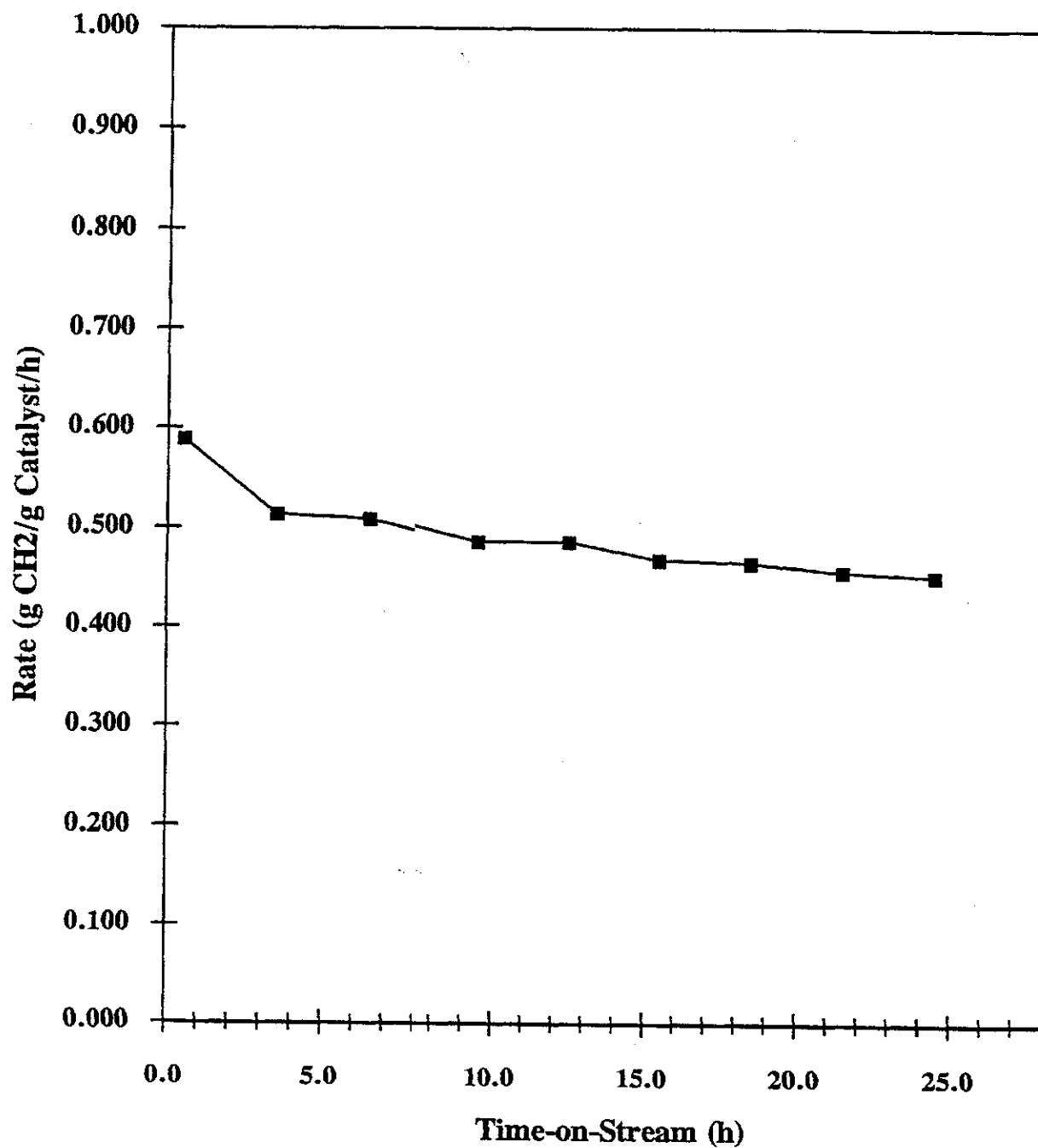


Time-on-Stream Plot for Co.053 - Run #3



(Co.054 - Run #1

Co wt%	NM wt %%	Promotor wt%		Support
20		K 0.30	Zr 8.50	SiO2

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm

T = 220 °C

H₂/CO = 2

weight of catalyst = 0.333 g

WHSV = 7.773 1/hr

time on stream = 24.5 hrs

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

O/P = 16.35

CO conversion (%)	1.2
rate (g CHH ₂ /g cat/hr)	0.04
alpha	0.79
C1 (wt%)	17.8
C2 - C4 (wt%)	19.0
C5 - C12 (wt%)	44.2
C13 + (wt%)	19.0

Performance of Co.054

Dates:s: 06/03/94 - 06/04/94 Run #1

flow rate = 90.0 cc/min, loading = 0.03 g, WHSV = 7.7 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	16.65	17.85	18.66	19.40	19.41	18.78
C2	4.02	4.27	4.43	4.56	4.52	4.34
C3	8.03	8.16	8.32	8.56	8.43	8.17
C4	8.29	8.02	8.22	8.30	8.23	8.02
C5	9.09	8.97	8.93	8.83	8.95	9.23
C6	7.45	7.12	6.27	6.53	6.38	6.18
C7	8.28	7.96	7.90	7.58	7.69	8.02
C8	7.24	7.15	7.03	6.81	6.92	7.09
C9	6.51	6.35	6.23	6.12	6.19	6.31
C10	5.68	5.71	5.61	5.46	5.50	5.61
C11	4.96	4.86	4.82	4.69	4.57	4.93
C12	4.19	4.29	4.24	4.10	4.10	4.22
C13	3.84	3.60	3.64	3.51	3.58	3.56
C14	3.12	3.08	3.10	3.02	2.93	2.93
C15	2.64	2.60	2.60	2.54	2.61	2.64
alpha chain growth probability	0.79	0.79	0.80	0.79	0.80	0.80

C1 - C50 estimated total product distribution, weight %

C1	14.7	15.8	16.5	17.2	17.1	16.5
C2 - C4	18.0	18.1	18.6	19.0	18.6	18.0
C5 - C12	47.1	46.2	45.0	44.4	44.4	45.2
C13 - C50	20.2	20.0	20.0	19.4	19.9	20.2

CO conversion, %	1.8	1.5	1.4	1.3	1.3	1.3
rate, g CH ₂ /g cat/hr	0.06	0.05	0.05	0.04	0.04	0.04
CO ₂ formation, %	0.2	0.2	0.1	0.1	0.1	0.1

Performance of Co.054

Dates: 06/03/94 - 06/04/94 Run #1

flow rate = 90.0 cc/min, loading = 0.3 g, WHSV = 7.7 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	18.5	21.5	24.5	27.5	30.5
reaction temperature, °C	220	220	220	220	220
pressure, atm	1.0	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	22.5	22.5

C1 - C15 product distribution, weight %

C1	19.43	19.92	20.08	20.33	20.82
C2	4.48	4.58	4.61	4.25	4.29
C3	8.30	8.42	8.45	8.31	8.42
C4	8.55	8.31	8.44	8.36	8.44
C5	8.90	8.87	8.82	8.93	9.00
C6	6.40	6.51	6.47	7.97	8.04
C7	7.62	7.57	7.64	7.40	7.42
C8	7.03	6.85	6.78	6.54	6.46
C9	6.16	6.09	6.04	5.92	5.69
C10	5.53	5.45	5.38	5.18	5.10
C11	4.69	4.60	4.49	4.48	4.40
C12	4.17	4.00	4.09	3.92	3.69
C13	3.47	3.45	3.38	3.24	3.16
C14	2.90	2.91	2.82	2.79	2.77
C15	2.36	2.47	2.50	2.38	2.31
alpha chain growth probability	0.79	0.79	0.79	0.79	0.78

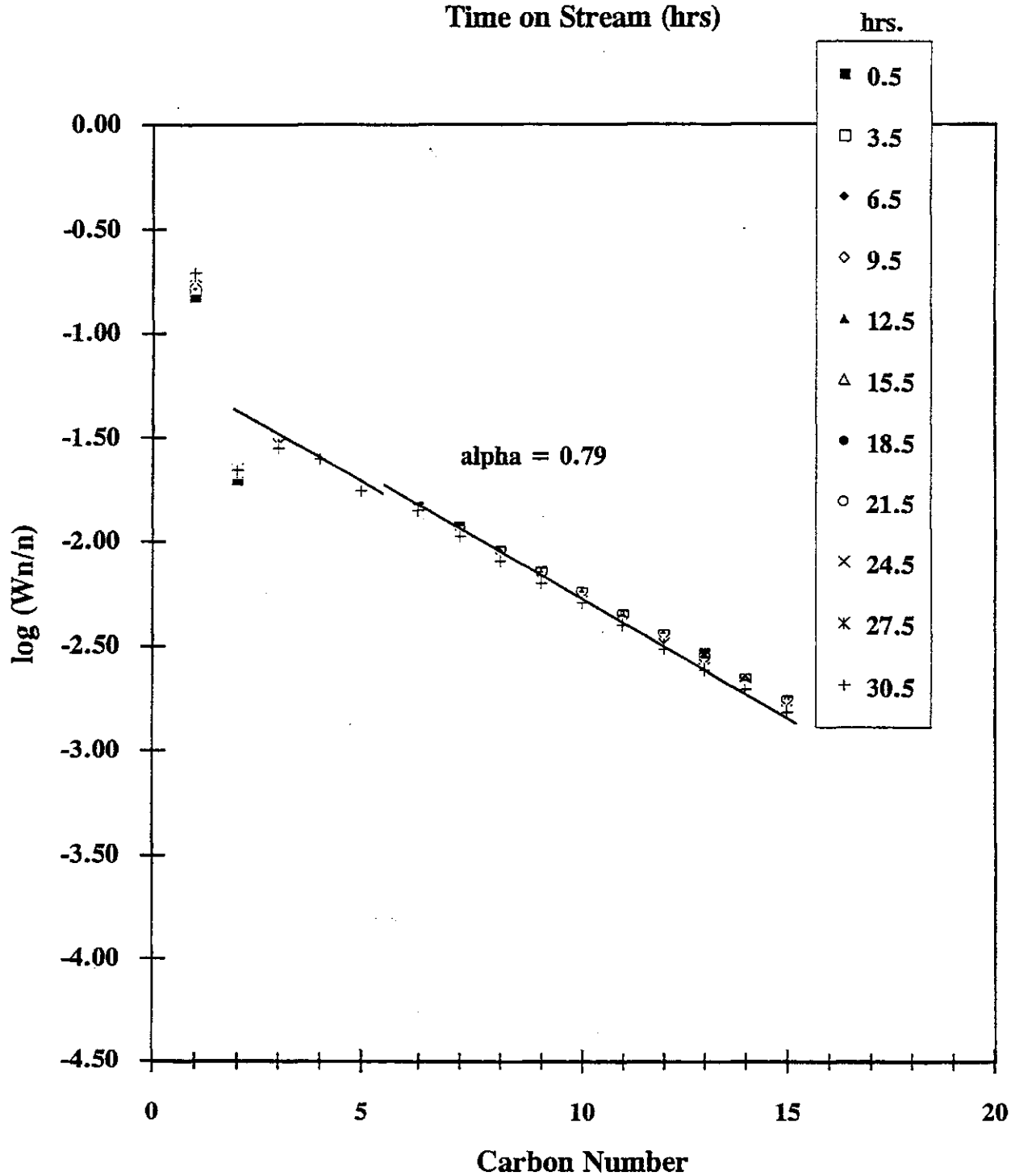
C1 - C50 estimated total product distribution, weight %

C1	17.5	17.7	17.8	18.2	18.7
C2 - C4	19.3	19.0	19.0	18.7	19.0
C5 - C12	45.1	44.5	44.2	45.1	45.0
C13 - C50	18.1	18.8	19.0	17.9	17.3

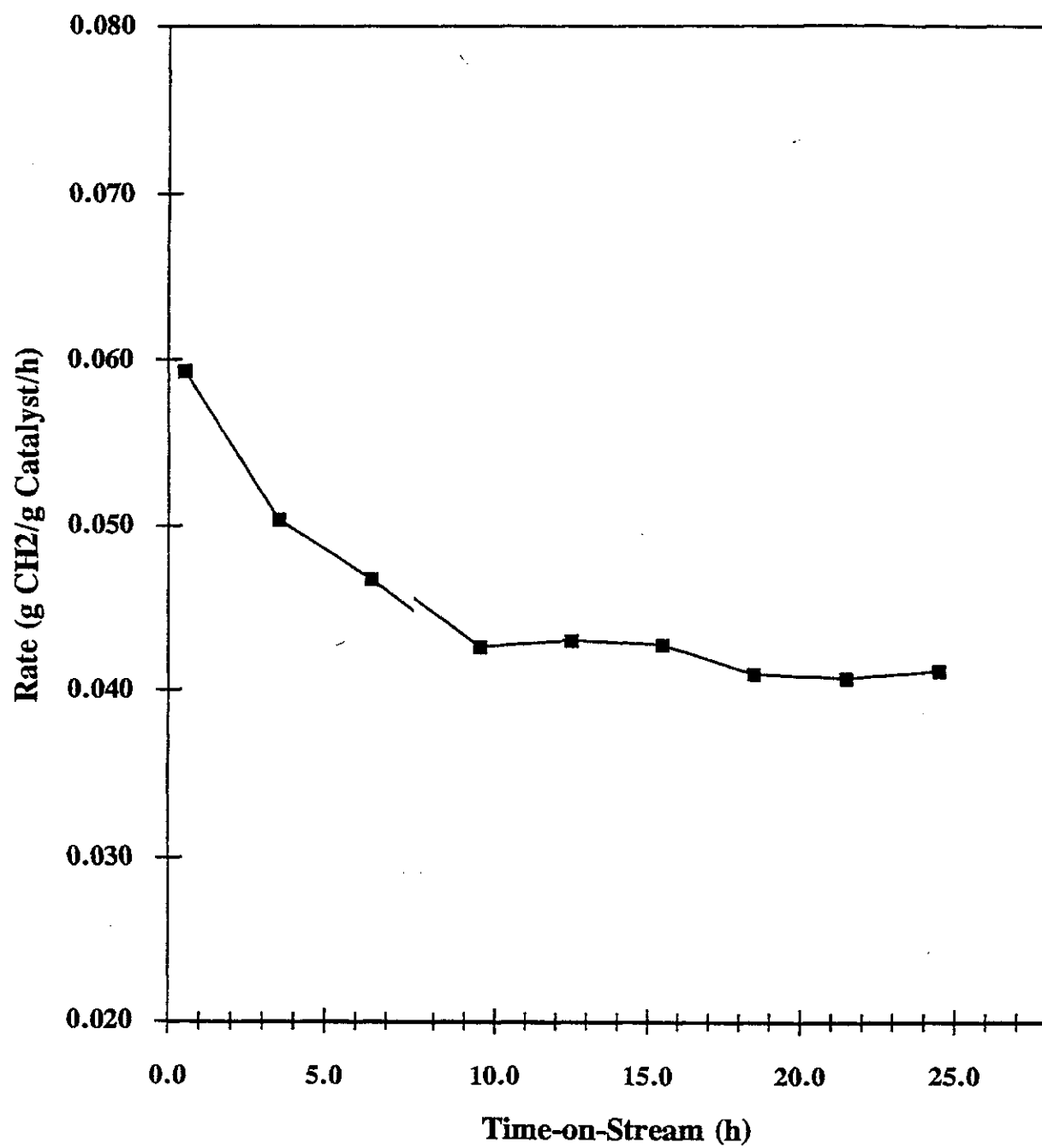
CO conversion, %	1.2	1.2	1.2	5.2	5.3
rate, g CH ₂ /g cat/hr	0.04	0.04	0.04	0.04	0.05
CO ₂ formation, %	0.1	0.1	0.1	0.6	0.6

Schulz-Flory Plot for Co.054 - Run #1

Time on Stream (hrs)



Time-on-Stream Plot for Co.054 - Run #1



CAL.011 - Run #3 (re-reduced)

Co wt%	NM wt %%	Promotor wt%		Support
20	Ru 0.500			Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
 T = 220 °C
 H₂/CO = 2
 weight of catalyst = 0.170 g
 WHSV = 15.5.09 1/hr
 time on stream = 25.5 hrs

CO₂ (g/g cat/hr) = 0.052
 CO₂ (% of CO) = 0.2
 O/P = 4.97

CO conversion (%)	2.5
rate (g CHH ₂ /g cat/hr)	0.16
alpha	0.63
C1 (wt%)	25.6
C2 - C4 (wt%)	31.7
C5 - C12 (wt%)	40.5
C13 + (wt%)	2.2

Performance of CAL.01

Dates: 03/31/94 - 04/01/94 Run #3 (re-reduced)

flow rate = 90.0 cc/min, loading = 0.0.2 g, WHSV = 15.1 l/hr, H₂/CO ratio in feed = 2

time on stream, hr	0.5	6.5	21.5	25.5
reaction temperature, °C	220	220	220	220
pressure, atm	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	90.0

C1 - C15 product distribution, weight %

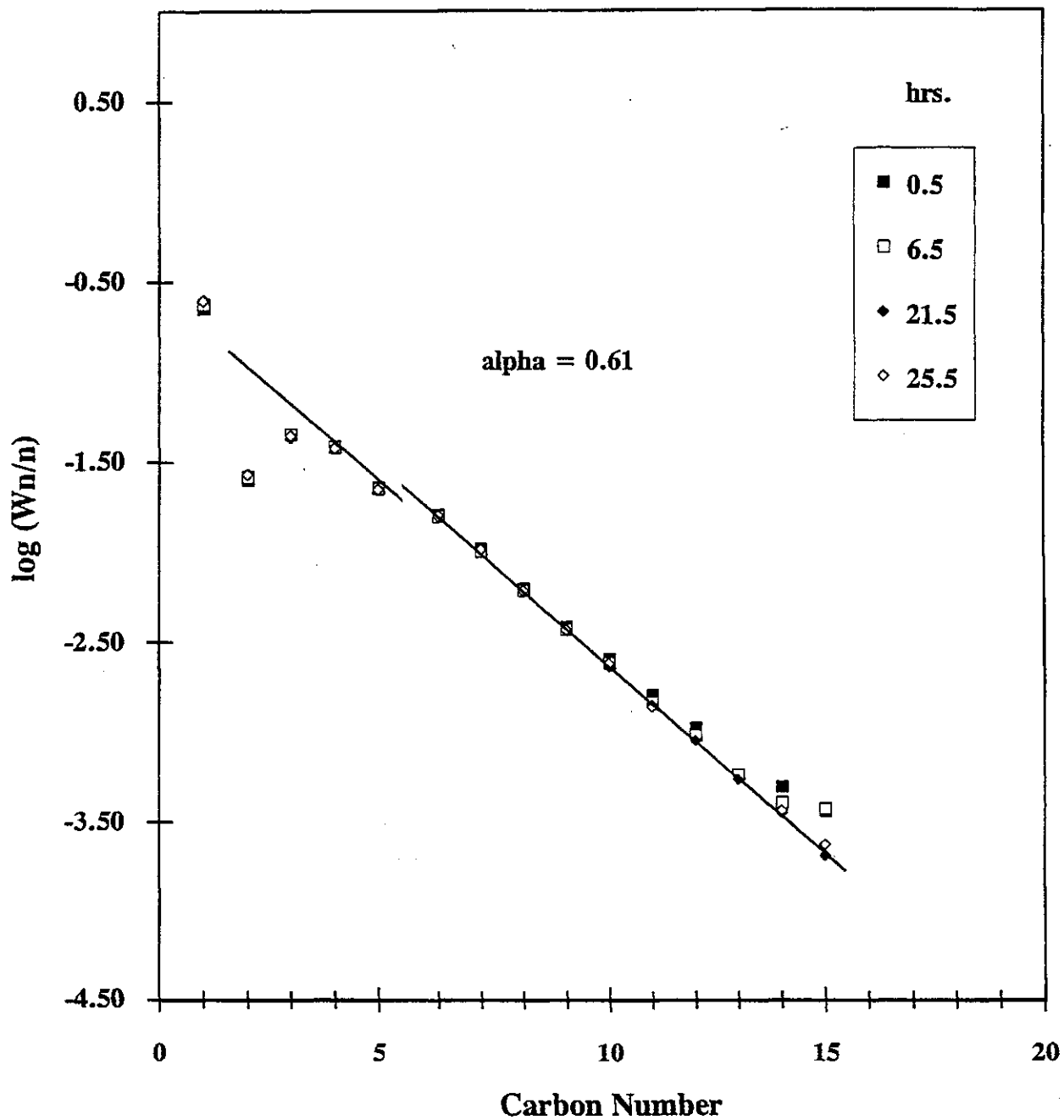
C1	23.88	25.35	25.81	25.78
C2	5.11	5.35	5.41	5.40
C3	12.59	12.61	12.42	12.44
C4	13.56	13.32	14.00	14.04
C5	12.41	12.13	12.02	11.97
C6	8.79	8.72	8.29	8.30
C7	7.32	7.10	7.26	7.21
C8	5.07	4.94	4.93	4.91
C9	3.49	3.36	3.37	3.35
C10	2.58	2.44	2.34	2.42
C11	1.79	1.63	1.55	1.52
C12	1.28	1.15	1.08	1.06
C13	0.89	0.76	0.70	0.72
C14	0.70	0.57	0.49	0.51
C15	0.54	0.56	0.31	0.35
alpha chain growth probability	0.64	0.63	0.62	0.63

C1 - C50 estimated total product distribution, weight %

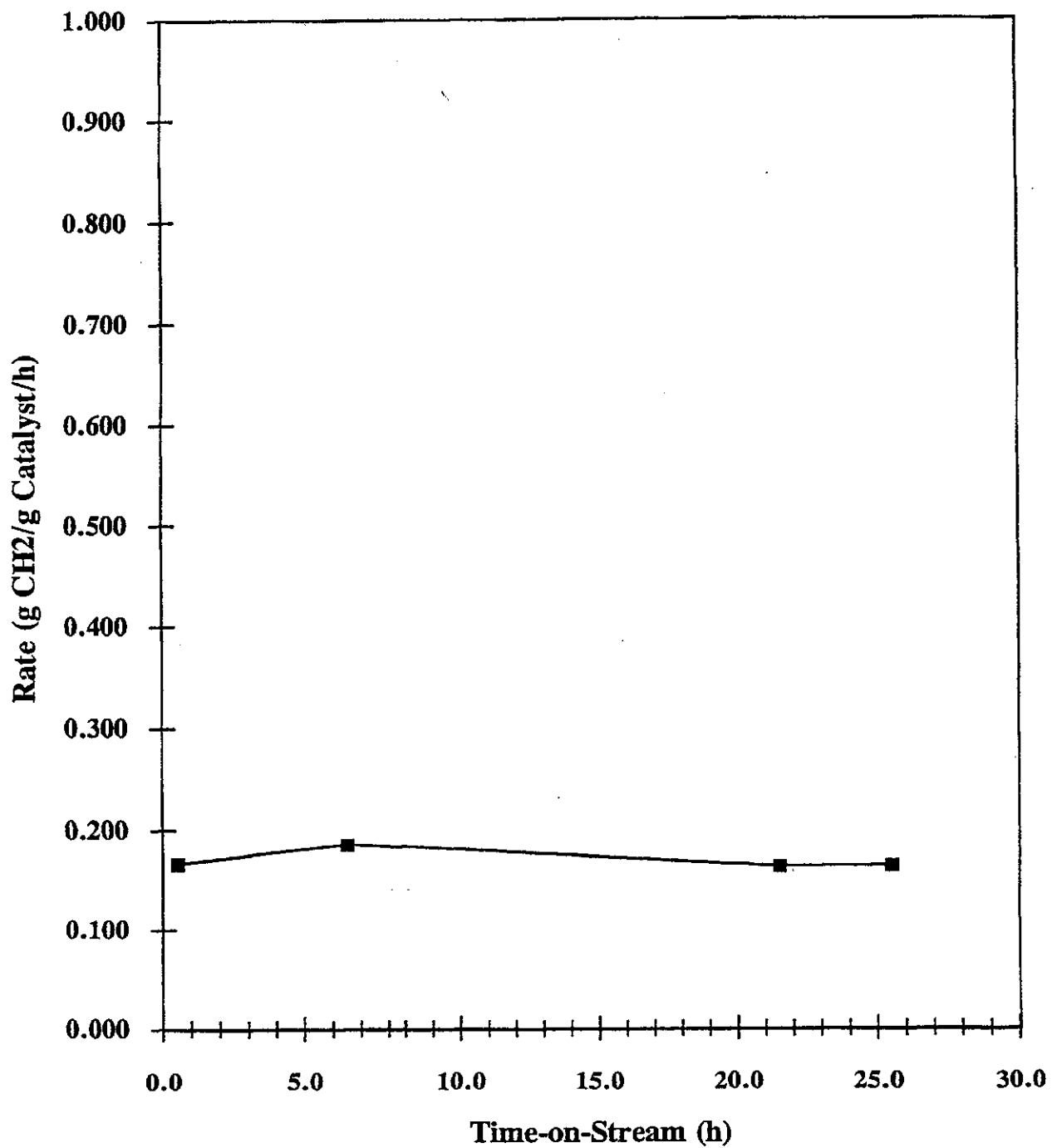
C1	23.7	25.3	25.7	25.6
C2 - C4	31.0	31.2	31.7	31.7
C5 - C12	42.5	41.3	40.6	40.5
C13 - C50	2.8	2.3	2.1	2.2

CO conversion, %	2.5	2.8	2.5	2.5
rate, g CH ₂ /g cat/hr	0.17	0.19	0.16	0.16
CO ₂ formation, %	0.2	0.2	0.2	0.2

Schulz-Florry Plot for CAL.01 - Run #3 (re-reduced)
Time on Stream (hrs)



Time-on-Stream Plot for CAL.01 - Run #4



CAL.001 - Run #4 (re-calcine)

Co wt%	NM wt %%	Promotor wt%		Support
20	Ru 0.500			Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
 T = 220 °C
 H₂/CO = 2
 weight of catalyst = 0.170 g
 WHSV = 155.09 1/hr
 time on stream = 25.0 hrs

CO₂ (g/g cat/hr) = 0.098
 CO₂ (% of CO) = 0.4
 O/P = 1.21

CO conversion (%)	7.3
rate (g CH ₄ /g cat/hr)	0.48
alpha	0.57
C1 (wt%)	35.8
C2 - C4 ((wt%))	33.3
C5 - C12 . (wt%)	30.1
C13 + (wt%)	0.9

Performance of CAL.01

Dates: 04/04/94 - 04/05/94 Run #4 (re-calcine)

flow rate = 90.0 cc/min, loading = 0.0.2 g, WHSV = 15.1 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	0.5	2.5	5.0	8.0	23.0	25.0
reaction temperature, °C	220	220	220	220	220	220
pressure, atm	1.0	1.0	1.0	1.0	1	1
flow, cc/min	90.0	90.0	90.0	90.0	90.0	90.0

C1 - C15 product distribution, weight %

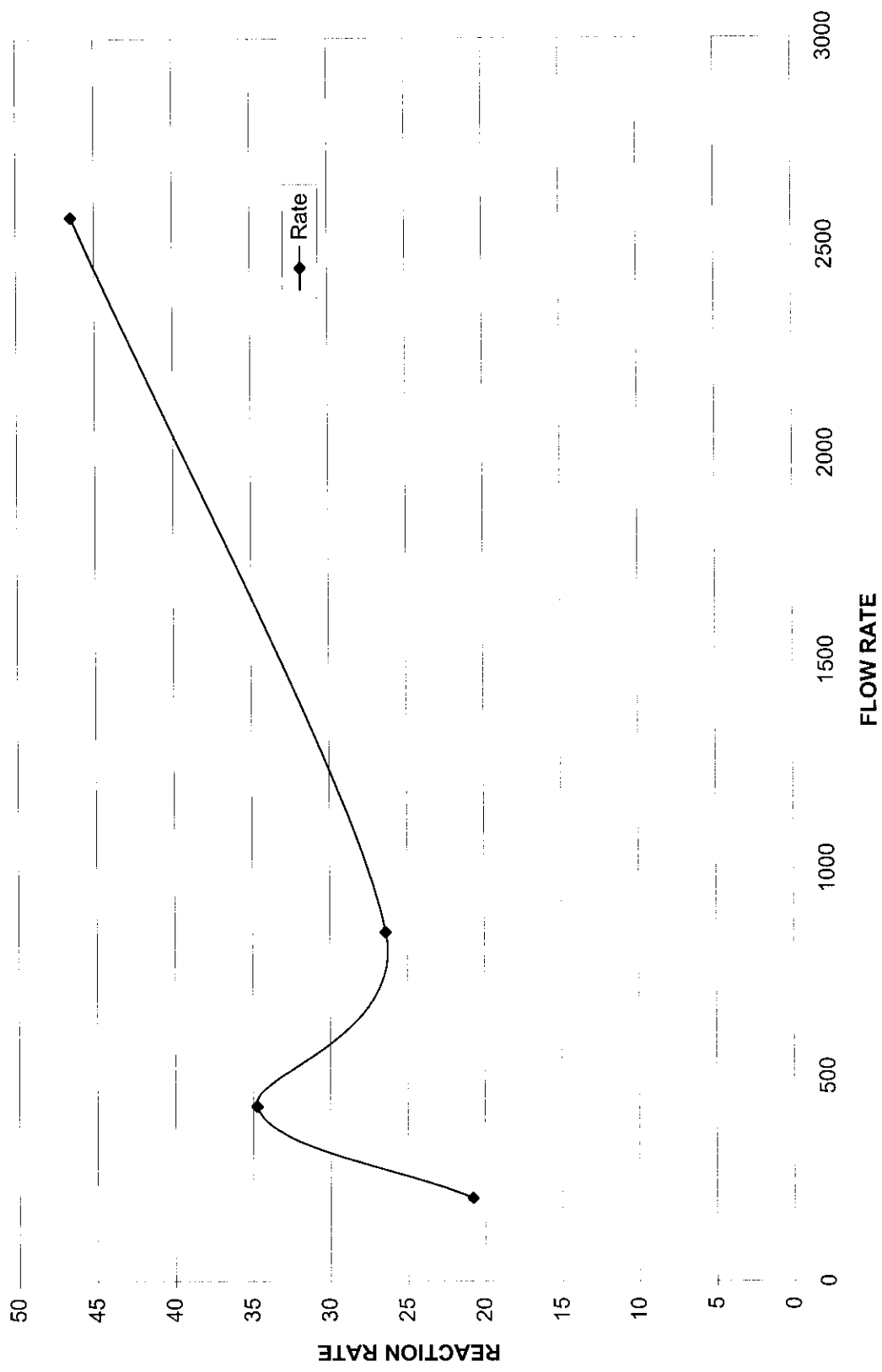
C1	34.89	37.36	34.50	35.31	35.20	35.95
C2	6.46	6.73	6.29	6.41	5.77	5.75
C3	13.83	13.98	14.02	14.07	14.02	14.25
C4	13.77	13.54	13.75	13.54	13.32	13.48
C5	11.20	10.60	11.36	10.78	10.59	10.75
C6	7.56	6.76	6.26	6.96	8.49	6.71
C7	4.68	4.24	5.21	4.90	4.87	5.02
C8	2.89	2.66	3.27	3.07	3.09	3.17
C9	1.83	1.63	2.06	1.90	1.84	1.92
C10	1.07	0.95	1.28	1.21	1.20	1.26
C11	0.74	0.64	0.85	0.74	0.67	0.69
C12	0.46	0.39	0.49	0.52	0.38	0.47
C13	0.27	0.22	0.30	0.26	0.24	0.26
C14	0.20	0.16	0.20	0.18	0.17	0.18
C15	0.14	0.12	0.14	0.13	0.15	0.13
alpha chain growth probability	0.59	0.58	0.58	0.58	0.58	0.57

C1 - C50 estimated total product distribution, weight %

C1	34.7	37.2	34.3	35.1	34.9	35.8
C2 - C4	33.8	34.1	33.9	33.9	32.8	33.3
C5 - C12	30.5	28.0	30.8	30.1	31.3	30.1
C13 - C50	1.0	0.8	1.0	0.9	1.0	0.9

CO conversion, %	7.4	7.4	7.5	7.7	7.3	7.3
rate, g CH ₂ /g cat/hr	0.49	0.49	0.50	0.51	0.48	0.48
CO ₂ formation, %	0.7	0.4	0.4	0.7	0.4	0.4

**Reaction Rate vs Flow Rate
(Catalyst 690, 1.5 Feed Ratio, 410F)**



Performance of CAL.01

Dates: 04/04/94 - 04/05/94 Run #4 (re-calcine)

flow rate = 90.0 cc/min, loading = 0.2 g, WHSV = 15.1 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	28.0
reaction temperature, °C	220
pressure, atm	1
flow, cc/min	90.0

C1 - C15 product distribution, weight %

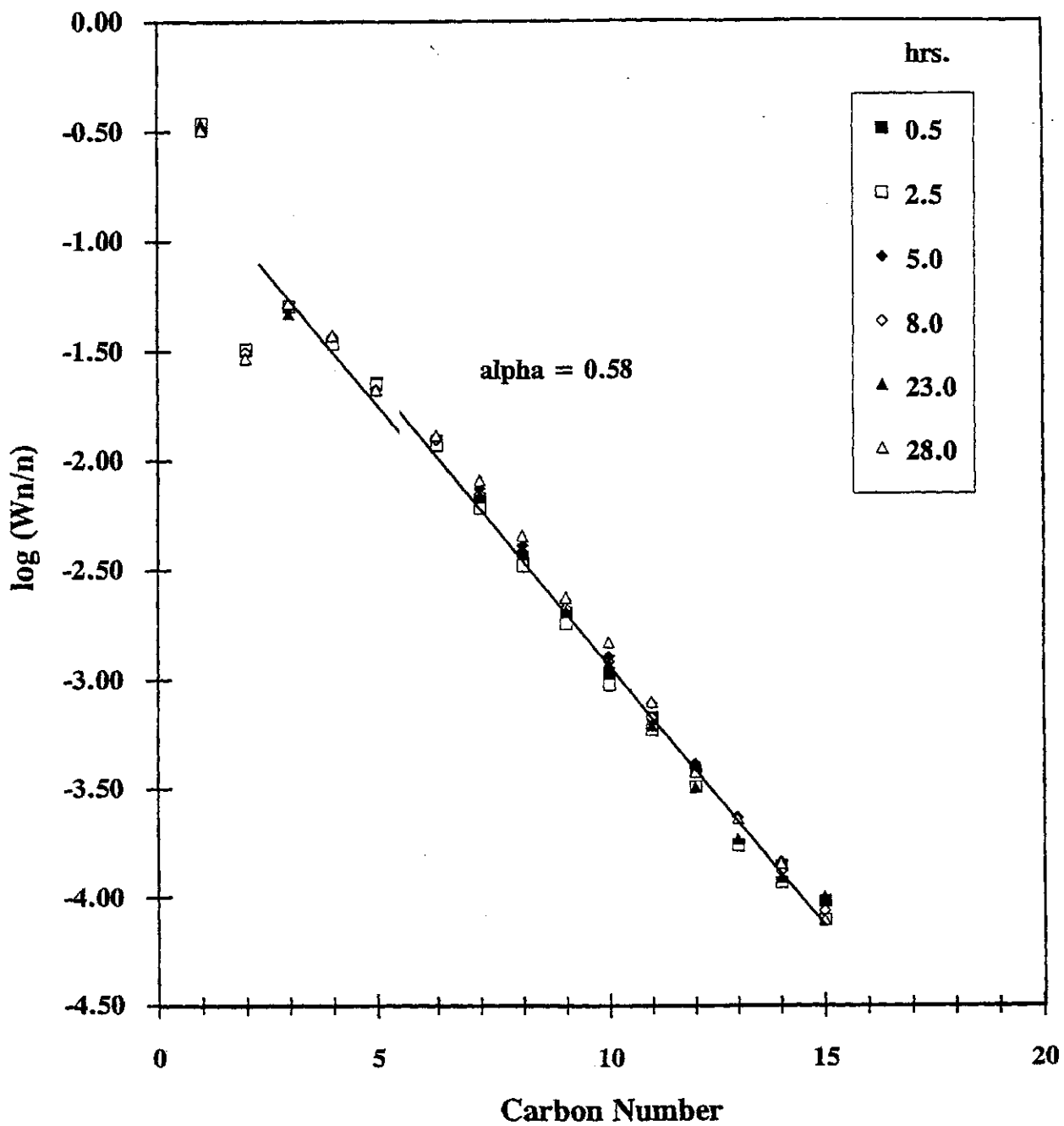
C1	39.99
C2	7.04
C3	16.23
C4	1.99
C5	12.09
C6	7.79
C7	5.70
C8	3.61
C9	2.13
C10	1.49
C11	0.87
C12	0.45
C13	0.30
C14	0.20
C15	0.12
alpha chain growth probability	0.57

C1 - C50 estimated total product distribution, weight %

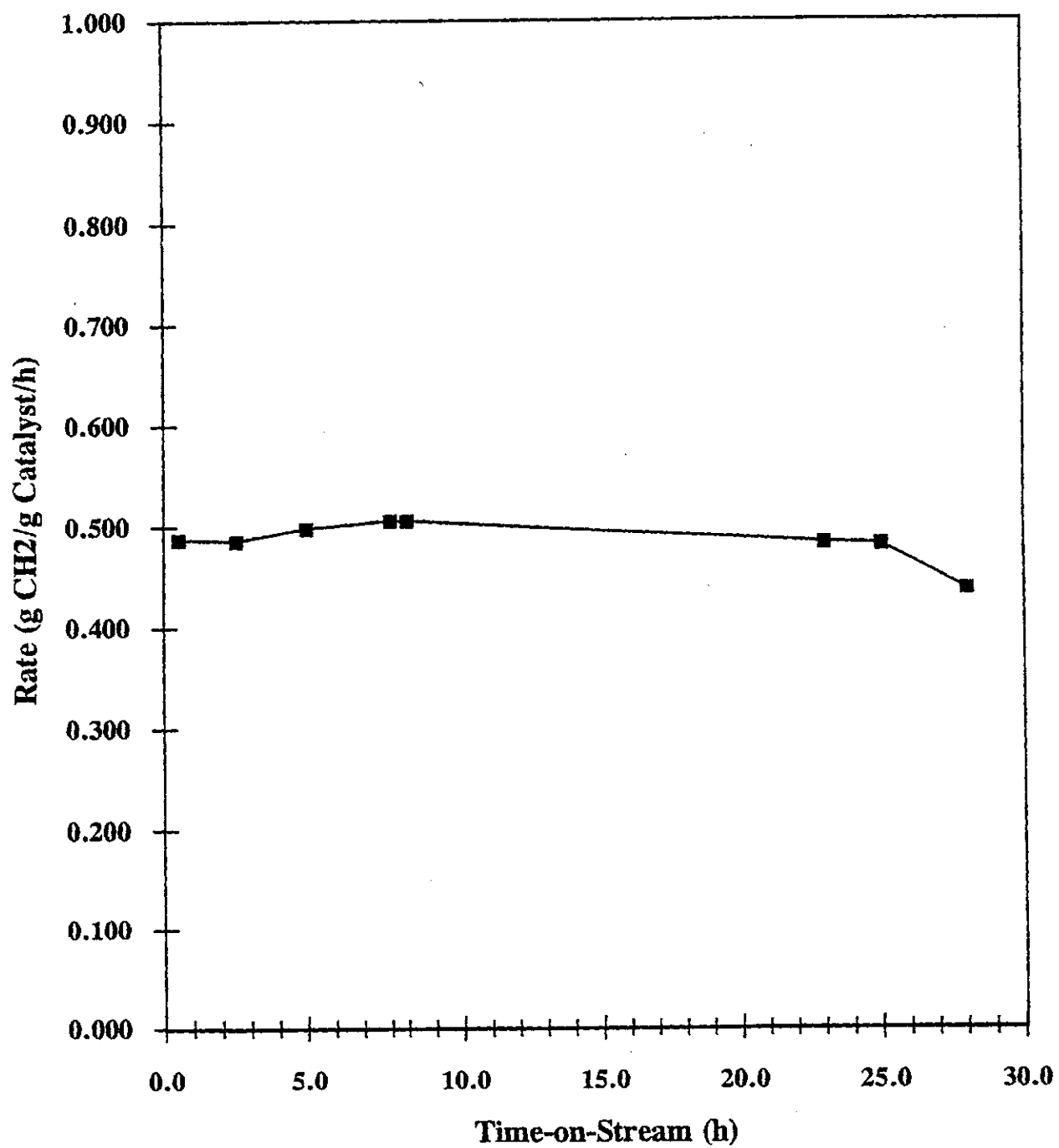
C1	39.9
C2 - C4	25.2
C5 - C12	34.1
C13 - C50	0.8

CO conversion, %	6.6
rate, g CH ₂ /g cat/hr	0.44
CO ₂ formation, %	0.3

Schulz-Florry Plot for CAL.01 - Run #4 (re-calcine)
Time on Stream (hrs)



Time-on-Stream Plot for CAL.01 - Run #4



(CAL.02 - Run #1

Co wt%	NM wt %%	Promotor wt%		Support
20	Ru 0.500			Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions: :

P = 1.0 atm

T = 220 °C

H₂/CO = 2

weight of catalyst = 0.182 g

WHSV = 144.11 1/hr

time on stream = 25.0 hrs

CO₂ (g/g cat/hr) = 0.040CO₂ (% of CO) = 0.2

O/P = 3.04

CO conversion (%)	6.1
rate (g CH ₂ /g cat/hr)	0.38
alpha	0.63
C1 (wt%)	27.3
C2 - C4 ((wt%))	30.7
C5 - C12 (wt%)	39.7
C13 + (wt%)	2.3

Performance of CAL.02

Dates: 05/05/94 - 05/06/94 Run #1

flow rate = 90.0 cc/min, loading = 0.0.2 g, WHSV = 14.1 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	0.5	2.5	5.0	8.0	23.0	25.0
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 %

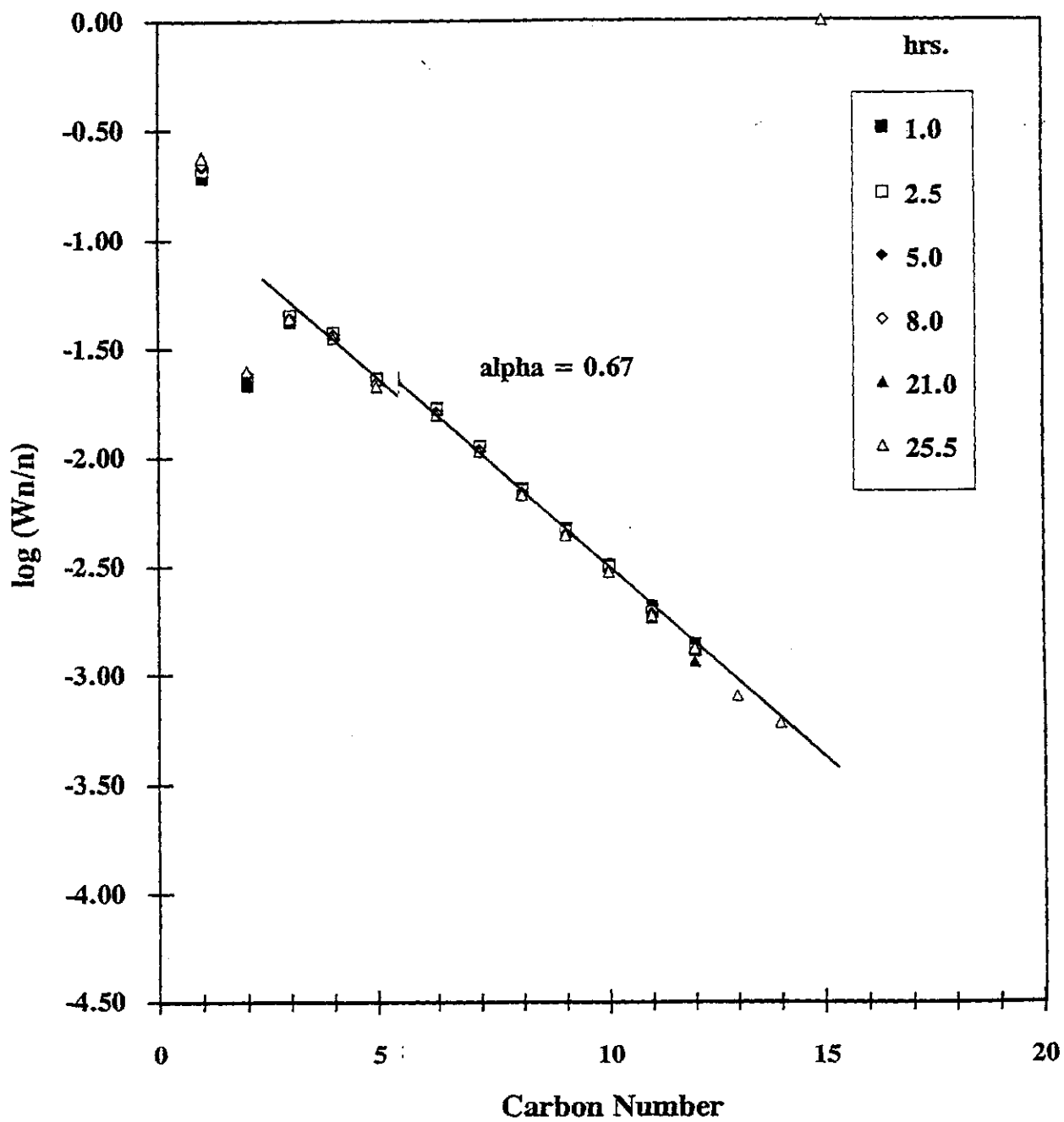
C1	24.79	25.50	26.34	26.49	27.02	27.35
C2	4.86	5.01	4.64	5.16	5.15	4.71
C3	13.17	13.25	13.34	13.38	13.18	13.14
C4	13.31	13.28	13.29	13.28	12.97	12.93
C5	11.76	11.75	11.68	11.63	11.48	11.37
C6	8.63	8.69	8.52	8.29	8.30	8.29
C7	7.02	6.95	6.87	6.87	6.82	6.77
C8	5.00	4.87	4.82	4.84	4.88	4.81
C9	3.53	3.37	3.31	3.34	3.33	3.26
C10	2.54	2.42	2.45	2.28	2.36	2.61
C11	2.00	1.84	1.74	1.76	1.68	1.96
C12	1.33	1.23	1.23	1.05	1.19	1.17
C13	0.85	0.80	0.82	0.72	0.80	0.77
C14	0.63	0.60	0.54	0.54	0.49	0.51
C15	0.57	0.43	0.41	0.37	0.35	0.34
alpha chain growth probability	0.66	0.64	0.64	0.63	0.63	0.63

C1 - C50 estimated total product distribution, weight %

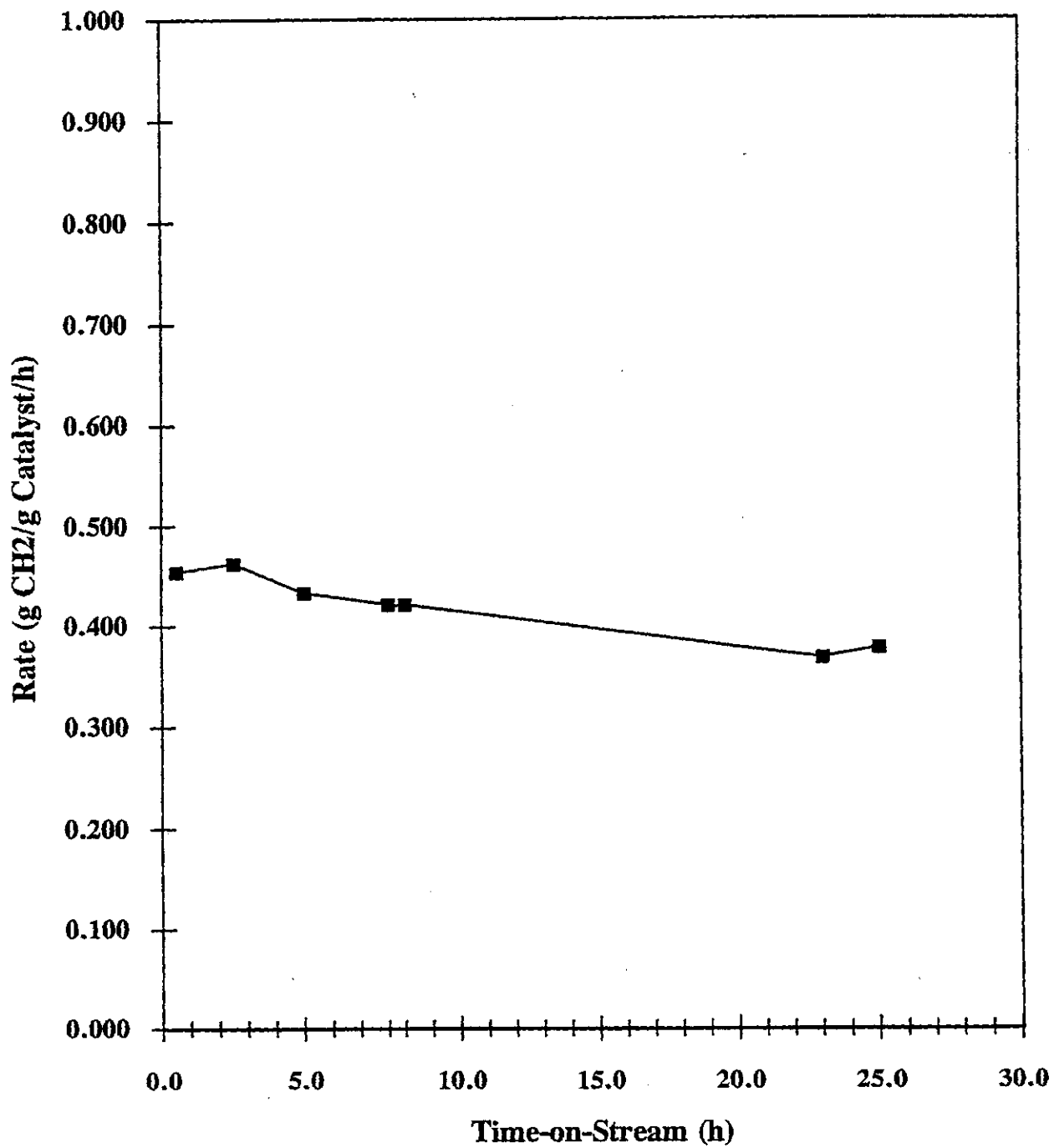
C1	24.2	25.2	26.1	26.2	26.8	27.3
C2 - C4	30.6	31.2	30.9	31.5	31.1	30.7
C5 - C12	41.4	40.8	40.3	39.8	39.7	39.7
C13 - C50	3.8	2.8	2.7	2.5	2.3	2.3

CO conversion, %	7.4	7.5	7.0	6.8	6.0	6.1
rate, g CH ₂ /g cat/hr	0.45	0.46	0.43	0.42	0.37	0.38
CO ₂ formation, %	0.3	0.3	0.3	0.2	0.2	0.2

Schulz-Flory Plot for CAL01 - Run #1
Time on Stream (hrs)



Time-on-Stream Plot for CAL.02 - Run #1



CCAL.03 - Run #1

Co wt%	NM wt %%	Promotor wt%		Support
20	Ru 0.500			Al ₂ O ₃

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
 T = 220 °C
 H₂/CO = 2
 weight of catalyst = 0.178 g
 WHSV = 144.46 1/hr
 time on stream = 27.0 hrs

CO₂ (g/g cat/hr) = 0.048
 CO₂ (% of CO) = 0.2
 O/P = 2.59

CO conversion (%)	7.3
rate (g CHH ₂ /g cat/hr)	0.46
alpha	0.60
C1 (wt%)	29.0
C2 - C4 ((wt%))	31.9
C5 - C12 : (wt%)	37.5
C13 + (wt%)	1.6

Performance of CAL.03

Dates: 05/09/94 - 05/11/94 Run #1

flow rate = 90.0 cc/min, loading = 0.02 g, WHSV = 14.5 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	1.0	3.0	5.0	9.0	21.0	23.0
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	28.62	29.32	28.89	28.38	28.84	29.33
C2	4.93	5.00	4.93	4.86	5.28	5.33
C3	13.79	13.94	13.81	13.61	13.57	13.59
C4	13.45	13.49	13.43	13.36	13.12	13.01
C5	11.43	11.34	11.42	11.58	11.34	11.11
C6	8.16	7.88	8.02	8.45	8.24	7.98
C7	6.47	6.35	6.46	6.53	6.52	6.44
C8	4.40	4.32	4.38	4.52	4.48	4.41
C9	2.92	2.89	2.97	3.02	2.96	2.97
C10	2.07	2.01	2.02	2.12	2.11	2.14
C11	1.34	1.36	1.43	1.47	1.44	1.49
C12	1.02	0.86	0.99	0.93	0.91	0.96
C13	0.61	0.61	0.60	0.54	0.57	0.62
C14	0.42	0.35	0.39	0.36	0.36	0.33
C15	0.36	0.29	0.26	0.25	0.26	0.27
alpha chain growth probability	0.63	0.61	0.61	0.61	0.61	0.61

C1 - C50 estimated total product distribution, weight %

C1	28.2	29.0	28.8	28.3	28.7	29.2
C2 - C4	31.7	32.1	32.0	31.7	31.8	31.8
C5 - C12	37.8	36.9	37.4	38.3	37.8	37.2
C13 - C50	2.4	1.9	1.7	1.6	1.7	1.8

CO conversion, %	9.9	8.9	8.4	8.2	7.7	7.1
rate, g CH ₂ /g cat/hr	0.63	0.56	0.53	0.52	0.49	0.45
CO ₂ formation, %	0.4	0.3	0.4	0.4	0.3	0.3

Performance of CAL.03

Dates: 05/09/94 - 05/11/94 Run #1

flow rate = 90.0 cc/min, loading = 0.2 g, WHSV = 14.5 1/hr, H₂/CO ratio in feed = 2

time on stream, hr	25.0	27.0	29.0	31.0	33.0	46.0
reaction temperature, °C	220	220	220	210	220	220
pressure, atm	1.0	1.0	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	22.5	22.5	22.5	90.0

C1 - C15 product distribution, weight %

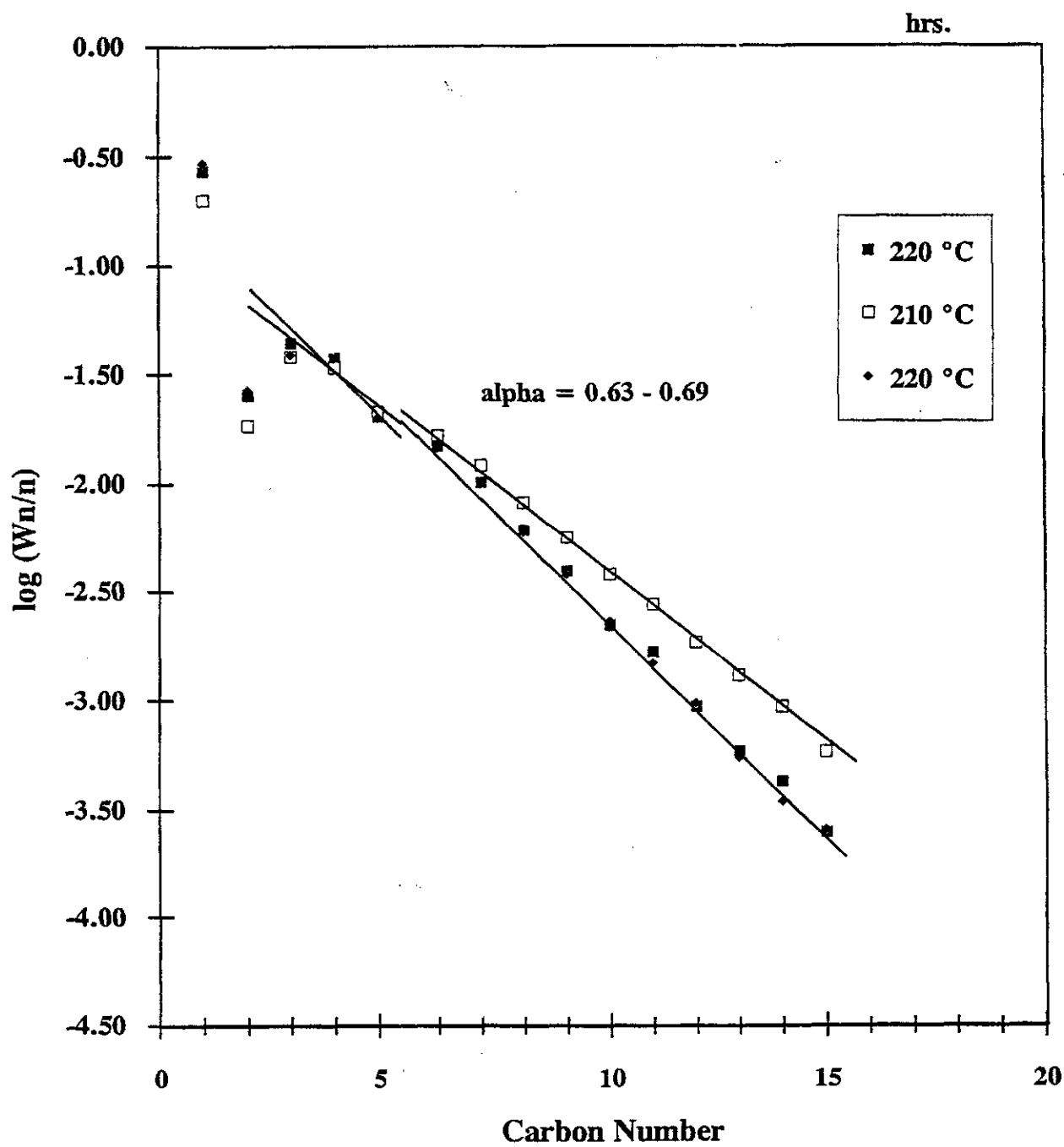
C1	29.19	29.09	28.45	20.40	29.21	27.64
C2	5.34	5.31	5.07	3.60	5.09	5.14
C3	13.61	13.60	11.47	9.81	11.27	13.18
C4	13.04	13.12	12.76	11.41	12.54	12.86
C5	11.10	11.30	11.34	11.62	11.32	11.55
C6	7.98	8.21	8.34	10.00	8.62	9.17
C7	6.46	6.49	7.16	8.53	7.02	6.70
C8	4.41	4.53	4.91	6.54	4.79	4.95
C9	2.92	3.03	3.56	5.08	3.41	3.14
C10	2.19	1.99	2.22	3.81	2.31	2.18
C11	1.61	1.35	1.84	3.04	1.64	1.30
C12	0.94	0.90	1.13	2.23	1.17	0.93
C13	0.54	0.50	0.77	1.72	0.72	0.54
C14	0.40	0.36	0.60	1.32	0.48	0.37
C15	0.29	0.23	0.38	0.88	0.39	0.36
alpha chain growth probability	0.62	0.60	0.63	0.69	0.64	0.63

C1 - C50 estimated total product distribution, weight %

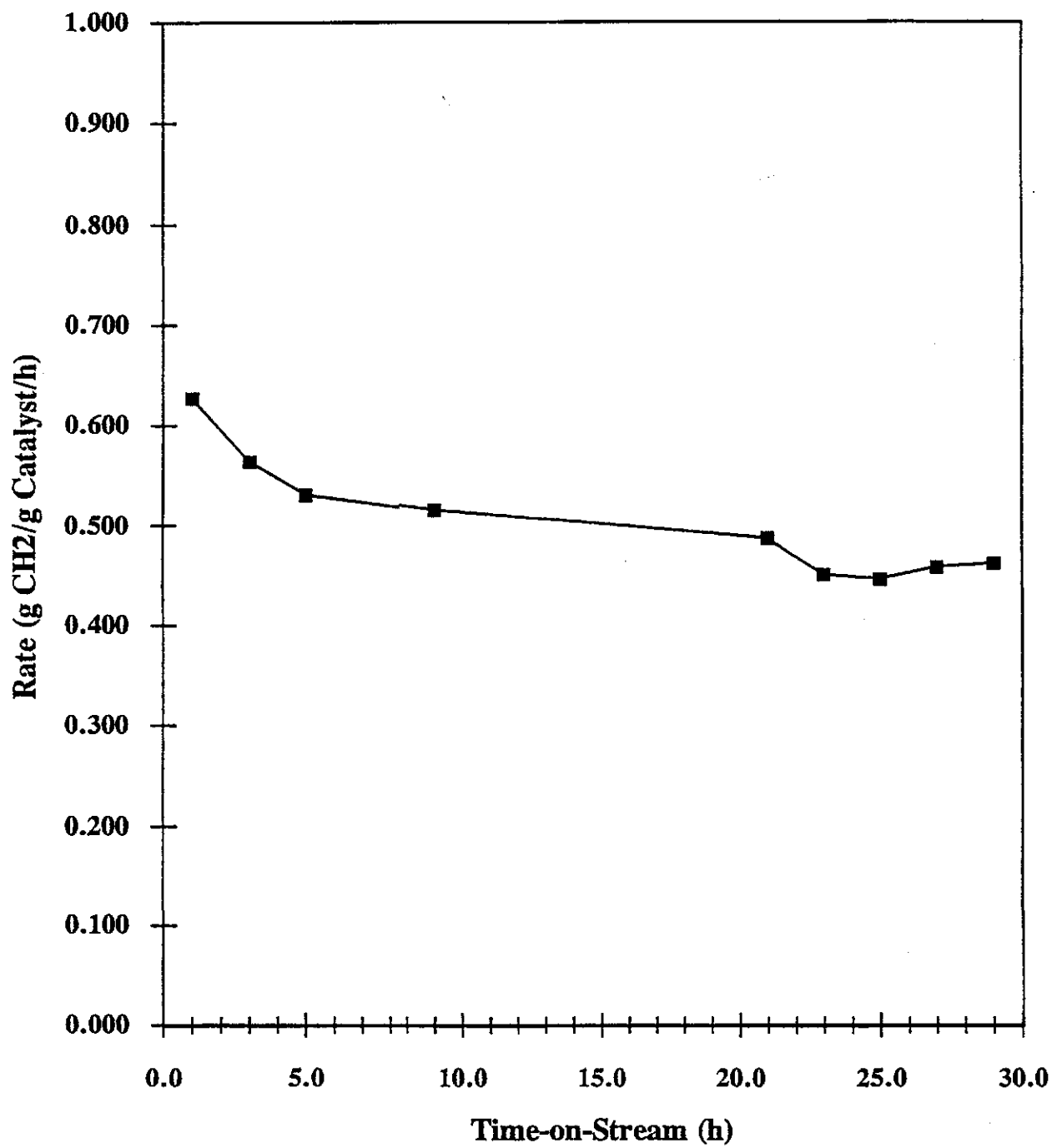
C1	29.0	29.0	28.3	20.0	28.9	27.2
C2 - C4	31.8	31.9	29.1	24.4	28.6	30.7
C5 - C12	37.3	37.5	40.1	49.6	40.0	39.8
C13 - C50	1.9	1.6	2.5	6.0	2.6	2.3

CO conversion, %	7.1	7.3	29.3	17.0	28.9	7.4
rate, g CH ₂ /g cat/hr	0.45	0.46	0.46	0.27	0.46	0.47
CO ₂ formation, %	0.2	0.2	1.9	1.2	1.9	0.4

Schulz-Flory Plot for CAL.03 - Run #1
High Conversion Study at Different Temperature



Time-on-Stream Plot for CAL.03 - Run #1



CCAL.03 - Run #1

Co wt%	NM wt %%	Promotor wt%		Support
20	Ru 0.500			Al2O3

SUMMARY REACTION DATA*

Reaction Conditions:

P = 1.0 atm
 T = 220 °C
 H₂/CO = 2
 weight of catalyst = 0.178 g
 WHSV = 3.662 1/hr
 time on stream = 29.0 hrs

CO₂ (g/g cat/hr) = 0.105
 CO₂ (% of CO) = 1.9
 O/P = 0.76

CO conversion (%)	29.3
rate (g CH ₂ /g cat/hr)	0.46
alpha	0.63
C1 (wt%)	28.3
C2 - C4 ((wt%))	29.1
C5 - C12 : (wt%)	40.1
C13 + (wt%)	2.5

* high conversion study

CCoW01 - Run #2

Co wt%		WGS Promotors wt%		Support
20		Cu 4.00	Zn 10.00	Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm

T = 220 °C

H₂/CO = 2

weight of catalyst = 0.800 g

WHSV = 3.221 1/hr

time on stream = 12.5 hrs

CO₂ (g/g cat/hr) = 0.006CO₂ (% of CO) = 0.1

O/P = 3.78

CO conversion (%)	1.2
rate (g CH ₄ /g cat/hr)	0.02
alpha	0.58
C1 (wt%)	30.2
C2 - C4 (wt%)	40.9
C5 - C12 (wt%)	27.9
C13 + (wt%)	1.0

Performance of CoW01

Dates: 06/06/94 - 06/08/94 Run #2

flow rate = 90.0 cc/min, loading = 0.0.8 g, WHSV = 3.2 1/hr, H₂/CO ratio in feed = 2

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

C1 - C15 product distribution, weight %

C1	31.26	31.18	30.89	30.34	30.20	rereduce 350C
C2	9.17	9.30	9.27	9.10	9.05	
C3	17.18	17.41	17.36	17.07	16.90	
C4	14.52	14.70	15.01	14.94	14.94	
C5	11.80	11.96	11.94	12.14	12.18	
C6	2.25	1.93	2.44	2.77	2.95	
C7	4.66	4.68	4.57	4.74	4.86	
C8	2.93	2.90	2.70	2.95	3.01	
C9	1.98	1.77	1.88	1.97	2.00	
C10	1.29	1.19	1.29	1.28	1.33	
C11	0.93	0.95	0.79	0.86	0.73	
C12	0.69	0.53	0.52	0.56	0.58	
C13	0.58	0.46	0.44	0.42	0.43	
C14	0.41	0.40	0.37	0.37	0.36	
C15	0.25	0.34	0.31	0.29	0.28	
alpha chain growth probability	0.58	0.57	0.57	0.58	0.58	

C1 - C50 estimated total product distribution, weight %

C1	31.3	31.4	31.0	30.4	30.2
C2 - C4	40.9	41.7	41.8	41.3	40.9
C5 - C12	26.7	26.0	26.3	27.4	27.9
C13 - C50	1.1	0.9	0.8	0.9	1.0

CO conversion, %	1.1	1.1	1.1	1.1	1.2
rate, g CH ₂ /g cat/hr	0.02	0.02	0.02	0.02	0.02
CO ₂ formation, %	0.2	0.2	0.1	0.1	0.1