3.129	3.700	4.865	1.838
14	6.207	5.835	6.283	4.779	5.713	4.532
15	7.704	7.642	9.297	5.856	6.505	7.473
16	8.682	8.716	11.055	6.794	7.151	9.524
17	8.999	8.991	11.306	7.456	7.554	10.288
18	8.705	8.638	10.456	7.752	7.638	9.997
19	7.977	7.899	9.059	7.662	7.373	9.077
20	7.018	6.985	7.533	7.238	6.795	7.896
21	5.996	6.041	6.111	6.580	5.997	6.688
22	5.021	5.151	4.889	5.797	5.096	5.576
23	4.150	4.356	3.885	4.984	4.198	4.608
24	3.403	3.667	3.081	4.207	3.376	3.793
25	2.780	3.081	2.446	3.505	2.669	3.119
26	2.267	2.589	1.947	2.894	2.086	2.567
27	1.849	2.178	1.556	2.376	1.619	2.117
28	1.511	1.836	1.249	1.944	1.252	1.751
29	1.238	1.551	1.007	1.589	0.968	1.453
30	1.016	1.313	0.815	1.298	0.748	1.210
31	0.837	1.115	0.663	1.060	0.580	1.010
32	0.691	0.949	0.541	0.867	0.450	0.846
33	0.571	0.809	0.444	0.710	0.351	0.711
34	0.474	0.690	0.365	0.583	0.274	0.598
35	0.394	0.590	0.301	0.478	0.215	0.504
36	0.328	0.505	0.248	0.393	0.169	0.426
37	0.273	0.432	0.206	0.324	0.133	0.360
38	0.228	0.370	0.170	0.267	0.105	0.304
39	0.190	0.316	0.141	0.220	0.083	0.257
40	0.158	0.269	0.117	0.181	0.066	0.217
41	0.132	0.229	0.097	0.149	0.052	0.183
42	0.109	0.194	0.080	0.122	0.042	0.153
43	0.090	0.163	0.066	0.099	0.033	0.127
44	0.073	0.135	0.053	0.080	0.026	0.105
45	0.059	0.111	0.043	0.064	0.020	0.085
46	0.046	0.088	0.033	0.050	0.015	0.067
47	0.035	0.067	0.025	0.037	0.011	0.051
48	0.024	0.046	0.017	0.026	0.008	0.035
49	0.013	0.026	0.010	0.014	0.004	0.020
50	0.003	0.005	0.002	0.003	0.001	0.004

Table H17 Carbon number distribution of poly-aromatic hydrocarbons obtained from each component

No. carbon. \ Catalyst	No Cat	MCM-48	HMOR	Kaolin	α -alumina
5	0.074	0.000	3.157	0.000	0.000
6	0.125	0.414	3.170	0.000	0.002
7	0.204	12.540	3.169	0.000	0.340
8	0.320	31.502	3.154	0.000	4.080
9	0.487	26.640	3.127	0.000	12.448
10	0.717	14.828	3.090	0.000	18.034
11	1.024	7.220	3.045	0.001	17.637
12	1.424	3.429	2.992	0.033	14.103
13	1.925	1.654	2.935	0.394	10.210
14	2.533	0.822	2.874	1.803	7.065
15	3.244	0.422	2.811	4.460	4.809
16	4.036	0.225	2.748	7.404	3.271
17	4.870	0.124	2.684	9.499	2.241
18	5.685	0.070	2.623	10.319	1.553
19	6.402	0.041	2.563	10.069	1.091
20	6.935	0.025	2.507	9.170	0.778
21	7.212	0.015	2.455	7.991	0.562
22	7.197	0.010	2.406	6.774	0.412
23	6.898	0.006	2.362	5.646	0.306
24	6.366	0.004	2.322	4.662	0.230
25	5.680	0.003	2.287	3.831	0.175
26	4.923	0.002	2.255	3.142	0.135
27	4.167	0.001	2.228	2.579	0.105
28	3.462	0.001	2.203	2.120	0.082
29	2.835	0.001	2.181	1.746	0.065
30	2.297	0.000	2.161	1.442	0.052
31	1.848	0.000	2.142	1.195	0.041
32	1.479	0.000	2.123	0.992	0.033
33	1.180	0.000	2.102	0.826	0.027
34	0.940	0.000	2.079	0.689	0.022
35	0.748	0.000	2.052	0.576	0.018
36	0.595	0.000	2.021	0.482	0.015
37	0.474	0.000	1.982	0.404	0.012
38	0.377	0.000	1.935	0.339	0.010
39	0.301	0.000	1.878	0.284	0.008
40	0.240	0.000	1.808	0.238	0.007
41	0.191	0.000	1.726	0.199	0.006
42	0.152	0.000	1.627	0.165	0.005
43	0.121	0.000	1.511	0.137	0.004
44	0.095	0.000	1.376	0.112	0.003
45	0.074	0.000	1.219	0.091	0.002
46	0.057	0.000	1.040	0.071	0.002
47	0.042	0.000	0.837	0.054	0.001
48	0.028	0.000	0.608	0.037	0.001
49	0.016	0.000	0.353	0.021	0.001
50	0.003	0.000	0.071	0.004	0.000

Table H18 Carbon number distribution of poly-aromatic hydrocarbons obtained from the Ru/MCM-48 extrudates

Catalyst No. carbon.	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
5	0.000	0.000	0.000	0.000	0.001
6	0.000	0.000	0.000	0.000	0.023
7	0.000	0.000	0.000	0.000	0.783
8	0.083	0.083	0.083	0.000	18.507
9	2.472	2.472	2.472	0.000	68.074
10	11.304	11.304	11.304	0.000	12.057
11	19.193	19.193	19.193	0.000	0.529
12	19.519	19.519	19.519	0.000	0.025
13	15.394	15.394	15.394	0.009	0.001
14	10.760	10.760	10.760	0.254	0.000
15	7.135	7.135	7.135	1.779	0.000
16	4.648	4.648	4.648	5.345	0.000
17	3.029	3.029	3.029	9.456	0.000
18	1.992	1.992	1.992	12.044	0.000
19	1.328	1.328	1.328	12.531	0.000
20	0.899	0.899	0.899	11.518	0.000
21	0.618	0.618	0.618	9.819	0.000
22	0.432	0.432	0.432	8.003	0.000
23	0.307	0.307	0.307	6.355	0.000
24	0.221	0.221	0.221	4.976	0.000
25	0.161	0.161	0.161	3.871	0.000
26	0.119	0.119	0.119	3.006	0.000
27	0.089	0.089	0.089	2.336	0.000
28	0.067	0.067	0.067	1.821	0.000
29	0.051	0.051	0.051	1.425	0.000
30	0.039	0.039	0.039	1.119	0.000
31	0.030	0.030	0.030	0.883	0.000
32	0.024	0.024	0.024	0.700	0.000
33	0.018	0.018	0.018	0.557	0.000
34	0.015	0.015	0.015	0.445	0.000
35	0.011	0.011	0.011	0.356	0.000
36	0.009	0.009	0.009	0.286	0.000
37	0.007	0.007	0.007	0.231	0.000
38	0.006	0.006	0.006	0.186	0.000
39	0.005	0.005	0.005	0.151	0.000
40	0.004	0.004	0.004	0.122	0.000
41	0.003	0.003	0.003	0.099	0.000
42	0.002	0.002	0.002	0.080	0.000
43	0.002	0.002	0.002	0.064	0.000
44	0.002	0.002	0.002	0.051	0.000
45	0.001	0.001	0.001	0.040	0.000
46	0.001	0.001	0.001	0.031	0.000
47	0.001	0.001	0.001	0.023	0.000
48	0.000	0.000	0.000	0.016	0.000
49	0.000	0.000	0.000	0.009	0.000
50	0.000	0.000	0.000	0.002	0.000

Table H19 Carbon number distribution of poly-aromatic hydrocarbons obtained from the Ru/HMOR extrudates

Catalyst No. carbon.	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
5	2.929	0.001	5.912	0.000	0.002
6	3.182	0.005	6.057	0.000	0.005
7	3.423	0.018	6.021	0.000	0.011
8	3.649	0.063	5.851	0.000	0.024
9	3.859	0.193	5.589	0.000	0.048
10	4.050	0.516	5.273	0.000	0.090
11	4.222	1.198	4.929	0.023	0.165
12	4.374	2.394	4.577	0.278	0.287
13	4.507	4.107	4.232	1.326	0.482
14	4.620	6.077	3.901	3.456	0.781
15	4.714	7.851	3.591	6.059	1.220
16	4.787	9.014	3.305	8.187	1.842
17	4.838	9.391	3.042	9.322	2.685
18	4.861	9.064	2.803	9.485	3.768
19	4.848	8.262	2.587	8.963	5.070
20	4.788	7.225	2.393	8.072	6.496
21	4.665	6.140	2.219	7.046	7.868
22	4.462	5.120	2.062	6.031	8.937
23	4.167	4.219	1.922	5.101	9.466
24	3.777	3.453	1.797	4.286	9.331
25	3.307	2.818	1.684	3.589	8.586
26	2.789	2.298	1.583	3.004	7.431
27	2.268	1.876	1.491	2.516	6.112
28	1.783	1.534	1.408	2.110	4.834
29	1.363	1.258	1.333	1.774	3.715
30	1.020	1.035	1.263	1.495	2.799
31	0.751	0.854	1.198	1.262	2.083
32	0.548	0.706	1.138	1.068	1.539
33	0.398	0.586	1.081	0.906	1.133
34	0.288	0.487	1.026	0.770	0.833
35	0.208	0.405	0.973	0.655	0.614
36	0.151	0.338	0.921	0.558	0.453
37	0.110	0.283	0.870	0.475	0.335
38	0.080	0.236	0.818	0.405	0.249
39	0.059	0.197	0.766	0.344	0.186
40	0.043	0.165	0.713	0.293	0.139
41	0.032	0.137	0.659	0.248	0.104
42	0.024	0.114	0.603	0.209	0.079
43	0.018	0.094	0.544	0.175	0.059
44	0.013	0.077	0.483	0.145	0.045
45	0.010	0.062	0.418	0.118	0.033
46	0.007	0.049	0.350	0.094	0.025
47	0.005	0.037	0.277	0.071	0.018
48	0.003	0.025	0.199	0.049	0.012
49	0.002	0.014	0.114	0.028	0.006
50	0.000	0.003	0.023	0.006	0.001

Table H20 Carbon number distribution of poly-aromatic hydrocarbons from using various matrixes

No. carbon. \ Catalyst	Bentonite	Mont	Talc	5-7RM-ben	5-7RM-mon	5-7RM-tal
5	2.997	4.712	0.718	4.825	0.113	0.015
6	3.108	4.840	0.928	4.903	0.175	0.030
7	3.202	4.866	1.174	4.890	0.262	0.058
8	3.278	4.808	1.456	4.804	0.382	0.108
9	3.337	4.688	1.774	4.665	0.540	0.193
10	3.380	4.524	2.124	4.489	0.745	0.330
11	3.409	4.331	2.503	4.289	1.003	0.542
12	3.424	4.120	2.906	4.076	1.320	0.858
13	3.427	3.902	3.324	3.858	1.702	1.309
14	3.421	3.684	3.747	3.642	2.155	1.930
15	3.406	3.470	4.164	3.432	2.683	2.741
16	3.384	3.266	4.560	3.231	3.286	3.745
17	3.358	3.072	4.915	3.041	3.964	4.904
18	3.328	2.890	5.209	2.864	4.711	6.127
19	3.296	2.721	5.421	2.699	5.508	7.263
20	3.261	2.566	5.532	2.547	6.320	8.133
21	3.226	2.423	5.525	2.408	7.085	8.577
22	3.188	2.292	5.396	2.281	7.706	8.519
23	3.148	2.173	5.149	2.165	8.056	7.996
24	3.104	2.065	4.802	2.059	8.012	7.136
25	3.054	1.966	4.379	1.963	7.508	6.104
26	2.995	1.876	3.910	1.876	6.594	5.048
27	2.923	1.794	3.427	1.796	5.430	4.070
28	2.836	1.719	2.955	1.722	4.223	3.222
29	2.728	1.649	2.512	1.655	3.137	2.519
30	2.596	1.584	2.111	1.591	2.253	1.954
31	2.439	1.523	1.758	1.532	1.582	1.509
32	2.257	1.465	1.453	1.475	1.096	1.162
33	2.052	1.409	1.195	1.420	0.755	0.895
34	1.832	1.353	0.978	1.366	0.519	0.690
35	1.605	1.299	0.798	1.312	0.357	0.532
36	1.379	1.243	0.650	1.258	0.246	0.412
37	1.164	1.187	0.529	1.202	0.171	0.319
38	0.967	1.128	0.430	1.144	0.119	0.248
39	0.792	1.068	0.349	1.083	0.084	0.193
40	0.641	1.003	0.283	1.019	0.059	0.151
41	0.514	0.935	0.229	0.951	0.042	0.118
42	0.408	0.863	0.185	0.878	0.030	0.092
43	0.322	0.785	0.148	0.800	0.022	0.072
44	0.251	0.702	0.118	0.715	0.016	0.056
45	0.193	0.611	0.093	0.624	0.011	0.043
46	0.146	0.514	0.072	0.525	0.008	0.032
47	0.106	0.409	0.053	0.417	0.006	0.024
48	0.071	0.294	0.036	0.301	0.004	0.016
49	0.039	0.170	0.020	0.174	0.002	0.009
50	0.008	0.034	0.004	0.035	0.000	0.002

Table H21 Carbon number distribution of polar-aromatic hydrocarbons obtained from each component

No. carbon. \ Catalyst	No Cat	MCM-48	HMOR	Kaolin	α -alumina
5	0.000	0.002	0.000	0.008	0.000
6	0.000	0.006	0.000	0.023	0.002
7	0.000	0.013	0.000	0.061	0.340
8	0.001	0.030	0.016	0.147	4.080
9	0.011	0.065	0.236	0.335	12.448
10	0.101	0.132	1.276	0.712	18.034
11	0.537	0.255	3.526	1.412	17.637
12	1.751	0.471	6.318	2.591	14.103
13	3.874	0.833	8.552	4.359	10.210
14	6.363	1.416	9.660	6.628	7.065
15	8.399	2.313	9.707	8.994	4.809
16	9.485	3.620	9.046	10.808	3.271
17	9.607	5.398	8.035	11.513	2.241
18	9.034	7.584	6.925	10.997	1.553
19	8.082	9.873	5.860	9.602	1.091
20	6.998	11.671	4.909	7.834	0.778
21	5.935	12.309	4.092	6.097	0.562
22	4.971	11.497	3.407	4.605	0.412
23	4.135	9.585	2.839	3.419	0.306
24	3.429	7.283	2.372	2.518	0.230
25	2.842	5.177	1.989	1.851	0.175
26	2.359	3.527	1.674	1.363	0.135
27	1.962	2.346	1.415	1.008	0.105
28	1.636	1.545	1.200	0.749	0.082
29	1.368	1.014	1.023	0.560	0.065
30	1.148	0.668	0.874	0.422	0.052
31	0.966	0.442	0.750	0.319	0.041
32	0.815	0.295	0.645	0.243	0.033
33	0.690	0.198	0.557	0.186	0.027
34	0.585	0.134	0.481	0.143	0.022
35	0.496	0.091	0.416	0.111	0.018
36	0.422	0.063	0.360	0.086	0.015
37	0.359	0.043	0.312	0.067	0.012
38	0.305	0.030	0.270	0.053	0.010
39	0.259	0.021	0.234	0.041	0.008
40	0.220	0.015	0.201	0.032	0.007
41	0.186	0.011	0.173	0.026	0.006
42	0.157	0.008	0.148	0.020	0.005
43	0.131	0.006	0.126	0.016	0.004
44	0.109	0.004	0.105	0.012	0.003
45	0.088	0.003	0.087	0.010	0.002
46	0.070	0.002	0.069	0.007	0.002
47	0.053	0.001	0.053	0.005	0.001
48	0.037	0.001	0.037	0.004	0.001
49	0.021	0.001	0.021	0.002	0.001
50	0.004	0.000	0.004	0.000	0.000

Table H22 Carbon number distribution of polar-aromatic hydrocarbons obtained from the Ru/MCM-48 extrudates

No. carbon. \ Catalyst	5-7RM48	10-7RM48	15-7RM48	20-7RM48	Ru/MCM-48
5	0.000	0.000	0.000	0.000	0.001
6	0.000	0.000	0.000	0.001	0.004
7	0.000	0.000	0.000	0.005	0.015
8	0.002	0.002	0.002	0.020	0.059
9	0.015	0.015	0.015	0.072	0.199
10	0.078	0.078	0.078	0.221	0.593
11	0.330	0.330	0.330	0.583	1.527
12	1.072	1.072	1.072	1.315	3.327
13	2.680	2.680	2.680	2.528	6.043
14	5.189	5.189	5.189	4.162	9.090
15	7.985	7.985	7.985	5.936	11.419
16	10.130	10.130	10.130	7.461	12.255
17	11.038	11.038	11.038	8.430	11.596
18	10.739	10.739	10.739	8.742	10.000
19	9.644	9.644	9.644	8.481	8.093
20	8.201	8.201	8.201	7.826	6.290
21	6.731	6.731	6.731	6.965	4.774
22	5.406	5.406	5.406	6.042	3.580
23	4.288	4.288	4.288	5.150	2.673
24	3.381	3.381	3.381	4.341	1.997
25	2.661	2.661	2.661	3.633	1.498
26	2.096	2.096	2.096	3.029	1.129
27	1.656	1.656	1.656	2.521	0.857
28	1.312	1.312	1.312	2.099	0.654
29	1.045	1.045	1.045	1.748	0.503
30	0.835	0.835	0.835	1.458	0.389
31	0.670	0.670	0.670	1.218	0.303
32	0.540	0.540	0.540	1.020	0.237
33	0.437	0.437	0.437	0.855	0.187
34	0.355	0.355	0.355	0.718	0.147
35	0.289	0.289	0.289	0.603	0.117
36	0.236	0.236	0.236	0.508	0.093
37	0.193	0.193	0.193	0.428	0.074
38	0.158	0.158	0.158	0.360	0.060
39	0.129	0.129	0.129	0.303	0.048
40	0.106	0.106	0.106	0.255	0.038
41	0.087	0.087	0.087	0.214	0.031
42	0.071	0.071	0.071	0.178	0.025
43	0.058	0.058	0.058	0.148	0.020
44	0.047	0.047	0.047	0.122	0.016
45	0.037	0.037	0.037	0.098	0.012
46	0.029	0.029	0.029	0.078	0.010
47	0.022	0.022	0.022	0.059	0.007
48	0.015	0.015	0.015	0.040	0.005
49	0.008	0.008	0.008	0.023	0.003
50	0.002	0.002	0.002	0.005	0.001

Table H23 Carbon number distribution of polar-aromatic hydrocarbons obtained from the Ru/HMOR extrudates

Catalyst No. carbon.	5-7RMOR	10-7RMOR	15-7RMOR	20-7RMOR	Ru/HMOR
5	0.128	0.000	0.672	0.462	5.123
6	0.306	0.006	1.055	0.731	4.972
7	0.654	0.054	1.573	1.108	4.813
8	1.257	0.285	2.227	1.607	4.649
9	2.161	0.987	2.990	2.225	4.483
10	3.332	2.383	3.807	2.944	4.315
11	4.628	4.321	4.599	3.717	4.149
12	5.838	6.280	5.284	4.479	3.984
13	6.762	7.741	5.792	5.157	3.824
14	7.283	8.466	6.083	5.683	3.669
15	7.391	8.503	6.152	6.013	3.519
16	7.152	8.047	6.024	6.131	3.375
17	6.674	7.310	5.742	6.051	3.239
18	6.060	6.462	5.355	5.809	3.109
19	5.395	5.612	4.910	5.450	2.985
20	4.738	4.821	4.444	5.018	2.869
21	4.123	4.116	3.984	4.554	2.758
22	3.568	3.504	3.547	4.087	2.652
23	3.079	2.983	3.144	3.638	2.550
24	2.654	2.541	2.779	3.219	2.451
25	2.288	2.170	2.453	2.837	2.354
26	1.975	1.859	2.164	2.494	2.256
27	1.708	1.597	1.910	2.189	2.158
28	1.480	1.376	1.686	1.920	2.056
29	1.286	1.189	1.490	1.684	1.950
30	1.119	1.031	1.318	1.477	1.840
31	0.976	0.896	1.167	1.296	1.723
32	0.852	0.781	1.034	1.137	1.601
33	0.745	0.682	0.916	0.998	1.474
34	0.652	0.596	0.812	0.876	1.344
35	0.571	0.521	0.719	0.768	1.212
36	0.500	0.456	0.637	0.673	1.082
37	0.438	0.399	0.563	0.589	0.955
38	0.383	0.349	0.497	0.515	0.834
39	0.334	0.304	0.438	0.449	0.720
40	0.291	0.265	0.384	0.390	0.616
41	0.252	0.229	0.336	0.338	0.522
42	0.217	0.197	0.291	0.290	0.437
43	0.185	0.169	0.250	0.248	0.362
44	0.156	0.142	0.212	0.208	0.296
45	0.129	0.118	0.176	0.172	0.238
46	0.104	0.095	0.143	0.138	0.186
47	0.080	0.073	0.110	0.106	0.139
48	0.056	0.051	0.077	0.074	0.096
49	0.032	0.029	0.044	0.042	0.053
50	0.006	0.006	0.009	0.008	0.011

Table H24 Carbon number distribution of polar-aromatic hydrocarbons from the using various matrixes

No. carbon. \ Catalyst	Bentonite	Mont	Talc	5-7RM-ben	5-7RM-mon	5-7RM-tal
5	1.585	0.001	0.078	3.034	0.105	0.771
6	2.022	0.032	0.260	3.302	0.275	1.032
7	2.512	0.300	0.696	3.558	0.629	1.345
8	3.040	1.253	1.511	3.796	1.259	1.708
9	3.582	3.057	2.714	4.013	2.210	2.117
10	4.108	5.222	4.136	4.205	3.420	2.558
11	4.585	7.043	5.497	4.368	4.716	3.016
12	4.980	8.113	6.541	4.497	5.874	3.470
13	5.266	8.415	7.136	4.590	6.711	3.897
14	5.426	8.136	7.286	4.643	7.142	4.272
15	5.456	7.510	7.080	4.652	7.182	4.576
16	5.362	6.724	6.636	4.616	6.914	4.792
17	5.164	5.903	6.060	4.534	6.440	4.912
18	4.885	5.122	5.435	4.406	5.855	4.936
19	4.551	4.414	4.816	4.234	5.233	4.870
20	4.186	3.793	4.235	4.024	4.622	4.727
21	3.812	3.258	3.707	3.781	4.051	4.522
22	3.443	2.801	3.239	3.514	3.534	4.272
23	3.090	2.415	2.829	3.232	3.077	3.992
24	2.762	2.088	2.473	2.942	2.677	3.698
25	2.460	1.812	2.166	2.653	2.331	3.399
26	2.187	1.578	1.901	2.373	2.031	3.105
27	1.941	1.379	1.672	2.106	1.774	2.822
28	1.722	1.210	1.475	1.857	1.552	2.554
29	1.527	1.065	1.304	1.628	1.361	2.304
30	1.353	0.940	1.155	1.420	1.196	2.072
31	1.199	0.832	1.025	1.233	1.052	1.858
32	1.063	0.738	0.912	1.067	0.928	1.663
33	0.942	0.655	0.812	0.920	0.819	1.485
34	0.834	0.583	0.723	0.791	0.723	1.323
35	0.738	0.519	0.644	0.679	0.639	1.176
36	0.652	0.462	0.574	0.581	0.564	1.043
37	0.575	0.410	0.511	0.496	0.498	0.922
38	0.507	0.364	0.454	0.422	0.439	0.813
39	0.445	0.323	0.402	0.359	0.386	0.714
40	0.389	0.285	0.355	0.304	0.338	0.625
41	0.339	0.250	0.312	0.256	0.295	0.544
42	0.293	0.218	0.272	0.215	0.256	0.470
43	0.251	0.189	0.235	0.179	0.219	0.402
44	0.212	0.161	0.201	0.148	0.186	0.340
45	0.176	0.135	0.168	0.120	0.155	0.282
46	0.142	0.109	0.136	0.094	0.125	0.227
47	0.109	0.084	0.105	0.071	0.096	0.174
48	0.076	0.059	0.074	0.049	0.067	0.122
49	0.043	0.034	0.042	0.028	0.038	0.069
50	0.009	0.007	0.008	0.006	0.008	0.014

APPENDIX I Petroleum Fractions of Derived Oils

Table I1 Petroleum fractions of derived oils obtained from each component

Catalyst Fraction	No Cat	HMOR	MCM- 48	Kaolin	α- alumina
Naphtha	21	34.0	22.5	34	35
Kerosene	29	33.5	41.5	33.5	28
Light Gas Oil	24	19.0	19.0	19	16
Heavy Gas Oil	17	9.5	13.5	9.5	15
Residues	9.0	4.0	3.5	4	6

Table I2 Petroleum fractions of derived oils obtained from the Ru/MCM-48 based extrudates

Catalyst Fraction	5- 7RM48	10- 7RM48	15- 7RM48	20- 7RM48	Ru/MCM- 48
Naphtha	19	25	29	33	27
Kerosene	32	33	41	40	36
Light Gas Oil	32	27	23	20	26
Heavy Gas Oil	14	12	4	6	8
Residues	4.5	3.5	3.5	2.5	2.9

Table I3 Petroleum fractions of derived oils obtained from the Ru/HMOR based extrudates

Catalyst Fraction	5- 7RMOR	10- 7RMOR	15- 7RMOR	20- 7RMOR	Ru/HMOR
Naphtha	38.0	38.0	36.0	38.0	38.0
Kerosene	26.0	27.5	26.0	26.0	26.0
Light Gas Oil	22.0	21.5	20.5	21.0	21.0
Heavy Gas Oil	10.0	8.5	13.0	9.5	9.5
Residues	4.0	4.5	4.5	5.5	5.5

Table I4 Petroleum fractions of derived oils from using various matrixes

# of reuse Fraction	Bentonite	Mont	Talc	5- 7RM- ben	5- 7RM- mon	5- 7RM- tal
Naphtha	39.5	37.5	43.5	38.5	33.0	42.5
Kerosene	20.5	25.0	25.0	23.5	26.0	20.5
Light Gas Oil	21.0	19.5	15.5	17.0	21.0	21.0
Heavy Gas Oil	9.5	10.5	9.0	11.0	13.0	9.5
Residues	6.5	7.5	7.0	10.0	7.0	6.5

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