

APPENDIX B

Fixed Bed Reaction Data

Co.005 - Run #8

Co wt%	NM wt %	Promotor wt%		Support
20				Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm

T = 220 °C

H₂/CO = 2

weight of catalyst = 0.199 g

WHSV = 12.91 1/hr

time on stream = 15.5 hrs

CO₂ (g/g cat/hr) = 0.019CO₂ (% of CO) = 0.1

O/P = 3.01

CO conversion (%)	2.7
rate (g CH ₂ /g cat/hr)	0.15
alpha	0.71
C1 (wt%)	22.6
C2 - C4 (wt%)	24.9
C5 - C12 (wt%)	45.5
C13 + (wt%)	7.0

Performance of Co.005

Dates: 02/27/95 - 02/28/95 Run #8

flow rate = 90.0 cc/min, loading = 0.2 g, WHSV = 12.9 l/hr, H₂/CO ratio in feed = 2

time on stream, hr	0.5	3.5	6.5	9.5	12.5	15.5
reaction temperature, °C	220	220	220	220	220	220
pressure, atm	1.0	1.0	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	90.0	90.0	90.0

C1 - C15 product distribution, weight %

C1	21.93	24.06	22.91	22.79	23.48	23.48
C2	4.64	5.25	4.69	4.65	4.78	4.76
C3	10.96	11.56	10.50	10.17	10.41	10.33
C4	11.81	12.03	11.17	10.77	10.93	10.80
C5	11.69	12.40	11.52	11.14	11.38	11.19
C6	10.00	4.51	9.12	8.95	8.90	9.24
C7	7.86	8.27	7.76	7.98	7.79	7.67
C8	5.97	6.25	5.87	6.02	5.85	5.72
C9	4.79	4.78	4.71	4.61	4.49	4.42
C10	3.57	3.67	3.53	3.64	3.61	3.61
C11	2.66	2.72	2.67	3.05	2.66	2.86
C12	1.93	2.01	2.09	2.07	1.99	2.00
C13	1.22	1.32	1.72	1.58	1.54	1.57
C14	0.65	0.76	1.24	1.37	1.16	1.29
C15	0.32	0.39	0.49	1.22	1.04	1.05
alpha chain growth probability	0.63	0.64	0.66	0.71	0.70	0.71

C1 - C50 estimated total product distribution, weight %

C1	22.4	24.5	23.3	21.6	22.5	22.6
C2 - C4	28.0	29.3	26.8	24.2	25.0	24.9
C5 - C12	47.4	43.5	46.6	45.9	45.5	45.5
C13 - C50	2.2	2.7	3.3	8.2	7.0	7.0

CO conversion, %	2.7	2.6	2.7	2.9	2.7	2.7
rate, g CH ₂ /g cat/hr	0.15	0.15	0.15	0.16	0.16	0.15
CO ₂ formation, %	0.1	0.1	0.1	0.1	0.1	0.1

Performance of Co.005

Dates: 02/27/95 - 02/28/95 Run #8

flow rate = 90.0 cc/min, loading = 0.2 g, WHSV = 12.9 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	18.5
reaction temperature, °C	220
pressure, atm	1.0
flow, cc/min	90.0

C1 - C15 product distribution, weight %

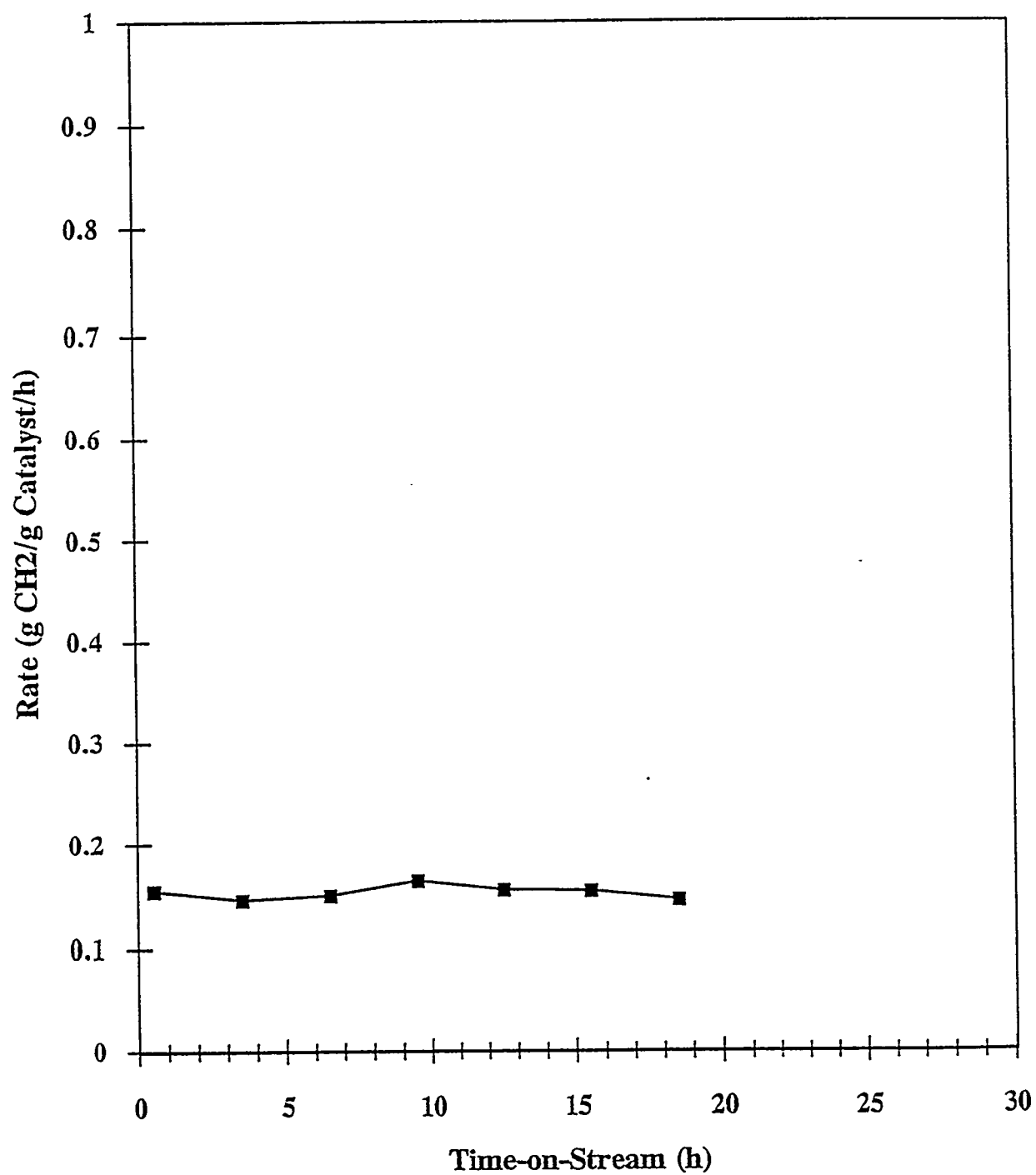
C1	23.84
C2	4.85
C3	10.47
C4	10.91
C5	11.38
C6	9.09
C7	7.73
C8	5.79
C9	4.49
C10	3.49
C11	2.57
C12	1.91
C13	1.43
C14	1.14
C15	0.90
alpha chain growth probability	0.69

C1 - C50 estimated total product distribution, weight %

C1	23.1
C2 - C4	25.4
C5 - C12	45.5
C13 - C50	6.0

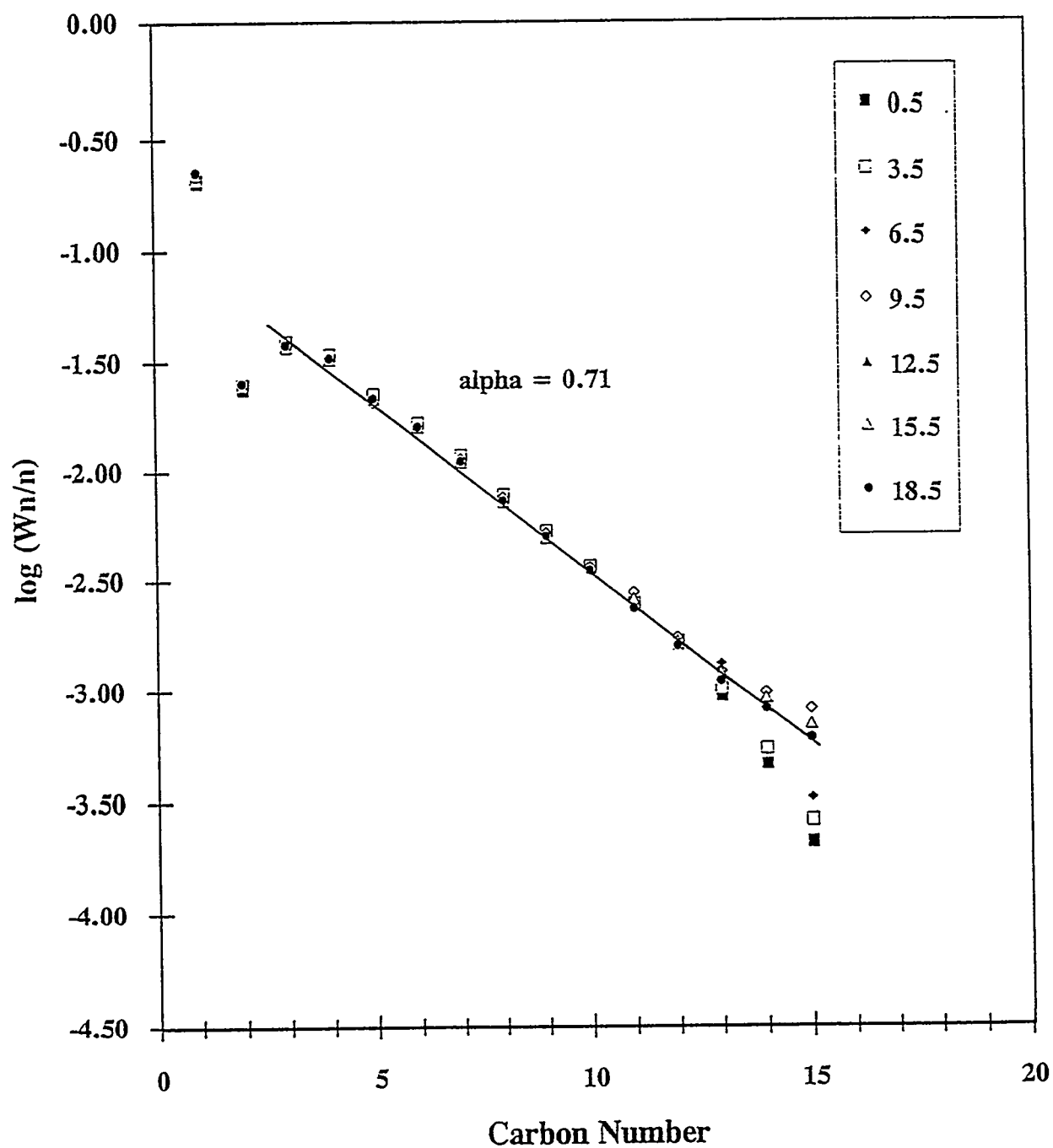
CO conversion, %	2.6
rate, g CH ₂ /g cat/hr	0.14
CO ₂ formation, %	0.1

Time-on-Stream Plot for Co.005 - Run #8



Schulz-Flory Plot for Co.005 - Run #8
Time on Stream (hrs)

hrs.



Co.005 - Run #8a

Co wt%	NM wt %	Promotor wt%		Support
20				Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm

T = 220 °C

H₂/CO = 2

weight of catalyst = 0.199 g

WHSV = 12.92 1/hr

time on stream = 21.5 hrs

CO₂ (g/g cat/hr) = 0.016CO₂ (% of CO) = 0.1

O/P = 3.65

CO conversion (%)	2.5
rate (g CH ₂ /g cat/hr)	0.14
alpha	0.72
C1 (wt%)	23.4
C2 - C4 (wt%)	25.7
C5 - C12 (wt%)	41.6
C13 + (wt%)	9.3

* 30 cc/min Ar added to the reaction mixture

Co.005 - Run #8b

Co wt%	NM wt %	Promotor wt%		Support
20				Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm

T = 240 °C

H₂/CO = 2

weight of catalyst = 0.199 g

WHSV = 12.92 1/hr

time on stream = 42.5 hrs

CO₂ (g/g cat/hr) = 0.032CO₂ (% of CO) = 0.2

O/P = 2.42

CO conversion (%)	4.2
rate (g CH ₂ /g cat/hr)	0.24
alpha	0.60
C1 (wt%)	40.0
C2 - C4 (wt%)	33.0
C5 - C12 (wt%)	25.6
C13 + (wt%)	1.4

Performance of Co.005

Dates: 02/28/95 - 03/01/95 Run #8b

flow rate = 120.0 cc/min, loading = 0.2 g, WHSV = 12.9 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	21.5	24.5	27.5	30.5	33.5	36.5
reaction temperature, °C	220	240	240	240	240	240
pressure, atm	1.0	1.0	1.0	1.0	1.0	1.0
flow, cc/min	120.0	120.0	120.0	120.0	120.0	120.0

C1 - C15 product distribution, weight %

C1	25.13	42.59	41.08	40.45	40.35	40.29
C2	5.33	7.05	6.87	6.76	6.74	6.74
C3	11.21	15.28	15.15	14.93	14.82	14.86
C4	11.10	11.47	11.49	11.43	11.39	11.45
C5	10.96	7.80	8.90	8.93	8.98	8.94
C6	8.08	6.41	5.66	5.82	5.84	5.97
C7	6.98	3.71	4.22	4.33	4.42	4.41
C8	5.18	2.19	2.54	2.65	2.72	2.63
C9	3.77	1.25	1.45	1.53	1.55	1.63
C10	2.97	0.74	0.86	1.03	1.03	1.11
C11	2.17	0.49	0.59	0.70	0.74	0.72
C12	2.17	0.30	0.41	0.45	0.48	0.43
C13	1.95	0.23	0.25	0.38	0.36	0.34
C14	1.61	0.25	0.25	0.32	0.30	0.28
C15	1.39	0.23	0.26	0.30	0.29	0.20
alpha chain growth probability	0.72	0.61	0.62	0.63	0.62	0.60

C1 - C50 estimated total product distribution, weight %

C1	23.4	41.7	40.2	39.5	39.5	39.8
C2 - C4	25.7	33.1	32.8	32.4	32.3	32.6
C5 - C12	41.6	23.7	25.3	26.1	26.3	26.2
C13 - C50	9.3	1.5	1.7	2.0	1.9	1.4

CO conversion, %	2.5	5.0	4.7	4.6	4.6	4.5
rate, g CH ₂ /g cat/hr	0.14	0.28	0.27	0.26	0.26	0.25
CO ₂ formation, %	0.1	0.2	0.1	0.2	0.2	0.2

Performance of Co.005

Dates: 02/28/95 - 03/01/95 Run #8b

flow rate = 120.0 cc/min, loading = 0.2 g, WHSV = 12.9 l/hr, H₂/CO ratio in feed = 2

time on stream, hr	39.5	42.5
reaction temperature, °C	240	240
pressure, atm	1.0	1.0
flow, cc/min	120.0	120.0

C1 - C15 product distribution, weight %

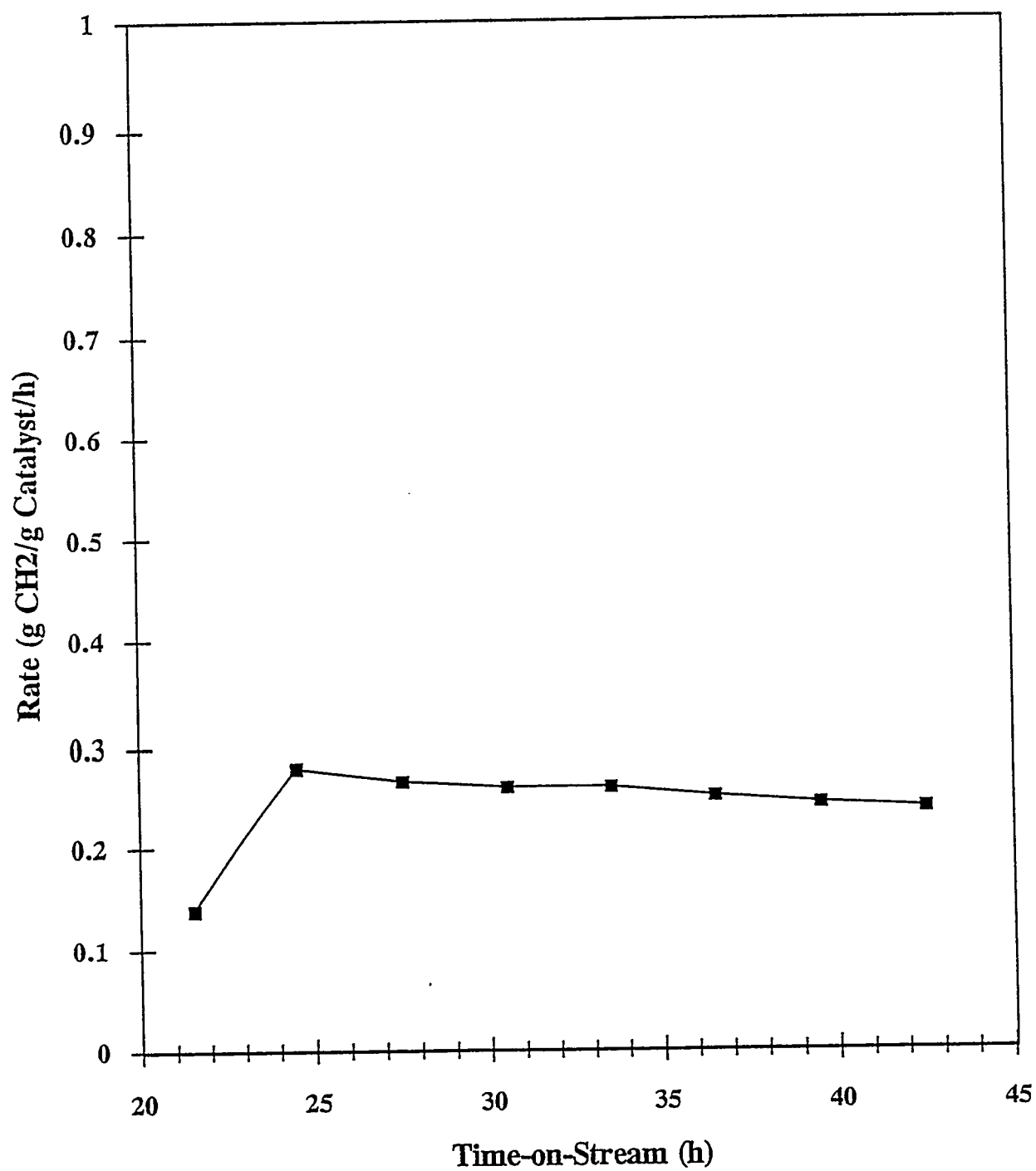
C1	39.73	40.44
C2	6.70	6.80
C3	14.75	14.98
C4	11.50	11.65
C5	9.18	9.18
C6	6.02	4.80
C7	4.52	4.54
C8	2.86	2.75
C9	1.71	1.71
C10	1.05	1.07
C11	0.71	0.73
C12	0.46	0.49
C13	0.35	0.38
C14	0.27	0.28
C15	0.19	0.21
alpha chain growth probability	0.60	0.60

C1 - C50 estimated total product distribution, weight %

C1	39.3	40.0
C2 - C4	32.6	33.0
C5 - C12	26.8	25.6
C13 - C50	1.2	1.4

CO conversion, %	4.3	4.2
rate, g CH ₂ /g cat/hr	0.24	0.24
CO ₂ formation, %	0.2	0.2

Time-on-Stream Plot for Co.005 - Run #8a



Co.005 - Run #8c

Co wt%	NM wt %	Promotor wt%		Support
20				Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
 T = 260 °C
 H₂/CO = 2
 weight of catalyst = 0.199 g
 WHSV = 12.92 1/hr
 time on stream = 69.5 hrs

CO₂ (g/g cat/hr) = 0.049
 CO₂ (% of CO) = 0.3
 O/P = 3.38

CO conversion (%)	3.5
rate (g CH ₂ /g cat/hr)	0.20
alpha	0.59
C1 (wt%)	49.6
C2 - C4 (wt%)	31.6
C5 - C12 (wt%)	18.1
C13 + (wt%)	0.8

Performance of Co.005

Dates: 03/01/95 - 03/02/95 Run #8c

flow rate = 120.0 cc/min, loading = 0.2 g, WHSV = 12.9 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	45.5	48.5	51.5	54.5	57.5	60.5
reaction temperature, °C	240	260	260	260	260	260
pressure, atm	1.0	1.0	1.0	1.0	1.0	1.0
flow, cc/min	120.0	120.0	120.0	120.0	120.0	120.0

C1 - C15 product distribution, weight %

C1	40.46	56.36	54.24	52.67	52.39	51.13
C2	6.80	7.49	7.48	7.44	7.55	7.57
C3	14.98	14.64	15.02	14.86	15.04	14.93
C4	11.65	8.81	9.08	9.19	9.23	9.37
C5	9.19	4.88	5.34	6.15	6.10	6.59
C6	4.80	3.46	3.77	3.52	3.34	3.31
C7	4.54	1.76	2.05	2.43	2.46	2.73
C8	2.75	1.02	1.20	1.43	1.42	1.62
C9	1.71	0.63	0.62	0.82	0.85	0.94
C10	1.07	0.32	0.40	0.50	0.54	0.61
C11	0.73	0.21	0.30	0.29	0.33	0.37
C12	0.49	0.16	0.19	0.25	0.27	0.29
C13	0.38	0.13	0.13	0.19	0.19	0.23
C14	0.28	0.07	0.13	0.13	0.16	0.17
C15	0.17	0.07	0.07	0.11	0.11	0.12
alpha chain growth probability	0.59	0.56	0.56	0.58	0.58	0.59

C1 - C50 estimated total product distribution, weight %

C1	40.1	56.0	53.9	52.2	52.0	50.7
C2 - C4	33.2	30.8	31.4	31.2	31.6	31.6
C5 - C12	25.5	12.8	14.2	15.9	15.7	16.9
C13 - C50	1.2	0.4	0.5	0.8	0.7	0.8

CO conversion, %	4.2	8.0	7.1	6.5	5.3	4.2
rate, g CH ₂ /g cat/hr	0.24	0.45	0.40	0.37	0.30	0.24
CO ₂ formation, %	0.2	0.4	0.3	0.3	0.3	0.3

Performance of Co.005

Dates: 03/01/95 - 03/02/95 Run #8c

flow rate = 120.0 cc/min, loading = 0.2 g, WHSV = 12.9 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	63.5	66.5	69.5
reaction temperature, °C	260	260	260
pressure, atm	1.0	1.0	1.0
flow, cc/min	120.0	120.0	120.0

C1 - C15 product distribution, weight %

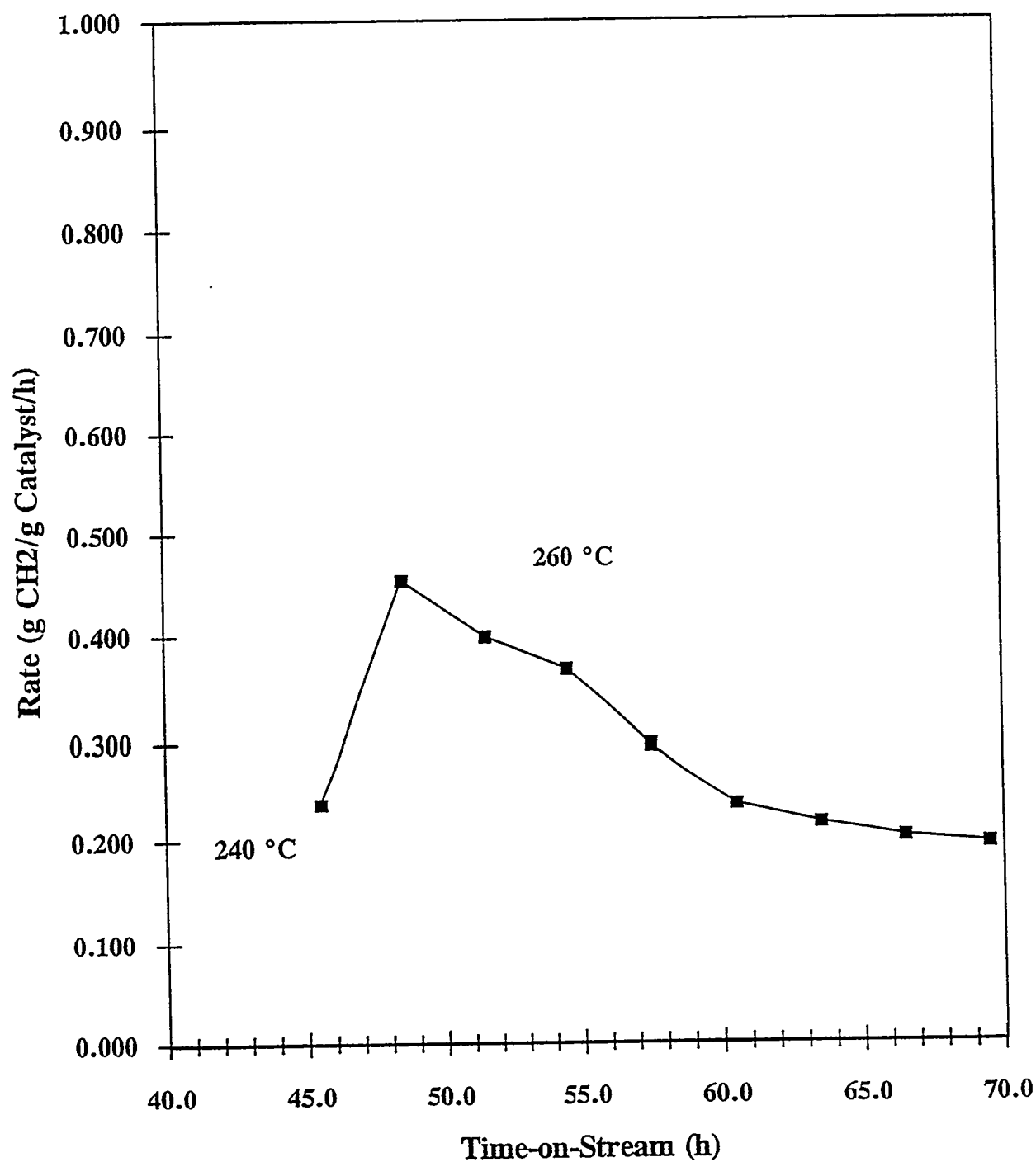
C1	50.97	50.75	49.97
C2	7.68	7.70	7.74
C3	14.88	14.70	14.61
C4	9.46	9.37	9.45
C5	6.43	6.46	6.59
C6	3.73	3.93	4.27
C7	2.68	2.70	2.74
C8	1.59	1.58	1.62
C9	0.94	1.03	1.11
C10	0.58	0.61	0.65
C11	0.37	0.44	0.44
C12	0.29	0.30	0.32
C13	0.17	0.17	0.20
C14	0.14	0.17	0.17
C15	0.10	0.10	0.12
alpha chain growth probability	0.57	0.58	0.59

C1 - C50 estimated total product distribution, weight %

C1	50.6	50.4	49.6
C2 - C4	31.8	31.6	31.6
C5 - C12	16.9	17.3	18.1
C13 - C50	0.7	0.7	0.8

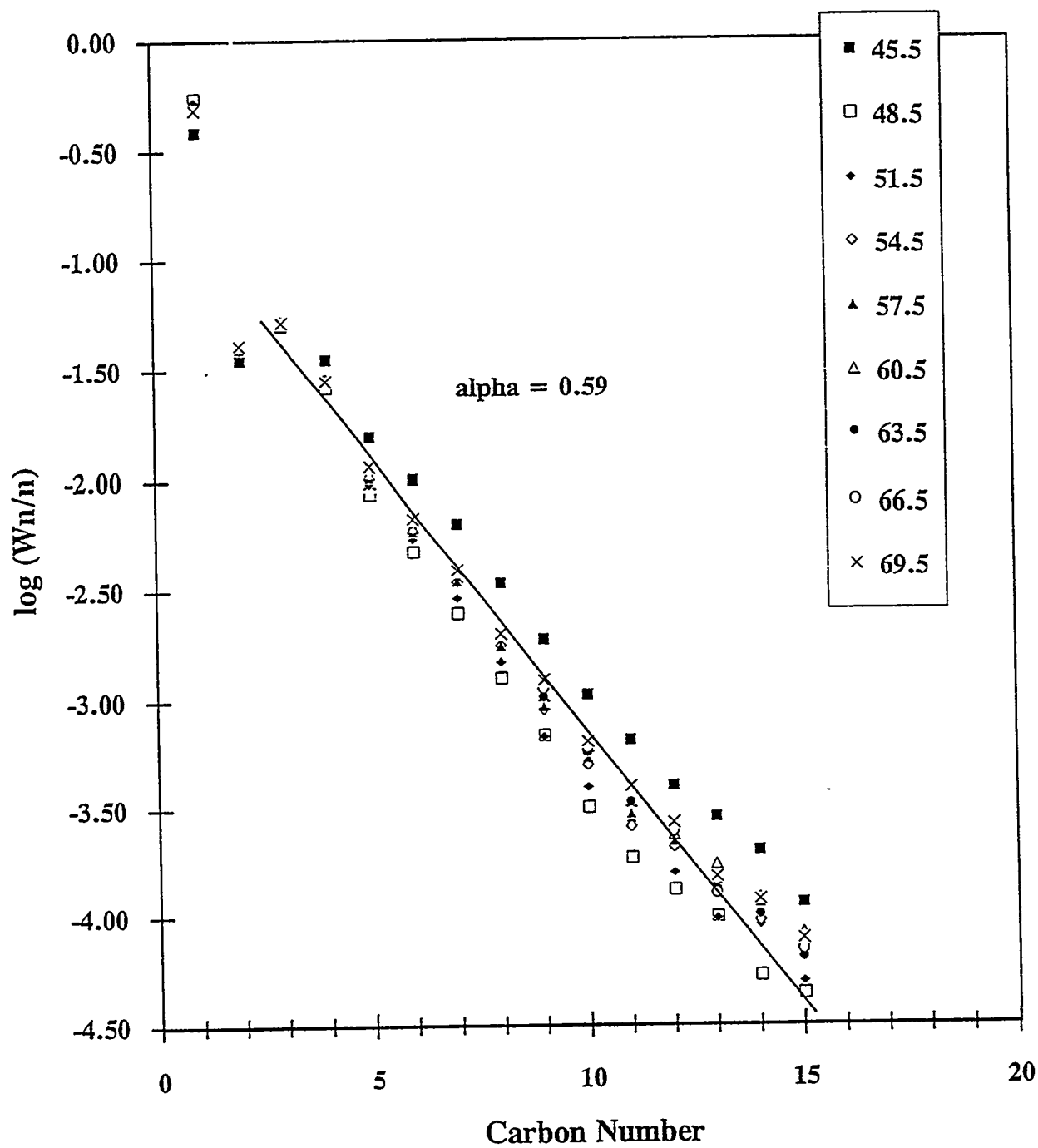
CO conversion, %	3.8	3.6	3.5
rate, g CH ₂ /g cat/hr	0.22	0.20	0.20
CO ₂ formation, %	0.3	0.3	0.3

Time-on-Stream Plot for Co.005 - Run #8c



Schulz-Flory Plot for Co.005 - Run #8c
Time on Stream (hrs)

hrs.



Co.005 - Run #8d

Co wt%	NM wt %	Promotor wt%		Support
20				Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm

T = 280 °C

H₂/CO = 2

weight of catalyst = 0.199 g

WHSV = 12.92 1/hr

time on stream = 93.5 hrs

CO₂ (g/g cat/hr) = 0.029CO₂ (% of CO) = 0.2

O/P = 4.72

CO conversion (%)	1.5
rate (g CH ₂ /g cat/hr)	0.09
alpha	0.64
C1 (wt%)	41.1
C2 - C4 (wt%)	34.5
C5 - C12 (wt%)	22.7
C13 + (wt%)	1.7

Performance of Co.005

Dates: 03/02/95 - 03/03/95 Run #8d

flow rate = 120.0 cc/min, loading = 0.2 g, WHSV = 12.9 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	69.5	72.5	75.5	78.5	81.5	84.5
reaction temperature, °C	260	280	280	280	280	280
pressure, atm	1.0	1.0	1.0	1.0	1.0	1.0
flow, cc/min	120.0	120.0	120.0	120.0	120.0	120.0

C1 - C15 product distribution, weight %

C1	49.62	60.30	54.15	50.60	48.13	45.90
C2	7.68	8.50	9.68	10.52	11.13	11.67
C3	14.51	14.22	14.13	13.82	13.54	13.32
C4	9.39	7.05	7.80	8.18	8.34	8.47
C5	6.87	4.04	5.03	5.81	6.12	6.33
C6	4.24	2.09	3.03	3.50	3.97	4.30
C7	2.86	1.42	2.29	2.47	2.88	3.13
C8	1.68	0.87	1.35	1.63	1.90	2.13
C9	1.16	0.54	0.82	1.09	1.27	1.49
C10	0.68	0.35	0.58	0.73	0.85	1.00
C11	0.46	0.22	0.39	0.52	0.61	0.74
C12	0.36	0.16	0.33	0.42	0.50	0.60
C13	0.21	0.11	0.18	0.25	0.32	0.36
C14	0.17	0.08	0.13	0.26	0.23	0.33
C15	0.12	0.06	0.11	0.18	0.22	0.24
alpha chain growth probability	0.59	0.57	0.60	0.62	0.63	0.63

C1 - C50 estimated total product distribution, weight %

C1	49.3	60.0	53.8	50.0	47.5	45.4
C2 - C4	31.3	29.6	31.4	32.2	32.6	33.1
C5 - C12	18.6	9.9	14.0	16.6	18.5	20.0
C13 - C50	0.8	0.4	0.7	1.2	1.4	1.6

CO conversion, %	3.5	7.1	4.8	3.7	3.0	2.5
rate, g CH ₂ /g cat/hr	0.20	0.40	0.27	0.21	0.17	0.14
CO ₂ formation, %	0.3	0.6	0.4	0.3	0.3	0.2

Performance of Co.005

Dates: 03/02/95 - 03/03/95 Run #8d

flow rate = 120.0 cc/min, loading = 0.2 g, WHSV = 12.9 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	87.5	90.5	93.5
reaction temperature, °C	280	280	280
pressure, atm	1.0	1.0	1.0
flow, cc/min	120.0	120.0	120.0

C1 - C15 product distribution, weight %

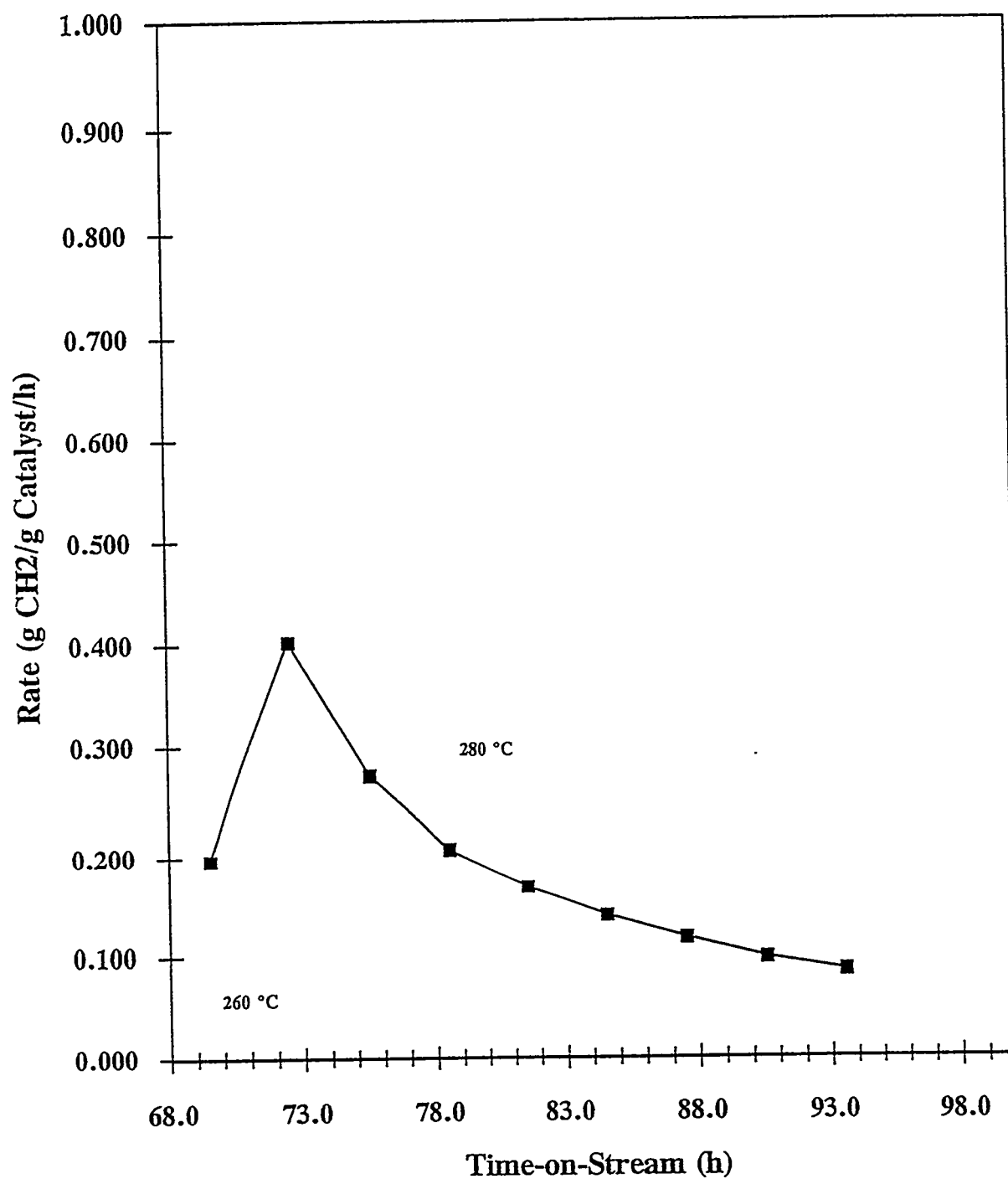
C1	44.29	43.67	41.49
C2	12.10	12.76	13.08
C3	13.22	13.41	13.22
C4	8.54	8.71	8.49
C5	6.37	6.69	6.50
C6	4.60	2.68	4.47
C7	3.34	3.69	3.61
C8	2.32	2.55	3.14
C9	1.63	1.82	1.83
C10	1.19	1.29	1.35
C11	0.82	0.97	1.03
C12	0.58	0.64	0.69
C13	0.43	0.45	0.52
C14	0.33	0.38	0.33
C15	0.25	0.28	0.26
alpha chain growth probability	0.64	0.64	0.64

C1 - C50 estimated total product distribution, weight %

C1	43.8	43.1	41.1
C2 - C4	33.4	34.4	34.5
C5 - C12	21.1	20.5	22.7
C13 - C50	1.7	1.9	1.7

CO conversion, %	2.1	1.7	1.5
rate, g CH ₂ /g cat/hr	0.12	0.10	0.09
CO ₂ formation, %	0.2	0.2	0.2

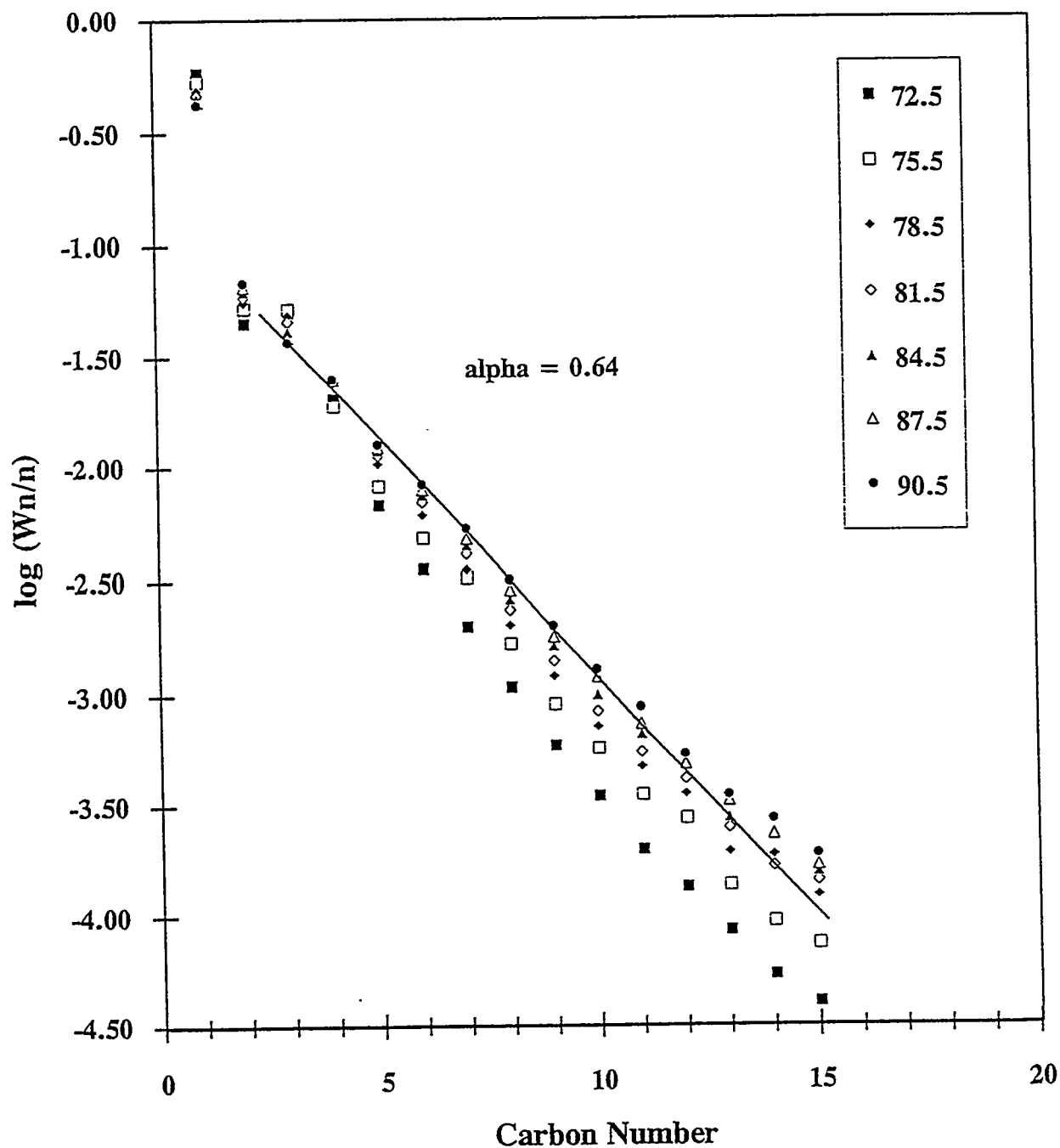
Time-on-Stream Plot for Co.005 - Run #8d



Schulz-Flory Plot for Co.005 - Run #8d

Time on Stream (hrs)

hrs.



Co.005 - Run #9

Co wt%	NM wt %	Promotor wt%		Support
20				Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
 T = 220 °C
 H₂/CO = 2
 weight of catalyst = 0.208 g
 WHSV = 12.36 1/hr
 time on stream = 18.5 hrs

CO₂ (g/g cat/hr) = 0.014
 CO₂ (% of CO) = 0.1
 O/P = 2.90

CO conversion (%)	1.5
rate (g CH ₂ /g cat/hr)	0.08
alpha	0.60
C1 (wt%)	27.7
C2 - C4 (wt%)	31.1
C5 - C12 (wt%)	39.9
C13 + (wt%)	1.3

Performance of Co.005

Dates: 03/05/95 - 03/06/95 Run #9

flow rate = 90.0 cc/min, loading = 0.2 g, WHSV = 12.4 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	0.5	3.5	6.5	9.5	12.5	15.5
reaction temperature, °C	220	220	220	220	220	220
pressure, atm	1.0	1.0	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	90.0	90.0	90.0

C1 - C15 product distribution, weight %

C1	24.82	25.64	26.35	26.76	26.79	27.13
C2	5.57	5.67	5.79	5.84	5.88	5.90
C3	12.24	12.18	12.27	12.26	12.24	12.27
C4	12.34	12.32	12.29	12.28	11.91	12.22
C5	11.85	12.01	11.83	11.85	11.85	11.85
C6	9.43	9.35	9.35	8.96	9.23	8.60
C7	7.19	7.25	7.13	7.18	7.19	7.21
C8	5.09	4.94	4.96	4.94	5.00	4.92
C9	3.57	3.44	3.40	3.41	3.40	3.43
C10	2.49	2.38	2.26	2.24	2.23	2.37
C11	1.85	1.75	1.71	1.68	1.70	1.64
C12	1.32	1.18	1.11	1.11	1.07	1.10
C13	0.96	0.81	0.71	0.71	0.73	0.69
C14	0.73	0.78	0.55	0.51	0.49	0.39
C15	0.55	0.30	0.29	0.27	0.29	0.27
alpha chain growth probability	0.66	0.62	0.62	0.62	0.62	0.62

C1 - C50 estimated total product distribution, weight %

C1	24.3	25.7	26.4	26.8	26.8	27.1
C2 - C4	29.6	30.3	30.4	30.4	30.0	30.4
C5 - C12	42.5	42.0	41.4	40.9	41.3	40.7
C13 - C50	3.6	2.0	1.9	1.8	1.9	1.8

CO conversion, %	1.9	1.7	1.7	1.6	1.6	1.6
rate, g CH ₂ /g cat/hr	0.10	0.09	0.09	0.09	0.09	0.08
CO ₂ formation, %	0.1	0.1	0.1	0.1	0.1	0.1

Performance of Co.005

Dates: 03/05/95 - 03/06/95 Run #9

flow rate = 90.0 cc/min, loading = 0.2 g, WHSV = 12.4 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	18.5
reaction temperature, °C	220
pressure, atm	1.0
flow, cc/min	90.0

C1 - C15 product distribution, weight %

C1	27.53
C2	5.97
C3	12.40
C4	12.50
C5	11.56
C6	8.70
C7	7.11
C8	4.85
C9	3.39
C10	2.20
C11	1.63
C12	1.02
C13	0.58
C14	0.39
C15	0.19
alpha chain growth probability	0.60

C1 - C50 estimated total product distribution, weight %

C1	27.7
C2 - C4	31.1
C5 - C12	39.9
C13 - C50	1.3

CO conversion, %	1.5
rate, g CH ₂ /g cat/hr	0.08
CO ₂ formation, %	0.1
