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APPENDIXES

APPENDIX A

Chrom-Card

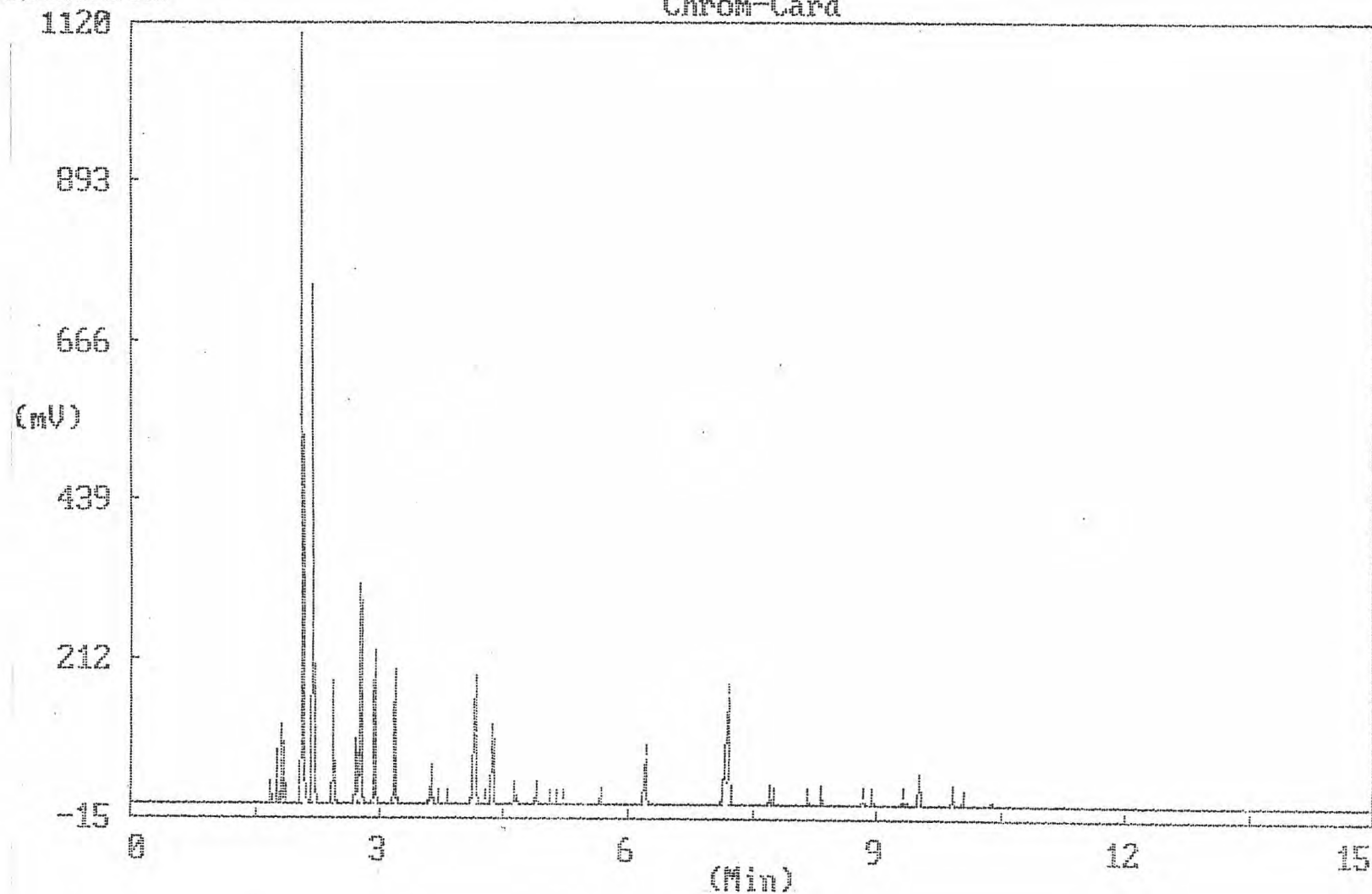


Figure A1 GC Chromatogram of product from using 0.6%Pt-1.0%F/Al₂O₃ catalyst, under 60 psi H₂, 370°C.
(The Optimum Reaction Condition)

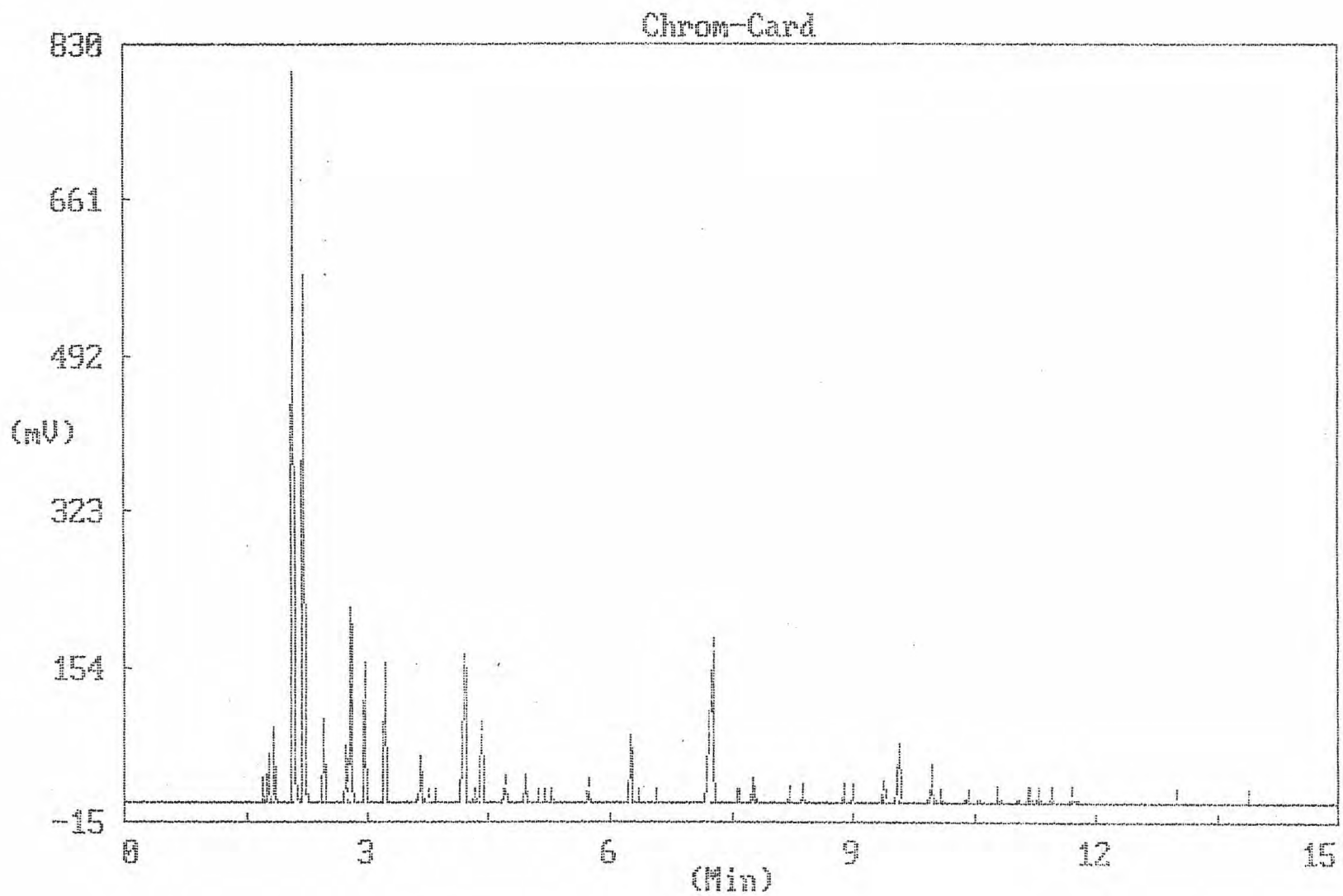


Figure A2 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 40 psi H₂, 370°C.

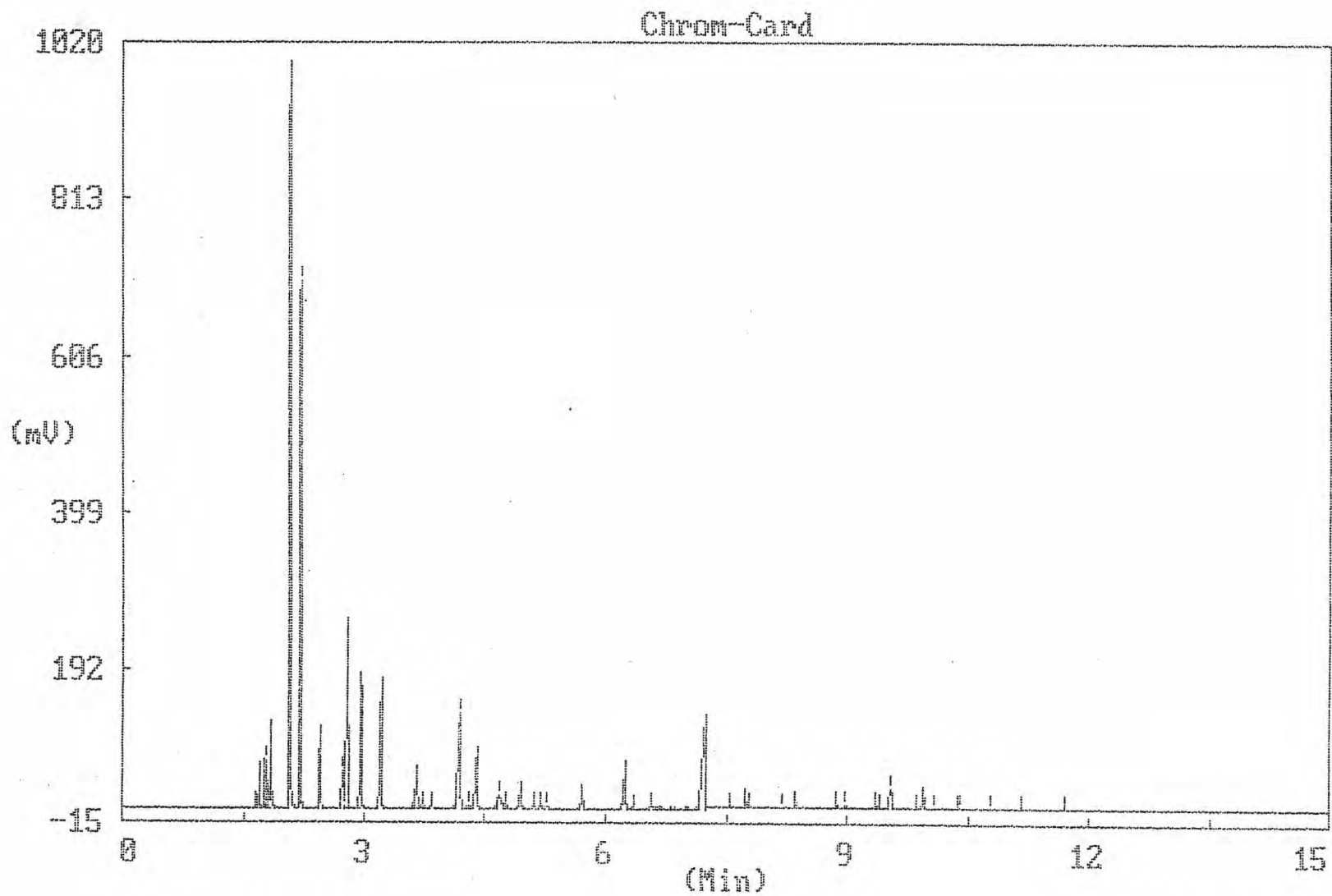


Figure A3 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 60 psi H₂, 370°C.

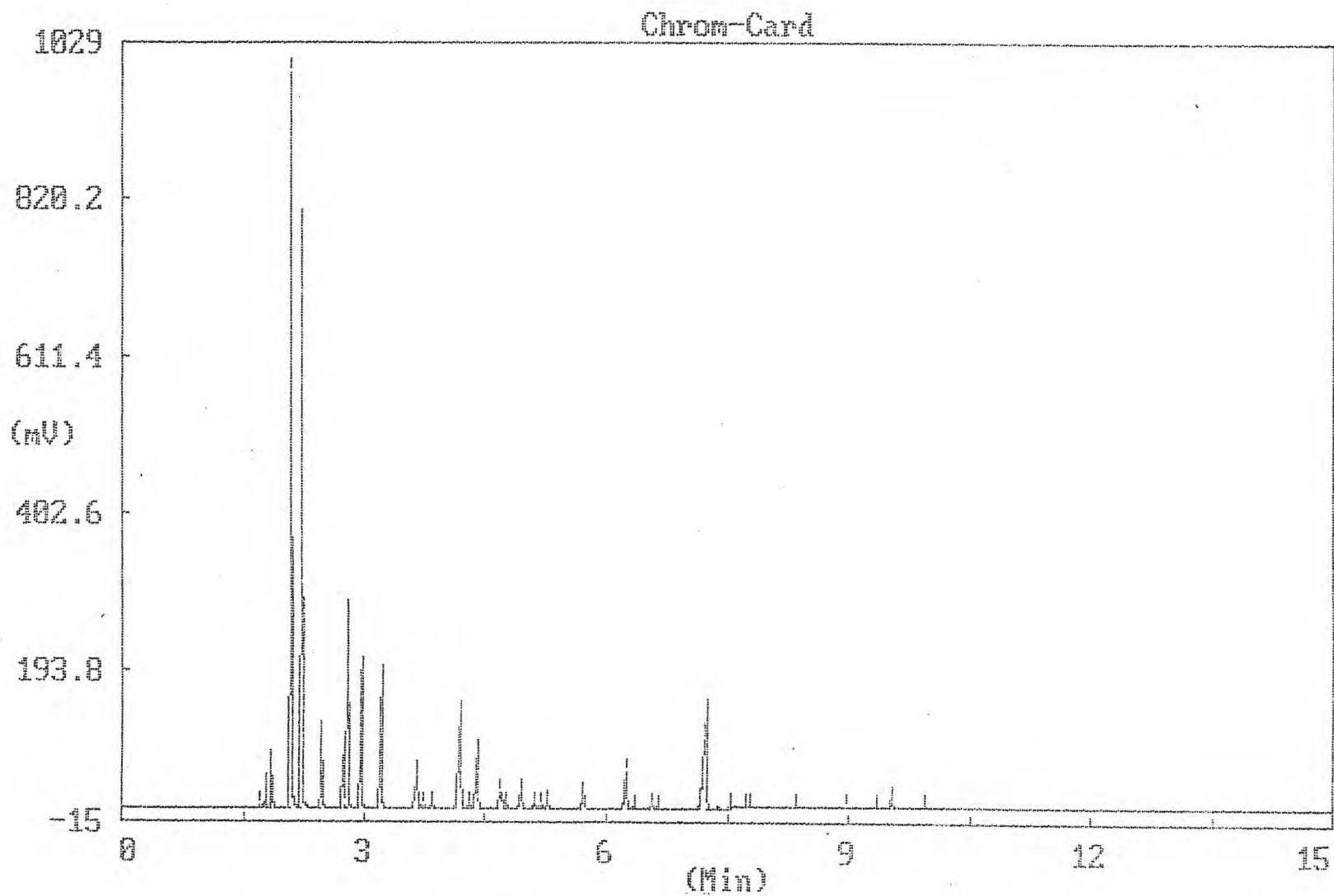


Figure A4 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 80 psi H₂, 370°C.

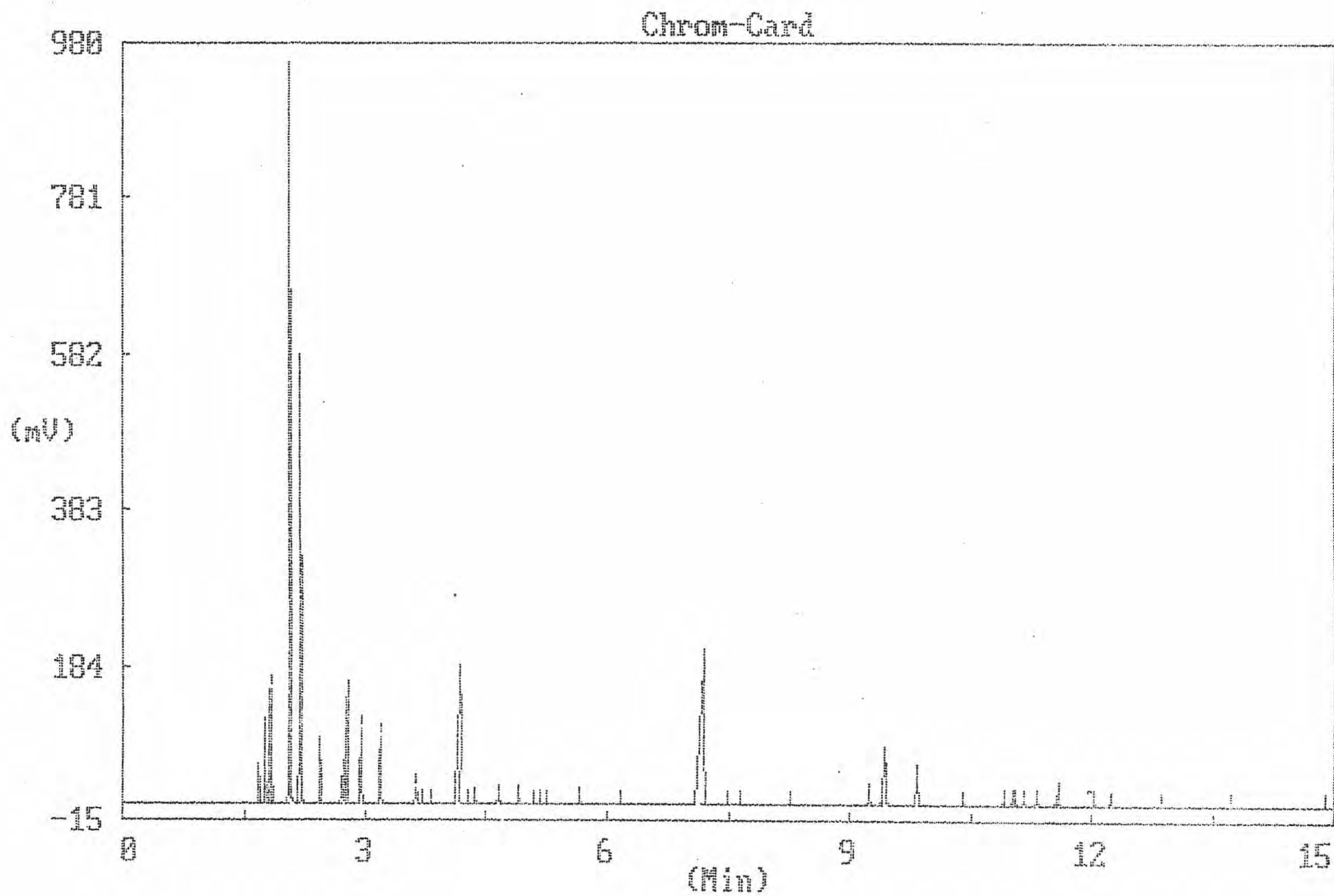


Figure A5 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 40 psi H₂, 400°C.

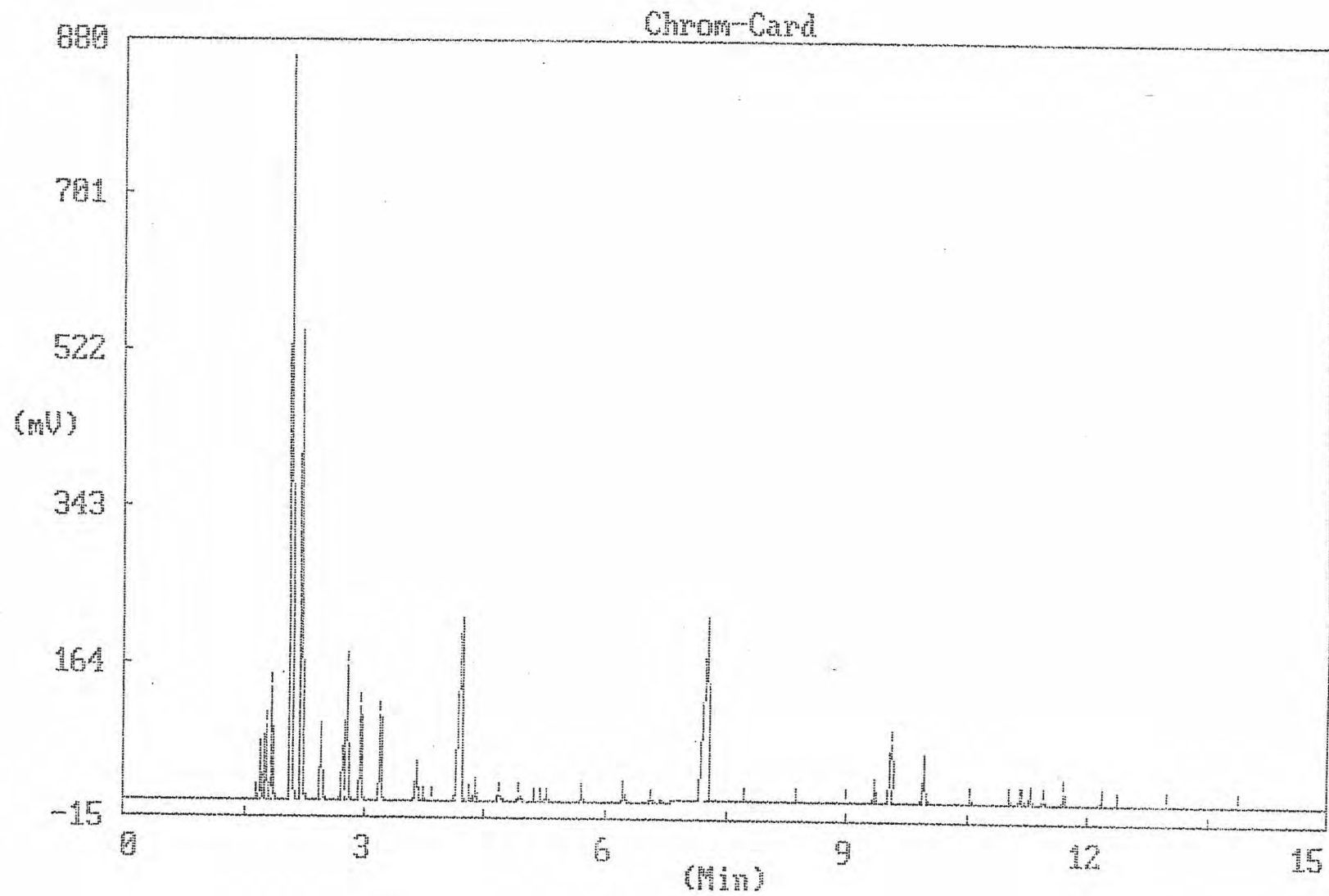


Figure A6 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 60 psi H₂, 400°C.

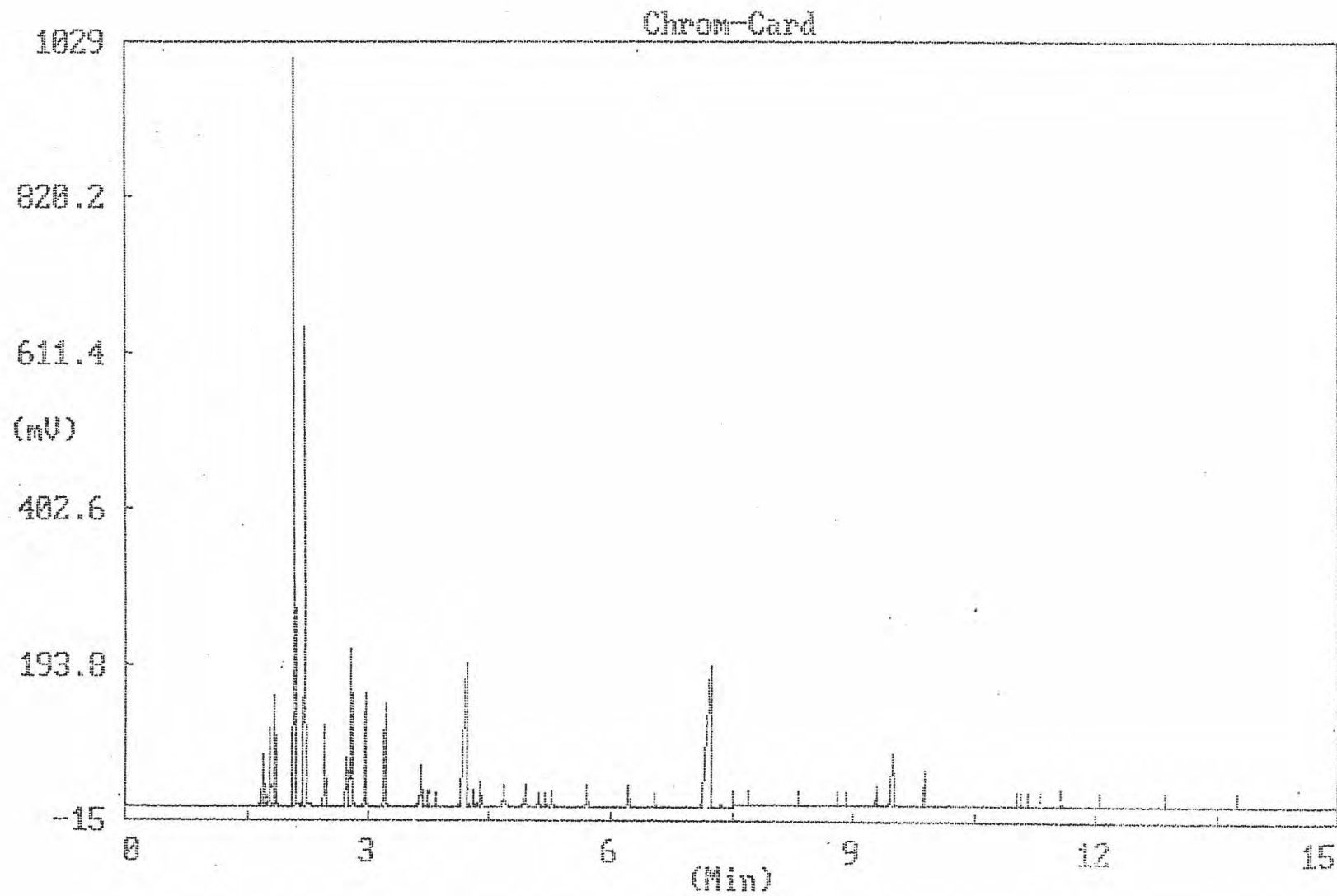


Figure A7 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 80 psi H₂, 400°C.

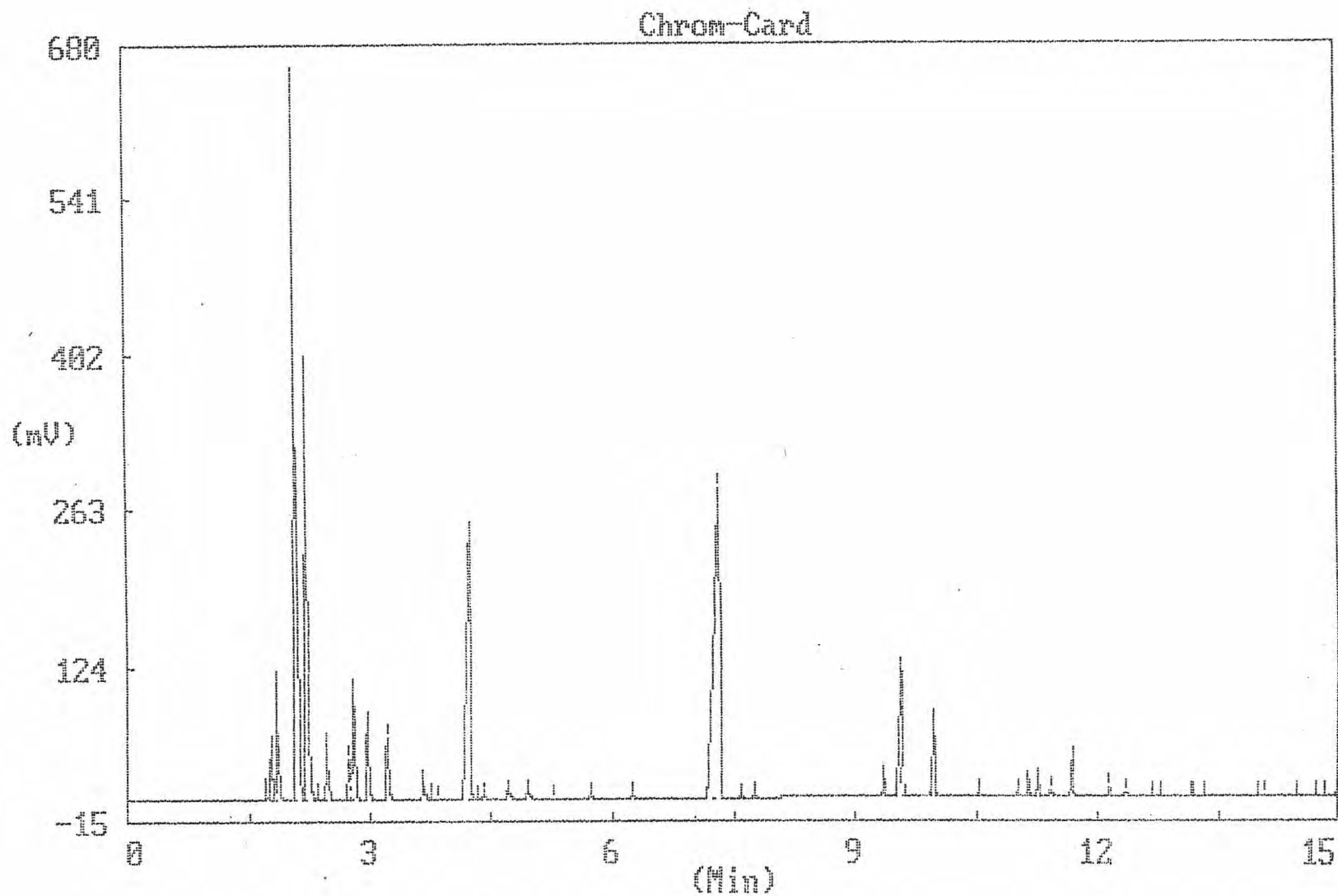


Figure A8 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 40 psi H₂, 420°C.

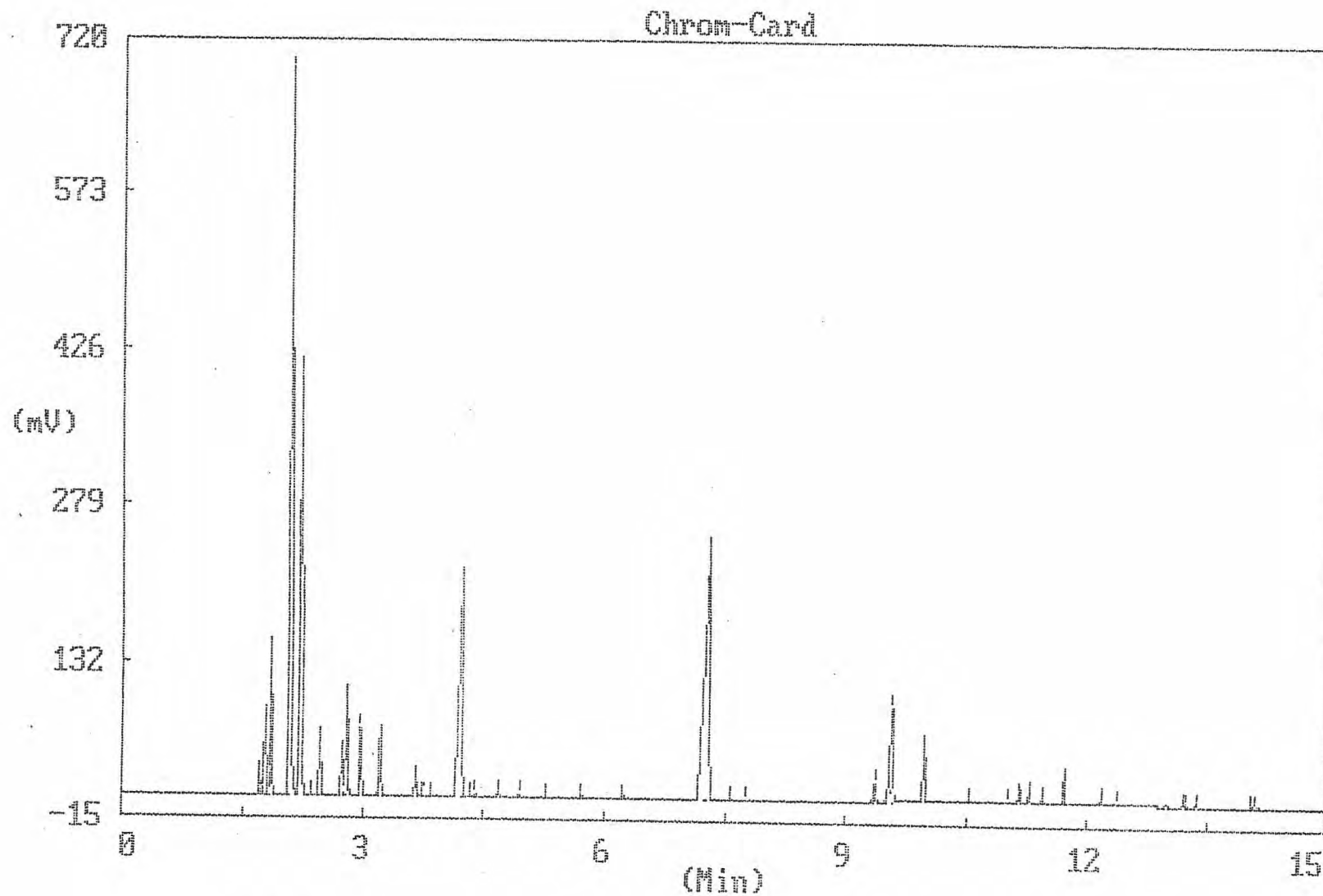


Figure A9 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 60 psi H₂, 420°C.

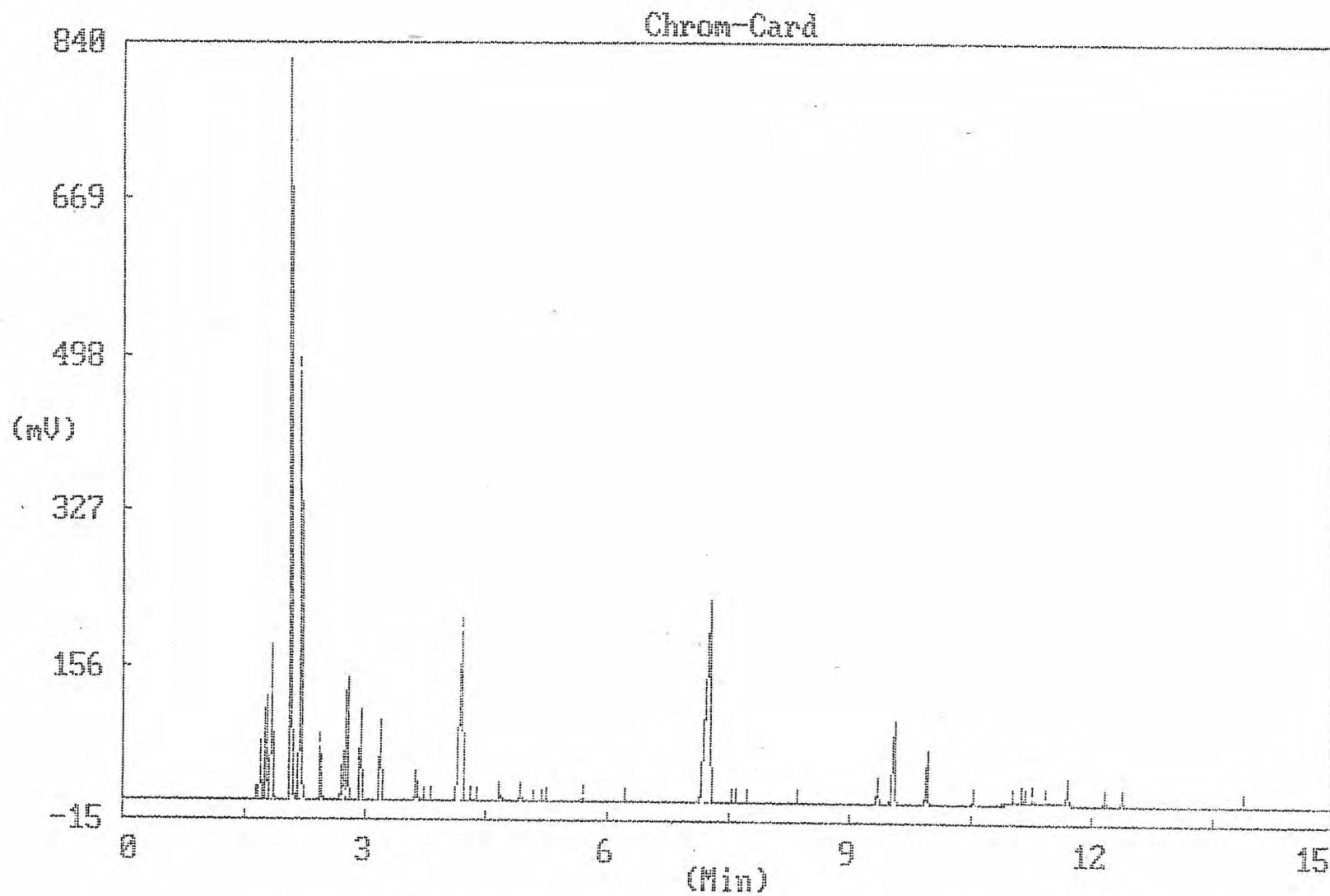


Figure A10 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 80 psi H₂, 420°C.

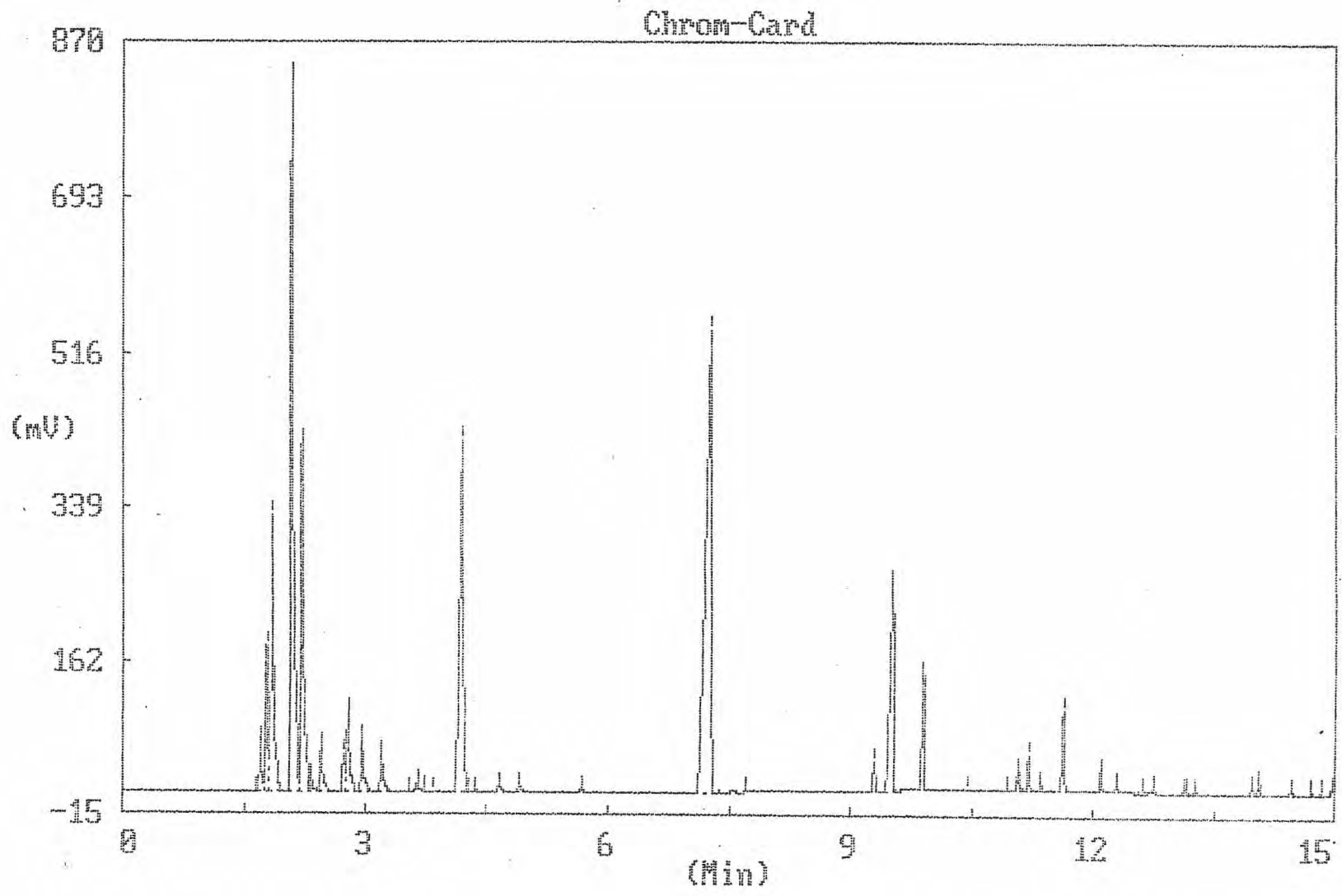


Figure A11 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 40 psi H₂, 450°C.

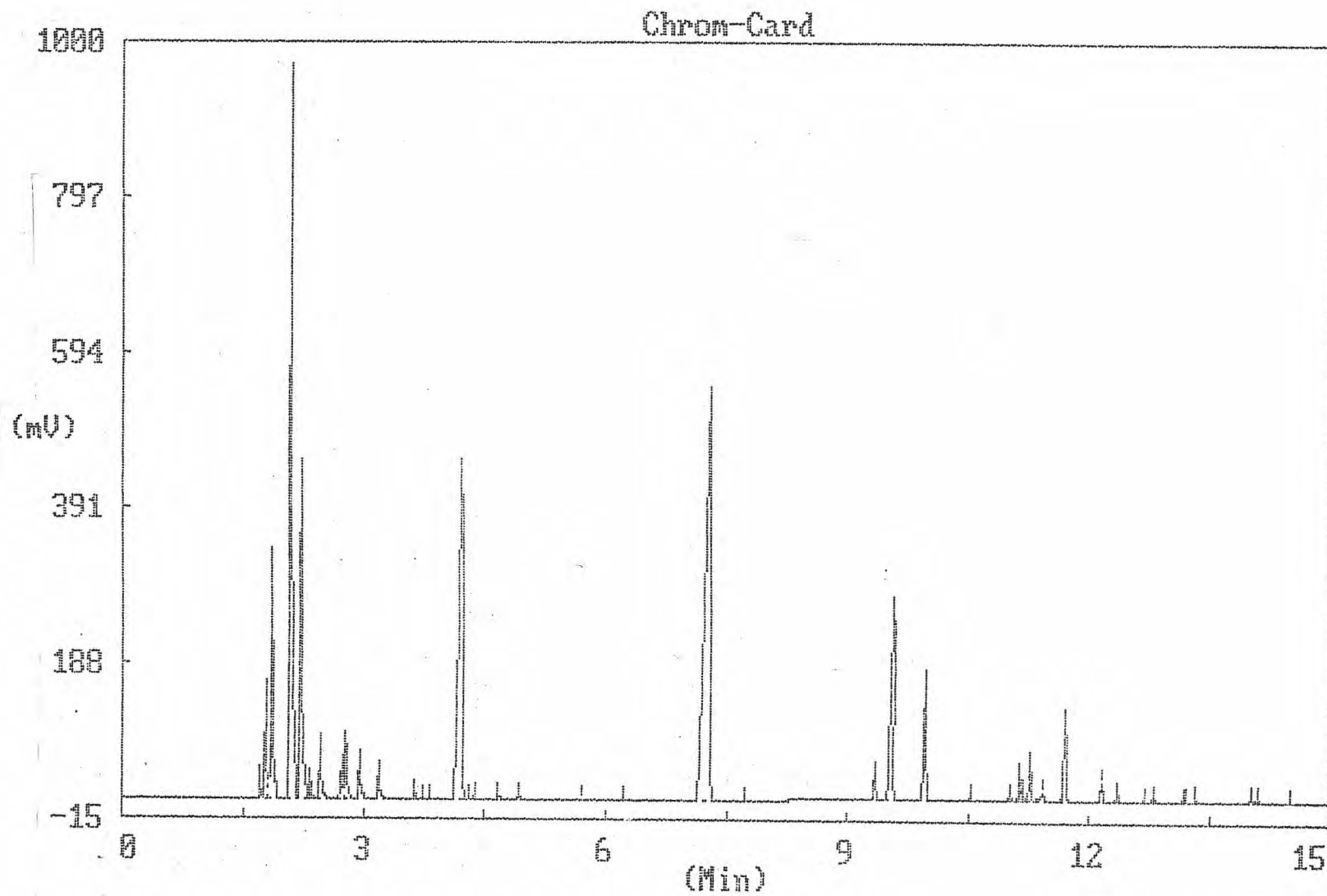


Figure A12 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 60 psi H₂, 450°C.

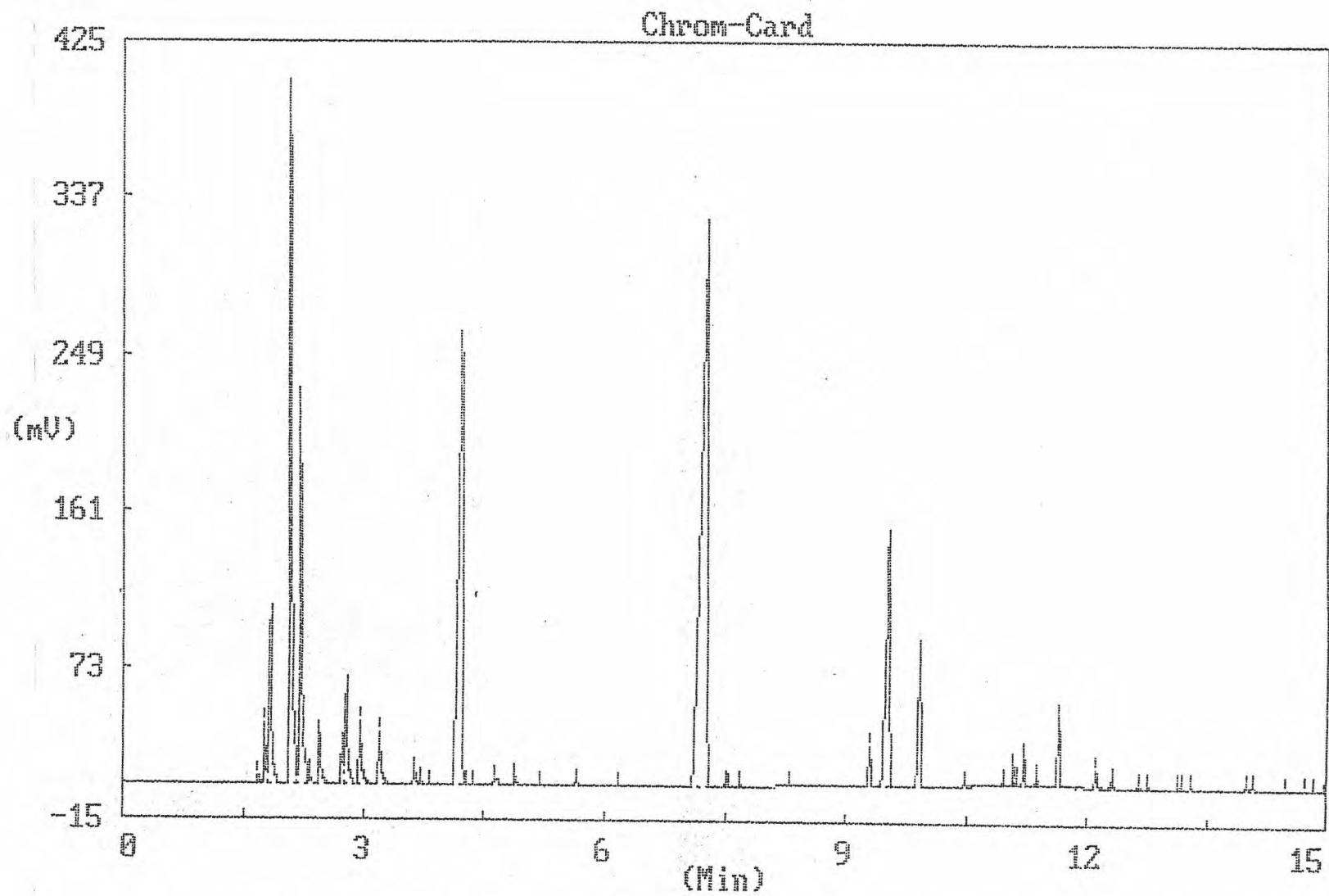


Figure A13 GC Chromatogram of product from using 0.6%Pt/Al₂O₃ catalyst, under 80 psi H₂, 450°C.

APPENDIX B

Table B1 %Compositions of products obtained from using 0.3%Pt-0.5%F/Al₂O₃ (fresh#1) catalyst.

Run No.	NGL	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Temp., °C		370	400	420	450	270	320	370	400	420	450	370	400	420	450
H ₂ pressure, psi		40	40	40	40	60	60	60	60	60	60	80	80	80	80
<u>Composition, %</u>															
Total C ₁ -C ₄	1.44	2.12	6.10	7.46	10.69	1.45	1.56	2.56	3.59	4.59	5.99	1.50	6.02	8.42	9.38
n-Pentane (C ₅)	18.51	15.70	15.03	14.34	10.52	13.69	13.49	16.16	16.20	14.74	10.24	18.42	16.09	16.33	12.67
i-Pentane (C ₅)	21.46	23.82	24.82	23.01	18.19	16.10	16.45	22.52	25.96	21.65	14.56	25.44	26.91	24.12	19.89
2-Methyl-2-butene (C ₅)	0	0	0	0.02	0.08	0	0	0.01	0.07	0.14	0.35	0	0	0	0.02
Total n-Paraffins (C ₆₊)	10.32	5.78	4.56	3.39	1.47	10.80	10.42	6.82	4.26	3.73	1.19	7.31	4.50	3.47	1.98
Total n-Olefins (C ₆₊)	1.01	0.09	0.07	0.05	0	1.01	0.98	0.19	0.04	0.03	0.02	0.16	0	0	0
Total i-Paraffins (C ₆₊)	21.62	19.34	16.30	12.48	7.40	23.28	23.86	22.35	14.75	12.70	5.29	24.19	15.99	13.04	7.66
Total Cycloparaffins (C ₆₊)	15.25	2.54	1.03	0.47	0.18	17.17	16.56	5.19	0.65	0.53	0.17	2.52	1.06	0.49	0.17
Total Aromatics (C ₆₊)	10.39	30.61	32.09	38.78	51.47	16.50	16.68	24.20	34.48	41.89	62.19	20.46	29.43	34.13	48.23

Table B2 %Compositions of products obtained from using 0.3%Pt-0.5%F/Al₂O₃ (fresh#2) catalyst and 0.3%Pt-0.5%F/Al₂O₃ (regenerated#1 & regenerated#2) catalysts.

Run No.	15	16	17	18	19	20	21	22	23	24	25	26
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	60	60	60	60	60	60	60	60	60	60	60	60
	(fresh#2)	(fresh#2)	(fresh#2)	(fresh#2)	(reg.#1)	(reg.#1)	(reg.#1)	(reg.#1)	(reg.#2)	(reg.#2)	(reg.#2)	(reg.#2)
<u>Composition, %</u>												
Total C ₁ -C ₄	1.66	7.09	8.31	5.14	2.19	5.52	8.29	10.24	1.54	1.73	2.81	3.58
n-Pentane (C ₅)	15.84	15.67	15.17	10.02	15.42	14.26	14.65	12.72	20.14	20.00	16.97	16.86
i-Pentane (C ₅)	23.51	26.63	24.52	15.19	22.12	22.66	23.35	19.07	21.25	23.36	21.94	22.18
2-Methyl-2-butene (C ₅)	0	0	0	0.39	0.04	0.17	0.31	0.48	0.10	0.10	0.14	0.26
Total n-Paraffins (C ₆₊)	6.78	3.91	3.14	1.20	7.66	5.37	4.09	2.47	10.58	8.83	7.29	6.25
Total n-Olefins (C ₆₊)	0.13	0	0	0	0.24	0.11	0.06	0.03	0.69	0.53	0.33	0.21
Total i-Paraffins (C ₆₊)	23.04	14.26	11.34	5.73	23.75	18.98	14.80	9.01	23.70	21.59	20.71	18.93
Total Cycloparaffins (C ₆₊)	2.55	0.95	0.55	0.13	3.16	0.83	0.44	0.18	5.23	5.36	2.69	1.86
Total Aromatics (C ₆₊)	26.49	31.49	36.97	62.20	25.42	32.10	34.01	45.80	16.77	18.50	27.12	29.87

Table B3 %Compositions of products obtained from using 0.6%Pt-0.5%F/Al₂O₃ catalyst.

Run No.	27	28	29	30	31	32	33	34	35	36	37	38
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Composition, %</u>												
Total C ₁ -C ₄	4.06	8.58	7.63	11.54	3.02	6.04	9.45	10.74	0.92	5.67	7.24	7.51
n-Pentane (C ₅)	15.21	15.17	14.35	11.37	16.46	15.46	15.07	10.64	17.38	14.35	14.79	12.37
i-Pentane (C ₅)	25.43	25.58	22.67	18.21	24.88	25.52	24.69	17.03	21.60	24.03	24.22	19.05
2-Methyl-2-butene (C ₅)	0	0	0	0	0	0	0	0	0	0	0	0
Total n-Paraffins (C ₆₊)	5.06	3.00	2.40	1.20	6.22	4.00	2.48	0.83	7.79	4.66	3.50	1.96
Total n-Olefins (C ₆₊)	0.11	0	0	0	0.17	0	0	0	0.23	0	0	0
Total i-Paraffins (C ₆₊)	18.33	11.26	9.20	5.17	21.61	14.79	9.56	4.08	25.26	16.65	12.88	7.84
Total Cycloparaffins (C ₆₊)	6.93	2.36	0.72	0.27	6.31	2.48	1.00	0.20	7.04	2.95	1.55	0.22
Total Aromatics (C ₆₊)	24.87	34.05	43.03	52.24	21.33	31.71	37.75	56.48	19.78	31.69	35.82	51.05

Table B4 %Compositions of products obtained from using 0.9%Pt-0.5%F/Al₂O₃ catalyst.

Run No.	39	40	41	42	43	44	45	46	47	48	49	50
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Composition, %</u>												
Total C ₁ -C ₄	1.32	1.90	2.14	8.03	1.18	0.97	2.19	5.06	1.58	1.06	1.31	0.31
n-Pentane (C ₅)	18.45	18.73	18.88	22.02	17.84	18.73	19.36	20.39	20.57	17.81	17.65	14.70
i-Pentane (C ₅)	21.06	21.40	20.50	23.03	20.07	20.84	21.45	20.72	24.25	20.08	19.06	12.80
2-Methyl-2-butene (C ₅)	0	0.17	0.28	0.41	0.02	0.15	0.25	0.44	0.06	0.10	0.19	0.33
Total n-Paraffins (C ₆₊)	10.01	10.10	10.71	9.70	10.42	10.38	10.38	10.77	10.00	10.66	11.12	13.63
Total n-Olefins (C ₆₊)	0.82	0.84	0.67	0	1.01	0.85	0.71	0.33	0.84	1.01	0.85	0.69
Total i-Paraffins (C ₆₊)	22.07	21.34	21.43	15.68	22.93	22.05	21.21	19.26	23.39	22.40	22.40	24.06
Total Cycloparaffins (C ₆₊)	14.64	14.00	13.34	6.38	15.50	14.31	13.17	8.63	12.42	15.52	15.26	15.51
Total Aromatics (C ₆₊)	11.63	11.52	12.05	14.75	11.03	11.73	11.28	14.40	6.89	11.37	12.16	17.97

Table B5 %Compositions of products obtained from using 0.6%Pt/Al₂O₃ catalyst.

Run No.	51	52	53	54	55	56	57	58	59	60	61	62
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Composition, %</u>												
Total C ₁ -C ₄	3.45	6.70	4.81	10.33	4.99	7.57	7.56	8.09	2.09	5.86	9.30	4.58
n-Pentane (C ₅)	17.05	15.14	12.32	8.61	18.39	15.30	13.61	7.84	20.18	15.60	14.63	8.05
i-Pentane (C ₅)	23.50	24.22	20.47	16.84	24.78	24.65	23.44	16.74	23.96	23.50	22.59	13.95
2-Methyl-2-butene (C ₅)	0	0	0.06	0.26	0	0	0.02	0.41	0	0	0	0.14
Total n-Paraffins (C ₆₊)	5.79	3.62	2.37	1.21	6.53	3.61	2.30	0.82	7.26	4.79	3.08	1.57
Total n-Olefins (C ₆₊)	0.18	0.07	0.05	0	0.21	0.06	0.04	0	0.27	0.11	0.06	0.04
Total i-Paraffins (C ₆₊)	18.97	13.52	10.30	6.50	21.37	13.82	10.41	5.27	22.39	16.50	12.45	7.09
Total Cycloparaffins (C ₆₊)	8.00	1.57	0.91	0.24	7.42	2.07	1.14	0.35	8.04	2.79	1.22	0.54
Total Aromatics (C ₆₊)	23.06	35.16	48.71	56.01	16.31	32.92	41.48	60.48	15.81	30.85	36.67	64.04

Table B6 %Compositions of products obtained from using 0.6%Pt-1.0%F/Al₂O₃ catalyst.

Run No.	63	64	65	66	67	68	69	70	71	72	73	74
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Composition, %</u>												
Total C ₁ -C ₄	2.79	7.48	8.21	9.58	3.25	5.58	6.30	8.60	2.64	2.79	7.57	8.48
n-Pentane (C ₅)	14.08	14.43	13.87	8.58	16.07	14.06	14.37	8.58	20.29	12.53	14.96	11.72
i-Pentane (C ₅)	23.08	20.58	19.95	14.29	25.63	23.55	20.07	14.17	28.92	20.43	18.50	16.75
2-Methyl-2-butene (C ₅)	0	0	0	0.07	0	0	0	0.05	0	0	0	0.02
Total n-Paraffins (C ₆₊)	4.85	2.54	1.43	0.93	5.76	3.13	1.82	0.87	5.87	3.98	2.55	1.17
Total n-Olefins (C ₆₊)	0.07	0.02	0	0.01	0.09	0	0.01	0	0.04	0.03	0.02	0
Total i-Paraffins (C ₆₊)	18.23	9.65	5.89	3.96	22.12	11.72	7.22	3.70	23.83	14.23	9.59	4.91
Total Cycloparaffins (C ₆₊)	8.98	4.17	1.73	1.17	8.23	5.24	2.39	1.01	8.04	7.38	3.14	1.07
Total Aromatics (C ₆₊)	27.92	41.13	48.92	61.41	18.85	36.72	47.82	63.02	10.37	38.63	43.67	55.88

APPENDIX C

Table C1 %Total conversions in significant reactions obtained from using 0.3%Pt-0.5%F/Al₂O₃ (fresh#1) catalyst.

Run No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Temp., °C	370	400	420	450	270	320	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	60	60	80	80	80	80
<u>Skeletal Isomerization</u>														
Total conversion of n-pentane (C ₅) in skeletal isomerization, %	14.21	18.55	17.15	21.10	0.76	2.70	9.80	17.15	12.87	12.07	9.31	19.20	12.83	16.02
Total conversion of n-paraffins & n-olefins (C ₆₊) in skeletal isomerization, %	32.31	35.68	37.16	51.82	2.12	5.99	30.56	34.40	33.59	45.86	31.40	36.14	38.88	40.27
<u>Aromatization</u>														
Total conversion of total paraffins & olefins (C ₆₊) in aromatization, %	22.95	26.33	46.09	74.57	10.54	10.71	11.33	33.77	50.48	84.96	0	19.14	35.23	70.25
<u>Dehydrogenation of cycloparaffins</u>														
Total conversion of total cycloparaffins (C ₆₊) in dehydrogenation, %	83.34	93.25	96.92	98.82	14.27	16.24	89.26	95.87	96.52	98.89	79.98	93.05	96.79	98.89
<u>Hydrocracking</u>														
Total conversion of total paraffins & olefins (C ₅₊) in hydrocracking, %	1.25	7.32	10.54	20.57	0.25	0.41	1.72	3.68	6.15	14.25	0.01	6.85	11.16	16.56

Table C2 %Total conversions in significant reactions obtained from using 0.3%Pt-0.5%F/Al₂O₃ (fresh#2) catalyst and 0.3%Pt-0.5%F/Al₂O₃ (regenerated#1 & regenerated#2) catalysts.

Run No.	15	16	17	18	19	20	21	22	23	24	25	26
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	60	60	60	60	60	60	60	60	60	60	60	60
	(fresh#2)	(fresh#2)	(fresh#2)	(fresh#2)	(reg.#1)	(reg.#1)	(reg.#1)	(reg.#1)	(reg.#2)	(reg.#2)	(reg.#2)	(reg.#2)
<u>Skeletal Isomerization</u>												
Total conversion of n-pentane (C ₅) in skeletal isomerization, %	13.09	20.02	17.47	15.48	11.40	16.97	17.43	14.88	0	0.63	6.15	7.36
Total conversion of n-paraffins & n-olefins (C ₆₊) in skeletal isomerization, %	32.92	37.42	36.93	49.64	27.42	34.86	36.32	36.84	6.28	12.07	21.78	26.03
<u>Aromatization</u>												
Total conversion of total paraffins & olefins (C ₆₊) in aromatization, %	10.19	27.23	45.07	84.17	8.50	22.96	31.74	63.86	0	1.75	12.83	19.35
<u>Dehydrogenation of cycloparaffins</u>												
Total conversion of total cycloparaffins (C ₆₊) in dehydrogenation, %	83.28	93.77	96.39	99.15	79.28	94.56	97.11	98.82	53.55	58.51	82.36	87.80
<u>Hydrocracking</u>												
Total conversion of total paraffins & olefins (C ₅₊) in hydrocracking, %	0.41	8.72	11.58	11.93	1.15	6.41	10.92	17.36	0.03	0.34	2.10	3.37

Table C3 %Total conversions in significant reactions obtained from using 0.6%Pt-0.5%F/Al₂O₃ catalyst.

Run No.	27	28	29	30	31	32	33	34	35	36	37	38
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Skeletal Isomerization</u>												
Total conversion of n-pentane (C ₅) in skeletal isomerization, %	19.18	19.61	16.30	16.99	14.01	18.53	18.16	16.97	3.71	19.26	18.14	14.99
Total conversion of n-paraffins & n-olefins (C ₆₊) in skeletal isomerization, %	36.03	38.82	39.84	45.22	33.64	38.09	40.10	50.86	29.92	36.41	37.86	41.84
<u>Aromatization</u>												
Total conversion of total paraffins & olefins (C ₆₊) in aromatization, %	20.77	43.03	60.96	80.84	6.67	31.27	52.13	86.34	3.42	29.69	41.73	72.34
<u>Dehydrogenation of cycloparaffins</u>												
Total conversion of total cycloparaffins (C ₆₊) in dehydrogenation, %	54.56	84.52	95.28	98.23	58.62	83.74	93.44	98.69	53.84	80.66	89.84	98.56
<u>Hydrocracking</u>												
Total conversion of total paraffins & olefins (C ₅₊) in hydrocracking, %	4.09	11.78	11.85	22.80	2.27	7.38	13.76	23.30	0	6.87	9.81	13.74

Table C4 %Total conversions in significant reactions obtained from using 0.9%Pt-0.5%F/Al₂O₃ catalyst.

Run No.	39	40	41	42	43	44	45	46	47	48	49	50
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Skeletal Isomerization</u>												
Total conversion of n-pentane (C ₅) in skeletal isomerization, %	0	0	0	0	0	0	0	0	1.04	0	0	0
Total conversion of n-paraffins & n-olefins (C ₆₊) in skeletal isomerization, %	4.27	1.45	0	0	3.26	1.89	0.17	0	7.91	0.41	0	0
<u>Aromatization</u>												
Total conversion of total paraffins & olefins (C ₆₊) in aromatization, %	1.88	0	0	0	0	1.19	0	0	0	2.80	4.90	16.49
<u>Dehydrogenation of cycloparaffins</u>												
Total conversion of total cycloparaffins (C ₆₊) in dehydrogenation, %	4.00	7.47	11.07	40.60	0	6.16	6.33	31.72	0	0	0	0
<u>Hydrocracking</u>												
Total conversion of total paraffins & olefins (C ₅₊) in hydrocracking, %	0	0.62	0.95	8.72	0	0	0.98	4.72	0.02	0	0	0

Table C5 %Total conversions in significant reactions obtained from using 0.6%Pt/Al₂O₃ catalyst.

Run No.	51	52	53	54	55	56	57	58	59	60	61	62
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Skeletal Isomerization</u>												
Total conversion of n-pentane (C ₅) in skeletal isomerization, %	9.20	16.93	19.00	27.68	8.01	17.30	20.71	32.26	1.27	13.84	15.12	21.49
Total conversion of n-paraffins & n-olefins (C ₆₊) in skeletal isomerization, %	30.39	37.66	44.66	54.38	30.27	38.99	46.64	60.86	26.81	33.41	41.44	46.18
<u>Aromatization</u>												
Total conversion of total paraffins & olefins (C ₆₊) in aromatization, %	17.85	39.19	65.34	79.88	0	34.84	57.11	85.25	0	27.21	44.00	81.74
<u>Dehydrogenation of cycloparaffins</u>												
Total conversion of total cycloparaffins (C ₆₊) in dehydrogenation, %	47.54	89.70	94.03	98.43	44.38	86.43	92.52	97.70	40.27	81.70	92.00	96.46
<u>Hydrocracking</u>												
Total conversion of total paraffins & olefins (C ₅₊) in hydrocracking, %	3.12	8.82	7.76	22.10	4.69	9.89	11.46	19.08	0.82	7.03	13.29	11.21

Table C6 %Total conversions in significant reactions obtained from using 0.6%Pt-1.0%F/Al₂O₃ catalyst.

Run No.	63	64	65	66	67	68	69	70	71	72	73	74
Temp., °C	370	400	420	450	370	400	420	450	370	400	420	450
H ₂ pressure, psi	40	40	40	40	60	60	60	60	80	80	80	80
<u>Skeletal Isomerization</u>												
Total conversion of n-pentane (C ₅) in skeletal isomerization, %	18.18	10.99	11.44	19.24	16.78	19.28	9.91	18.74	10.97	17.90	3.45	11.16
Total conversion of n-paraffins & n-olefins (C ₆₊) in skeletal isomerization, %	38.21	39.02	43.18	44.23	39.20	38.70	41.20	44.64	42.22	36.09	38.56	44.05
<u>Aromatization</u>												
Total conversion of total paraffins & olefins (C ₆₊) in aromatization, %	32.72	61.69	77.36	88.29	4.90	52.36	73.08	89.36	0	52.76	63.52	83.74
<u>Dehydrogenation of cycloparaffins</u>												
Total conversion of total cycloparaffins (C ₆₊) in dehydrogenation, %	41.11	72.66	88.66	92.33	46.03	65.64	84.33	93.38	14.41	51.61	79.41	92.98
<u>Hydrocracking</u>												
Total conversion of total paraffins & olefins (C ₅₊) in hydrocracking, %	2.53	11.96	14.99	24.13	2.57	7.82	10.92	22.40	1.33	3.29	12.53	18.11

Calculation Methods of Percentage of Conversions in Significant Reactions

1. Skeletal Isomerization

1.1 %Total Conversion of *n*-Pentane (C₅)

The percentage of conversion of *n*-pentane in skeletal isomerization reaction could be calculated by equation C-1 below:

$$\begin{array}{l} \text{\%total conversion of } n\text{-pentane} \\ \text{in skeletal isomerization} \end{array} = \frac{A-B}{A} \times 100 \% \quad (\text{C-1})$$

which, $A = \%$ fraction of *n*-pentane in NGL

$B = \%$ fraction of *n*-pentane in product

The percentage of fraction of *n*-pentane in skeletal isomerization (A or B) could be calculated from the percentage of compositions in Appendix B by equation C-2 below:

$$\begin{array}{l} \text{\%fraction of } n\text{-pentane in} \\ \text{skeletal isomerization (A or B)} \end{array} = \frac{a}{a+b+c} \times 100 \% \quad (\text{C-2})$$

which, $a = \%$ composition of *n*-pentane (C₅)

$b = \%$ composition of *i*-pentane (C₅)

$c = \%$ composition of 2-methyl-2-butene (C₅)

$a+b+c = \%$ total compositions of total C₅ hydrocarbons

1.2 %Total Conversion of *n*-Paraffins & *n*-Olefins (C_{6+})

The percentage of conversion of *n*-paraffins & *n*-olefins (C_{6+}) in skeletal isomerization reaction could be calculated by equation C-3 below:

$$\begin{array}{l} \text{\%total conversion of } n\text{-paraffins \& } n\text{-olefins } (C_{6+}) \\ \text{in skeletal isomerization} \end{array} = \frac{C-D}{C} \times 100 \% \quad (C-3)$$

which, $C = \%$ fraction of *n*-paraffins + *n*-olefins (C_{6+}) in NGL

$D = \%$ fraction of *n*-paraffins + *n*-olefins (C_{6+}) in product

The percentage of fraction of *n*-paraffins + *n*-olefins (C_{6+}) in skeletal isomerization (C or D) could be calculated from the percentage of compositions in Appendix B by equation C-4 below:

$$\begin{array}{l} \text{\%fraction of } n\text{-paraffins \& } n\text{-olefins } (C_{6+}) \\ \text{in skeletal isomerization (C or D)} \end{array} = \frac{d+e}{d+e+f} \times 100 \% \quad (C-4)$$

which, $d = \%$ composition of *n*-paraffins (C_{6+})

$e = \%$ composition of *n*-olefins (C_{6+})

$f = \%$ composition of *i*-paraffins (C_{6+})

$d+e = \%$ total compositions of *n*-paraffins (C_{6+})+*n*-olefins (C_{6+})

$d+e+f = \%$ total compositions of total C_{6+} paraffins & olefins

2. Aromatization

The percentage of conversion of total paraffins & olefins (C_{6+}) in aromatization reaction could be calculated by equation C-5 below:

$$\begin{aligned} \text{\%total conversion of total paraffins \& olefins (C}_{6+}\text{)} \\ \text{in aromatization} \end{aligned} = \frac{E-F}{E} \times 100 \% \quad (\text{C-5})$$

which, $E = \text{\%fraction of total paraffins (C}_{6+}\text{) + total olefins (C}_{6+}\text{) in NGL}$

$F = \text{\%fraction of total paraffins (C}_{6+}\text{) + total olefins (C}_{6+}\text{) in product}$

The percentage of fraction of total paraffins (C_{6+}) + total olefins (C_{6+}) in aromatization (E or F) could be calculated from the data in Appendix B by equation C-6 below:

$$\begin{aligned} \text{\%fraction of total paraffins (C}_{6+}\text{)+total olefins (C}_{6+}\text{)} \\ \text{in aromatization (E or F)} \end{aligned} = \frac{d+e+f}{(d+e+f)+(\text{\%aromatics II})} \times 100 \% \quad (\text{C-6})$$

Note: The percentage of compositions of total aromatics (C_{6+}) in product could be separately considered in three type following equation C-7 below:

$$\begin{aligned} \text{\%compositions of total aromatics (C}_{6+}\text{)} \\ \text{in product} \end{aligned} = (\text{\%aromatics I}) + (\text{\%aromatics II}) + (\text{\%aromatics III}) \quad (\text{C-7})$$

which,

$\text{\%aromatics I} = \text{\%compositions of aromatics (C}_{6+}\text{) existing in NGL}$

$\text{\%aromatics II} = \text{\%compositions of aromatics (C}_{6+}\text{) from aromatization}$

$\text{\%aromatics III} = \text{\%compositions of aromatics (C}_{6+}\text{) from dehydrogenation of cycloparaffins(C}_{6+}\text{)}$

$$= \{\text{\%compositions of cycloparaffins (C}_{6+}\text{) in NGL}\} - \{\text{\%compositions of cycloparaffins (C}_{6+}\text{) in product}\}$$

3. Dehydrogenation of Cycloparaffins

The percentage of conversion of total cycloparaffins (C_{6+}) in dehydrogenation reaction could be calculated by equation C-8 below:

$$\begin{aligned} \text{\%total conversion of total cycloparaffins (C}_{6+}\text{)} \\ \text{in dehydrogenation} \end{aligned} = \frac{G-H}{G} \times 100 \% \quad (\text{C-8})$$

which, G = %fraction of total cycloparaffins (C_{6+}) in NGL

H = %fraction of total cycloparaffins (C_{6+}) in product

The percentage of fraction of total cycloparaffins (C_{6+}) in dehydrogenation (G or H) could be calculated from the data in Appendix B by equation C-9 below:

$$\begin{aligned} \text{\%fraction of total cycloparaffins (C}_{6+}\text{)} \\ \text{in dehydrogenation (G or H)} \end{aligned} = \frac{g}{g+(\%aromatics \text{ III})} \times 100 \% \quad (\text{C-9})$$

which, g = %composition of total cycloparaffins (C_{6+})

4. Hydrocracking

The percentage of conversion of total paraffins & olefins (C_{5+}) in hydrocracking reaction could be calculated by equation C-10 below:

$$\begin{aligned} \text{\%total conversion of total paraffins \& olefins (C}_{5+}\text{)} \\ \text{in hydrocracking} \end{aligned} = \frac{I-J}{I} \times 100 \% \quad (\text{C-10})$$

which, I = %fraction of total paraffins (C_{5+}) + total olefins (C_{5+}) in NGL

J = %fraction of total paraffins (C_{5+}) + total olefins (C_{5+}) in product

The percentage of fraction of total paraffins (C₅₊) + total olefins (C₅₊) in hydrocracking (I or J) could be calculated from the data in Appendix B by equation C-11 below:

$$\% \text{fraction of total paraffins (C}_{5+}\text{) + total olefins (C}_{5+}\text{)} = \frac{(a+b+c)+(d+e+f)}{(a+b+c)+(d+e+f)+(h)} \times 100 \% \quad (\text{C-11})$$

in hydrocracking (I or J)

which, h = %composition of total C₁-C₄ hydrocarbons

VITA

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