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TECHNOLOGY DEVELOPMENT FOR COBALT F-T CATALYSTS

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EXECUTIVE SUMMARY

A number of important technical accomplishments and conclusions have been reached during this reporting period.

Following the catalyst pretreatment effects reported in the previous quarterly report, it appears that the higher activity obtained for the catalysts prepared using an organic solution and reduced directly without prior calcination was the result of higher dispersions obtained under such pretreatment.

A Ru-promoted Co catalyst on alumina with 30% Co loading exhibited a four-fold increase in dispersion and a two-fold increase in activity in the fixed-bed reactor from that obtained with the non-promoted catalyst, reported in the previous report. Compared with the results obtained with the Ru-promoted 20 wt% Co catalyst, the increase in activity due to higher Co loadings is not as significant as that reported for the non-promoted catalysts. This would confirm the suggestion that a greater percent of the additional Co is reducible to the metal without the presence of a reduction promoter such as Ru.

Several slurry bubble column reactor runs during this reporting period have again focused on pushing conversion to higher levels. Larger charges of catalysts than in previous runs, in addition to raising the temperature and varying the reactants flow rates, were used in order to achieve higher conversions. The maximum conversion obtained has been 49.7% with 26g catalyst at 260°C and 403 SL/h (25% N_2 in a H_2 + CO mixture). The higher catalyst charge resulted in higher conversions at the standard reaction conditions. However, as in the previous runs at high conversions, low flow rates and higher temperatures resulted in greater heat being released. This resulted in difficulties in temperature control and faster loss of activity especially at the high

temperatures. When a low activity catalyst was used, relatively high conversions could be achieved at temperatures as high as 280°C without excessive deactivation.

Further investigations of the effect of reaction temperature on the performance of Co catalysts during F-T synthesis were started using a low activity catalyst and one of the most active catalysts. The catalysts were tested in the fixed-bed reactor at various temperatures while monitoring their deactivation. The preliminary results obtained during this quarter confirm that Co catalysts are very sensitive to temperature. They deactivate very fast at temperatures above 240°C. Further tests will be carried out in the following quarter in order to determine the nature of this deactivation process and possible means to prevent it.

The three 1 kg catalyst batches prepared by Calsicat for the reproducibility and aging studies were tested in both the fixed-bed and slurry bubble column reactors under the standard reaction conditions. Their performances for F-T synthesis were similar, and they were also similar to the performances obtained with two catalysts previously prepared by Calsicat in smaller batches and with the reference catalyst prepared in-house. The 1000 hour aging test was started with one of these catalysts prepared by Calsicat.

The effects of adding various promoters to some cobalt catalysts have also been addressed. Based on the SBCR results, La and Zr promotion of Co/Al_2O_3 appear to have little or no effect on catalyst activity. However, these activities were also among the highest already obtained in SBCR. On the other hand, Re and La addition to Co/SiO_2 did not improve the activity over that obtained with the low activity unpromoted Co/SiO_2 catalyst.

Finally, a special test run was made to determine whether slugging or plugging occurred in the reactor system at higher solids loading. A charge of 50 wt% inactive catalyst in synfluid was tested at 240°C, 450 psi. Nitrogen gas feed rate was varied between 900 SL/h and 1300 SL/h with no solids carryover. In addition, synfluid was fed at 30 ml/hr and no overhead slugging and no plugging occurred in the internal heavy product filter. This test suggests that the reactor system can handle high catalyst loading. However, the reactor cannot handle high heat generation because there is no capability for removing the heat of reaction.

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ACKNOWLEDGEMENT

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I. INTRODUCTION AND BACKGROUND

The goal of this project is the development of a commercially-viable, cobalt-based Fischer-Tropsch (F-T) catalyst for use in a slurry bubble column reactor. Cobalt-based catalysts have long been known as being active for F-T synthesis. They typically possess greater activity than iron-based catalysts, historically the predominant catalyst being used commercially for the conversion of syngas based on coal, but possess two disadvantages that somewhat lessen its value: (1) cobalt tends to make more methane than iron does, and (2) cobalt is less versatile with low H_2/CO ratio syngas due to its lack of water-gas shift activity. Therefore, the major objectives of this work are (1) to develop a cobalt-based F-T catalyst with low ($<5\%$) methane selectivity, (2) to develop a cobalt-based F-T catalyst with water-gas shift activity, and (3) to combine both these improvements into one catalyst. It will be demonstrated that these catalysts have the desired activity, selectivity, and life, and can be made reproducibly. Following this experimental work, a design and a cost estimate will be prepared for a plant to produce sufficient quantities of catalyst for scale-up studies.

II. PROJECT DESCRIPTION

The Cobalt Fischer-Tropsch Catalyst Project is divided into five tasks designed to systematically develop catalysts through thorough investigation of influences of various promoters, additives, and supports on minimizing methane selectivity and increasing water-gas-shift activity.

Cobalt has long been known to be an excellent catalyst for the F-T synthesis. Nevertheless, all currently operating F-T plants feeding coal produced syngas use iron catalysts, in spite of the fact that cobalt-based catalysts have higher activity. Two factors that lower cobalt's value as a F-T

catalyst are its poorer selectivity, that is, it produces more methane and its inability to be used with low H_2/CO ratio syngas because of its lack of water-gas shift activity. The broad objective of this proposal is to overcome these deficiencies.

In pursuing F-T catalyst development, there are several aspects that need to be considered. These are catalyst formulation, catalyst pretreatment, and catalyst performance. All of these aspects will be dealt with in this project.

In broad terms, the technical approach that will be used is outlined below.

a. Conduct a thorough review of the literature on F-T synthesis, both the journal literature and the patent literature. In this review, identify approaches for improving methane selectivity of cobalt-based catalysts, identify additives that have WGS activity, identify catalyst formulation options, and define critical pretreatment parameters.

b. Based on the above review, develop a list of catalyst formulations with potential for low methane selectivity and a list of catalyst formulations with potential for promoting the WGS reaction.

c. Screen these catalysts in a small, fixed-bed reactor. If no catalyst meets the target specifications, go back to step b. Otherwise, run catalysts that meet discrimination criteria in a slurry bubble column reactor.

d. Once catalysts with low methane selectivity and WGS activity have been identified, develop a catalyst combining both these functions and test as described above.

e. Having found catalysts that meet the desired criteria for activity and selectivity, optimize the pretreatment conditions.

f. Demonstrate catalyst reproducibility by having a commercial subcontractor prepare multiple batches for testing.

g. Demonstrate catalyst stability by running aging tests in a slurry bubble column reactor.

h. Based on above results, prepare a design for a plant to produce demonstration scale batches of catalyst. Develop capital and operating costs of this plant.

The program to carry out the above outlined work will consist of five major tasks:

Task 1 -- Catalyst Development

Task 2 -- Catalyst Testing

Task 3 -- Catalyst Reproducibility Tests

Task 4 -- Catalyst Aging Tests

Task 5 -- Preliminary Design and Cost Estimate for a Demonstration Scale Catalyst Production Facility

All aspects of the catalyst's role in F-T processing will be addressed, including catalyst preparation, pretreatment, and performance (activity, selectivity, and aging). In addition to gathering process data, the catalyst will be subjected to a number of analytical measurements at each stage to see how various treatments have affected the catalyst and its performance.

III. OBJECTIVES

The objective of this project is to investigate the influence of various promoters, additives, and supports on minimizing the methane selectivity and increasing the water-gas shift (WGS) activity of cobalt (Co) Fischer-Tropsch (F-T) catalysts. The ultimate goal of this investigation is

to identify and demonstrate a catalyst preparation procedure that will be scaled up for the reproducible synthesis of commercial quantities of supported CO catalysts with desired activity, selectivity, and lifetime for use in F-T synthesis in three-phase slurry bubble column reactors.

IV. SUMMARY OF WORK ACCOMPLISHED THIS QUARTER

Two new catalysts were formulated and prepared during this period under subtask 1.2. Three more catalysts were prepared by Calsicat for the reproducibility tests.

The characterization of all the catalysts in order to determine their physical properties (BET surface area, pore volume, pore size diameter, particle size distribution), as well as the cobalt reducibility, extent of reduction, and dispersion) was continued.

The investigation of the effect of pretreatment in various atmospheres (calcination in air or nitrogen prior to reduction in hydrogen, direct reduction without prior calcination, and reduction-oxidation-reduction (ROR)) of a selected number of catalysts was continued by completing their characterization following the different pretreatments.

Fixed-bed reactor testing of the catalysts was continued. Four new catalysts, including the three catalysts prepared by Calsicat, were tested for their F-T synthesis performance.

The effect of reaction temperature on the performance of Co catalysts during F-T synthesis was investigated in the fixed-bed reactor using a low activity catalyst and one of the most active catalysts in order to determine their deactivation behavior.

During this reporting period a total of 11 runs were performed in the slurry bubble column reactor. Out of these 11 runs, three were high CO conversion runs, three were reproducibility

tests using the Low methane selectivity catalysts prepared by Calsicat, and the others were miscellaneous runs made to evaluate the effects of various promoters.

A special test run was made in the M3-SBCR to determine whether slugging or plugging occurred in the reactor system at higher solids loading.

V. DETAILED DESCRIPTION OF TECHNICAL PROGRESS

A. TASK 1: CATALYST DEVELOPMENT

a. Technology Assessment (Subtask 1.1)

Except for regular updating of the literature with the most recent publications, there was no activity during this period to report in this subtask.

b. Catalyst Formulation (Subtasks 1.2, 1.3, 1.4)

An updated list of all the catalysts formulated so far within Subtask 1.2 (including those catalysts listed in previous quarterly reports) is given in Table 1 on page 17 with their compositions. The last column of Table 1 indicates whether the catalyst has already been prepared. Of the 83 catalysts listed in Table 1, two new Co catalysts (highlighted in Table 1) were formulated and prepared in-house during this period and three others (CAL.11-CAL.13) were prepared by Calsicat. The detailed formulations of the new catalysts are given in Appendix A.

Co.064 (with 20% Co, 0.5% Ru, and 8.5% Zr on alumina) and Co.065 (with 20% Co, 0.5% Ru, 8.5% Zr, and 0.3% K on alumina), were prepared this quarter in order to complete the investigation of the effect of ZrO_2 promotion on the catalytic properties of Al_2O_3-supported Co In F-T synthesis. Both catalysts were promoted with 8.5 wt% Zr which was first impregnated on the support prior to the Co impregnation, and Co.065 was also promoted with 0.3% wt% K.

Calsicat prepared three independent 1 kg batches (CAL.11-CAL.13) of a catalyst similar to Co.047 (with 20% Co, 0.5% Ru, and 0.3% K on alumina) which was selected as the low methane catalyst for the reproducibility test. The three catalysts were calcined in nitrogen.

Under Subtask 1.3 no new catalysts was prepared during this period. The list of the catalysts prepared previously is given in Table 2 on page 23 with their composition.

c. Catalyst Pretreatment (Subtask 1.5)

The investigation of the effects of pretreatment on the catalytic properties of a selected number of catalysts (Co.004, Co.015, and Co.055), all promoted with La_2O_3 and Ru or Re in the case of Co.055, was continued during this period by the characterization (mainly TPR and H_2 chemisorption measurements) of these catalysts following the different pretreatments. The effects of pretreatment in various atmosphere (calcination in air or in nitrogen prior to reduction in H_2, direct reduction in H_2 without prior calcination, and reduction-oxidation-reduction (ROR) were addressed. The results are included in subtask 1.6, "Catalyst Characterization".

d. Catalyst Characterization (Subtask 1.6)

Physical Properties

Table 3 on page 24 gives an update on the physical property measurements carried out so far. Nitrogen physisorption at 77 K was used to obtain surface area, pore volume and pore diameter of the calcined catalysts. Average particle size of the catalysts was determined using a Microtrac particle size analyzer.

Static Hydrogen Chemisorption

An updated summary of the properties of the Co catalysts as determined by H_2 chemisorption is given in Table 4 on page 27. Co.004, Co.015, and Co.055 were characterized by static hydrogen chemisorption at the University of Pittsburgh following different pretreatments.

Temperature Programmed Reduction (TPR)

TPR experiments were carried out in an automated Altamira Instruments AMI-1 system. The procedure for these measurements was described in a previous quarterly report. All the TPR results obtained so far are summarized in Table 4 on page 27. During this period, Co.004, Co.015, and Co.055 were characterized by TPR following different pretreatments.

B. TASK 2: CATALYST TESTING

a. Subtask 2.1 - Fixed Bed Reaction Studies:

The reaction conditions and procedure were described in previous quarterly reports. Four (4) new catalysts (Co.061, CAL.11-CAL.13) were tested for the first time during this reporting period. Catalysts Co.005 (runs #8-10c), Co.053 (run #7-11a) were also retested in order to investigate the effect of reaction temperature on the Co catalysts deactivation during F-T synthesis and determine the cause of such deactivation.

The performances of all these catalysts (highlighted in Table 5) at steady state are compared in Table 5 on page 31 with those reported in the previous quarterly report. All the pertinent data (CO conversion, rates, product distributions, chain growth probabilities, Anderson-Schulz-Flory distributions, time-on-stream activity and Arrhenius plots when available) obtained with each run for each catalyst is given in Appendix B.

Co.061, a Ru-promoted Co catalyst with 30% Co loading was tested as part of an ongoing study of the effect of Co loading. As the results indicate, the Ru promotion results in a two-fold increase in activity from that obtained with the non-promoted catalyst, Co.060, reported in the previous report.

The three catalysts prepared by Calsicat (CAL.11-CAL.13) for the reproducibility study were tested in the fixed bed reactor. Their performances for F-T synthesis were similar, and they were also similar to the performance obtained with Co.047 under the same reaction conditions.

In previous runs, most of the highly active catalysts deactivated promptly as soon as they were subjected to relatively high temperatures resulting from excessive and uncontrolled release of the heat of reaction. Thus, the effect of reaction temperature on the performance of Co catalysts during F-T synthesis was investigated using a low activity catalyst, Co.005, and one of the most active catalysts, Co.053. The catalysts were tested at various temperatures while monitoring their deactivation. In most cases, the catalysts were diluted with alumina and the reactants with argon in order to avoid any uncontrolled temperature increases due to the heat released by the reaction at high temperature. It is clear from these preliminary results that Co catalysts are very sensitive to temperature. They deactivate very fast at temperatures above 240°C. Further discussion of these results will be left until the completion of this study by other tests which are required in order to determine the nature of this deactivation process and the means to prevent it.

b. Slurry Bubble Column Reactor

1. Run Chronology

During this reporting period a total of 11 runs were performed in the SBCR's, Runs M3-35 through 39, and M4-28 through 33. A chronology of the experimental runs performed in the two slurry bubble column reactors - M3 and M4 - is given in Appendix C. All comparisons of CO conversion and CH_4 selectivities discussed in this chronology were obtained from results

obtained at the initial startup conditions -- 240°C temperature, 450 psi pressure, and 2/1 H_2/CO feed gas ratio.

A complete summary of all runs in the M3-SBCR is given in Table I in Appendix D. Four tables of data were prepared in order to compare catalyst activities for Runs 2 to 39 in M3-SBCR at the same run conditions (see Tables II, III, IV, and V in Appendix D).

A complete summary of all runs made in the M4-SBCR is given in Table VI, Appendix D. Four tables were prepared to compare catalyst activities for Runs 3 to 33 in M4-SBCR at the same run conditions (see Tables VII, VIII, IX, and X in Appendix D).

2. Discussion of Results

a. High CO Conversion Runs

Three high CO conversion runs were made during this reporting period. Two runs were made with a larger charge of catalysts, and one run was made with a normal charge of 15 gm of catalyst.

Run No. 35 in the M3-SBCR was started with a charge of 26.0 gm of Catalyst No. Co.041. This catalyst contained 20% Co plus 8.5% Zr and 0.5% Ru on silica support. The CO conversion was 35.7% at startup conditions and increased to 42.1% at 250°C, and 45.1% at 260°C reaction temperature (see Table 6). Lowering the total gas feed rate from 905 SLH ("standard liter per hour") to 544 SLH resulted in a slight increase in CO conversion to 46.7%, and lowering the feed gas rate to 403 SLH increased conversion to 49.6%. Reducing the N_2 feed rate to 40% of total with a corresponding increase in H_2 and CO rates reduced the conversion to 47.9%. Reducing the N_2 feed rate to 25% increased the conversion back to 49.7%. Returning the reactor to startup conditions resulted in 19.6% CO conversion, about one half of the initial activity. The

activity loss probably occurred at the higher temperatures. The CO conversions for this run were similar to previous high conversion runs.

Run No. 29 in M4-SBCR was started with a charge of 45.4 gm of Catalyst No. Co.061 (30% Co with 0.5% Ru on alumina support). The initial CO conversion was 42%, but slowly diminished to 29% over a 24-hour period. Catalyst was found in the overhead product for the next three days. The run was shut down and the reactor was drained without flushing. The reactor walls and internal filter were clean on the surfaces. The internal filter pores were filled with wax and catalyst which was easily removed by steaming. The internal filter will be cleaned more thoroughly after each run until the optimum catalyst loading that can be used in the existing SBCR's has been determined.

Run No. 30 in the M4-SBCR was started with a charge of 15.9 gm of catalyst No. Co.011, an unpromoted 20% Co on silica supported catalyst. The CO conversion was only 8% at startup conditions. The CO conversion increased as the reaction temperature was increased to 280°C and the feed gas rates were reduced, but never exceeded 38.5% (see Table 7). This run may be repeated at a higher catalyst charge level.

Further attempts to operate at higher CO conversions will be made during the next reporting period as soon as new catalysts are prepared.

b. High Catalyst Charge Run to Evaluate Slugging and Plugging in the SBCR Reactor System

A special test run was made in the M3-SBCR to determine whether slugging or plugging occurred in the reactor system at higher solids loading. A charge of 50 wt% inactive catalyst in synfluid was charged to the M3 reactor. The reactor was brought up to 240°C, 450 psi, and 900

SLH nitrogen gas feed rate. No catalyst carryover was observed. The gas rate was increased to 1300 SLH with still no solids carryover. Finally synfluid was fed at 30 ml/hr and no overhead slugging and no plugging occurred in the internal heavy product filter. The reactor system can handle high solids loading. However, the reactor cannot handle high heat generation because there is no capability for removing the heat of reaction except by lowering the inlet gas temperature and by adding more nitrogen in the feed gas.

c. Miscellaneous Runs Made to Evaluate the Effects of Various Promoters

One run was made with a catalyst containing 20% Co, 1.0% Re, and 1.0% La_2O_3 on silica support (see Run 28 in M4-SBCR in Table 8). The conversion is very similar to that obtained with an unpromoted silica support catalyst, Co.011 (see Run 9 in M3-SBCR in Table 9). Addition of Re and La_2O_3 does not improve catalyst activity on either silica or alumina supports.

One run was made with a catalyst containing 20% Co and 8.5% Zr on alumina support prepared with aqueous IW coimpregnation. The initial CO conversion was 24.0% (see Run 36 in M3-SBCR in Table 9). This was about 3.5% lower than obtained in multiple steps, aqueous IW, with Zr pre-impregnation (see Run 15 in M4-SBCR in Table 8).

One run was made with a catalyst containing 20% Co and 4% Zr on silica support (see Run 32 in M3-SBCR in Table 9). Conversion was only 14.8% at startup conditions which was at least 4% lower than obtained with similar catalysts containing 0.0, 0.7, 8.5, and 15% Zr (see Runs 9, 17, 19, and 32 in M3-SBCR on Table 9). There is something wrong with this catalyst and the run should be repeated.

Run 38 in M3-SBCR was made with a catalyst containing 20% Co plus 1% La_2O_3 on alumina support. The CO conversion at startup conditions was 28.0% which was nearly identical to that obtained with Catalyst No. Co.005 which contained 20% Co and no additives (see Run 15 in M3-SBCR in Table 9). The addition of a small amount of La_2O_3 had no effect on catalyst activity.

The last run made this period to test the effects of various promoters was made with a catalyst that contained 20% Co with 0.5% Ru and 8.5% Zr on alumina support (see Run 39 in M3-SBCR in Table 9). The CO conversion and CH_4 selectivity was almost identical to that obtained with Catalyst No. Co.053 which contained 0.5% Ru and no Zr (see Run 12 in M4-SBCR on Table 8). The addition of Zr to promoted or unpromoted alumina catalysts has little or no effect on catalyst activity.

The following conclusions can be made on the effects of adding various promoters based on the preceding experiments:

- The addition of Re and La_2O_3 on silica supported catalysts does not improve catalyst activity.
- Aqueous IW coimpregnation of Zr on alumina supported catalyst appears to yield lower activity than preparation of catalyst in multiple steps using aqueous IW with Zr pre-impregnation.
- The addition of 1% La_2O_3 on alumina supported catalyst had little effect on catalyst activity.
- The addition of Zr to promoted and unpromoted alumina catalysts has little or no effect on catalyst activity.

c. Subtask 3.1 - Reproducibility of Catalyst with Low Methane Selectivity

Three 1 Kg samples were obtained from Calsicat for reproducibility and aging tests. Each catalyst contained 20% Co, 0.5% Ru, and 0.3% potassium on Vista Catapal B alumina.

Run No. 31 in the M4-SBCR was started with a charge of Calsicat Catalyst No. CAL.12 (see Table 10). The initial CO conversion at startup conditions was 27.6%, the THC production rate was 1.26 g C_1+/g cat./hr, and the CH_4 selectivity was 7.9%. These values are very similar to those obtained with two previously formulated Calsicat catalysts, CAL.03 and CAL.05, and to the reference catalyst prepared by Pitt, Catalyst No. Co.047 (see Runs 16, 19, 31 in M4-SBCR and Run 23 in M3-SBCR on Table 10).

The other two Calsicat catalysts, Nos. CAL.11 and CAL.13, yielded similar CO conversions and production rates (see Runs 32 and 33 in M4-SBCR on Table 10). Run 33 will be extended up to 1000 hours at the same run conditions as the catalyst aging test of the low methane selectivity catalyst prepared by Calsicat. At 111 hours into the run, the CO conversion had dropped from 28.1% to 25.12% and the THC production rate from 1.28 g/g cat./hr to 1.15 g/g cat./hr. For the next 400 hours the CO conversion slowly dropped at 0.6% per day to 17.2% and the THC production rate dropped at 1.1 g/g cat./hr. This run will be continued to 1000 hours on stream as scheduled.

3. Catalyst Recovery Analyses

The catalysts charged for all runs, except for Runs 4, 20, and 29 in M4, have been recovered and the particle size distributions have been measured. The charge and recovered weights of all catalysts are given in Table 11. The charge weights are in the H_2 reduced state

while the recovered weights are in the oxidized state. Taking this into account, catalyst recoveries are quite good (greater than 90%). The mean volumetric diameters of both the charged and recovered catalysts with the calculated percent reductions in particle size are also given in Table 11. The particle size at the lower 10% pass-through point of the sample for both the charged and recovered catalysts are also given in Table 11.

A comparison of the mean volume diameters of the total feed and recovered samples shows that most of the alumina supported catalysts exhibited the least amount of particle size attrition (5 to 10%) during the reaction. The silica supported catalysts showed a 10 to 20% particle size reduction while a titanium supported catalyst had the highest reduction, 18.2% (see Run 8 in the M4-SBCR in Table 11).

Nine catalysts prepared by Calsicat have been tested in the SBCR and the particle size reduction was very low, 0.5% for CAL.08 and 1.6% for CAL.05. All these catalysts were prepared on a Vista-B gamma-alumina catalyst support which has shown good resistance to attrition in the SBCR's.

If you compare the particle size of each sample of the 10% pass-through point, the increase in the amount of fines found in the recovered catalysts, as indicated by the lower particle size at the 10% point, is nearly proportional to the reduction in particle size obtained by comparing the mean volume diameters of the charge vs. recovered catalysts (see Table 11). Since the particle size of the charge catalyst was determined on the catalyst after hydrogen reduction and air oxidation, we know that attrition occurred only during the SBCR reaction.

VI. PLANS FOR THE NEXT REPORTING PERIOD

Several tasks are planned for the next reporting period:

(a) The fixed-bed reactor testing of new catalysts will be continued.

(b) The systematic characterization of all the catalysts will be continued using the following techniques:

- Selective hydrogen chemisorption on the reduced catalysts at 100°C;
- X-ray diffraction before reduction, after reduction, and after slurry bubble column reaction;
- Temperature programmed reduction (TPR);

(c) The investigation of the effect of temperature on catalyst deactivation will be continued.

(d) New catalyst formulations will be generated in order to pursue the effect of certain promoters on catalyst deactivation.

(e) Additional runs will be made in the SBCR's to maximize the CO conversion.

(f) Reproducibility tests and aging runs will be made on catalyst obtained from Calsicat.

(g) Several catalyst formulations and mixtures will be tested for water-gas shift activity.

VII. ASSESSMENT OF PROSPECTS FOR FUTURE PROGRESS

The technical approach which had been proposed remains the same and all the tasks are proceeding within schedule.

Table 1. List of Co-based FT Catalysts Formulated

CAT. NO.	wt% Co	wt% M	wt% Prom.	Support	Basis	Prepared
Co.001	20%	1% Re	1% La_2O_3 0.13% K	γ-alumina	U.S. Pat. 4,880,763	P
Co.002	20%	0.43% Ru	1% La_2O_3	γ-alumina	U.S. Pat. 4,413,064	P
Co.003	20%	0.5% Ru	1% La_2O_3	γ-alumina	U.S. Pat. 4,413,064	P
Co.004	20%	0.43% Ru	1% La_2O_3	γ-alumina	Reproduce Co.002	P
Co.005	20%	0	0	γ-alumina	Base Catalyst	P
Co.005A	20%	0.4% Ru	0	γ-alumina	Ru added to calcined Co.005 by IW impreg.	P
Co.006	12%	0.75% Re	0	Titania	U.S. Pat. 4,794,009	P
Co.007	20%	0	0	Titania	Base Catalyst	P
Co.008	20%	0	0	Silica	UK Pat. Appl. GB 2 125 062 A (Kneaded with excess liquid)	P
Co.009	20%	0.5% Ru	0	γ-alumina	Ru-Promoted Catalyst (use Ru Chloride, single-step aquaous IW)	P
Co.010	20%	0	0	γ-alumina	Base Catalyst (non-calcined)	P
Co.010A	20%	0.4% Ru	0	γ-alumina	Ru added to dried Co.010 by IW impreg.	P
Co.011	20%	0	0	Silica	UK Pat. Appl. GB 2 125 062 A (Kneaded)	P
Co.012	20%	0	0	Silica	Base Catalyst (Inc. Wetness)	P
Co.013	20%	0	0	Titania	Base Catalyst like Co.007, but all aqueous	P
Co.014	12%	0.5% Ru	0	Titania	Ru-Promoted Catalyst (aqueous IW co-impregnation)	P
Co.015	20%	0.43% Ru	1% La_2O_3	γ-Alumina	Similar to Co.002, but all aqueous	P

Table 1. List of Co-based FT Catalysts Formulated (contd.)

CAT. NO.	wt% Co	wt% M	wt% Prom.	Support	Basis	Prepared
Co.016	20%	0.43% Ru	1% La_2O_3	γ-Alumina	Similar to Co.015, but calcined after Co impregnation	P
Co.017	20%	0.5% Ru	1% La_2O_3	γ-Alumina	Similar to Co.003, but all aqueous	P
Co.018	20%	0.5% Ru	0	γ-Alumina	Ru-Promoted Catalyst (single-step, aqueous IW)	P
Co.019	20%	0.5% Ru	0	Silica	Ru-Promoted Catalyst (single-step, aqueous IW)	P
Co.020	0	0.5% Ru	0	γ-Alumina	Ru Base Catalyst	P
Co.020A	20%	0.4% Ru	0	γ-Alumina	Co added to dried Co.020 by IW impreg.	P
Co.020B	20%	0.4% Ru	0	γ-Alumina	Co added to reduced Co.020 by IW impreg.	P
Co.020C	20%	0.4% Ru	0	γ-Alumina	Co added to calcined Co.020 by IW impreg.	P
Co.021	20%	0	0.7% Zr	Silica	U.K. Pat. Appl. GB 2 125 062 A (single-step, aqueous kneaded)	P
Co.022	20%	0	0.7% Zr	Silica	U.K. Pat. Appl. GB 2 125 062 A (aquaous, multiple-steps, kneaded Co pre-impregnation, IW Zr)	P
Co.023	20%	0	1.4% Zr	Silica	U.K. Pat. Appl. GB 2 125 062 A (aquaous, multiple-steps, kneaded Co pre-impregnation, IW Zr)	P
Co.024	20%	0	8.5% Zr	Silica	Eur. Pat. Appl. 0 167 215 A2 (non-aqueous, IW, multiple-steps, Zr pre-impregnation)	P
Co.025	20%	0	8.5% Zr	Silica	Similar to Co.024 but aqueous Zr pre-impregnation	P
Co.026	20%	0	0	Silica (Davison Grade 59)	Similar to Co.012 but different grade silica	P

Table 1. List of Co-based FT Catalysts Formulated (contd.)

CAT. NO.	wt% Co	wt% M	wt% Prom.	Support	Basis	Prepared
Co.027	20%	0.5% Ru	0	Silica (Davison Grade 59)	Similar to Co.019 but different grade silica	P
Co.028	20%	0.5% Ru	0.5% K	γ-alumina	Ru- and K-Promoted Catalyst (single-step IW)	P
Co.029	30%	0.5% Ru	0.5% K	γ-alumina	Similar to Co.028 but 30% Co	P
Co.030	20%	0	0.1% Zr	γ-alumina	Zr-Promoted Catalyst (single-step aqueous IW)	P
Co.031	20%	0	1.4% Zr	γ-alumina	Zr-Promoted Catalyst (single-step aqueous IW)	P
Co.032	20%	0	8.5% Zr	γ-alumina	Zr-Promoted Catalyst (single-step aqueous IW)	P
Co.033	20%	0	8.5% Zr	γ-alumina	Multiple-steps, aqueous IW, Co pre-impregnation	P
Co.034	20%	0	8.5% Zr	γ-alumina	Multiple-steps, aqueous IW, Zr pre-impregnation	P
Co.035	20%	0	8.5% Zr	Silica	Zr-Promoted Catalyst (single-step aqueous, kneaded)	P
Co.036	20%	0	8.5% Zr	Silica	Mltiple-steps, aq. Co pre-impreg. by kneading, aqueous IW Zr impreg.	P
Co.037	12%	0	0	Titania	Similar to Co.013, but TiO_2 mainly anatase	P
Co.038	12%	0.5% Ru	0	Titania	Similar to Co.014, but TiO_2 mainly anatase	P
Co.039	12%	0	0	Titania	Similar to Co.007, but only 12% Co	P
Co.040	12%	0	0	Titania	Similar to Co.013, but only 12% Co	P
Co.041	20%	0.5% Ru	8.5% Zr	Silica	Similar to Co.025, but Ru-promoted	P
Co.042	0	0	8.5% Zr	Silica	Blank Zr-promoted SiO_2	P
Co.043	20%	0.5% Ru	8.5% Zr 0.5% K	Silica	Similar to Co.041, but K-promoted	P

Table 1. List of Co-based FT Catalysts Formulated (contd.)

CAT. NO.	wt% Co	wt% M	wt% Prom.	Support	Basis	Prepared
Co.064	20%	0.5% Ru	8.5% Zr	γ-alumina	Multiple-steps, aqueous IW, Zr pre-impregnation	-
Co.065	20%	0.5% Ru	8.5% Zr 0.3% K	γ-alumina	Multiple-steps, aqueous IW, Zr pre-impregnation	
CAL.01 (97E-13E)	20%	0.5% Ru	0	γ-alumina	Similar to Co.018 (Calsicat Prep.)	P
CAL.02 (97E-16B)	20%	0.5% Ru	0	γ-alumina	Similar to CAL.01 (New Batch)	P
CAL.03 (97E-13F	20%	0.5% Ru	0	γ-alumina	Multiple-step impreg., Simlar to CAL.02	P
CAL.04 (97E-50C)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to Co.047 Stand. Calc. in Air	P
CAL.05 (97E-50D)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to Co.047 Stand. Calc. in N_2	P
CAL.06 (97E-51A)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to Co.047 Red. and Pas. in Air	P
CAL.07 (97E-51B)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to Co.047 Red. and Protected in Paraffin (51.3% Cat. Conc.)	P
CAL.08 (97E-51C)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to Co.047 Calc., Red. and Protected in Paraffin (54.4% Cat. Conc.)	P
CAL.09 (97E-69C)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to CAL.05, Reduced and Protected in Soya (51.7% Cat. Conc.)	P
CAL.10 (97E-79A)	20%	0.5% Ru	0.3% K	γ-alumina (Condea)	Similar to CAL.05, but on Condea Al_2O_3	P
CAL.11 (29E-07B)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to CAL.05	P
CAL.12 (29E-05D)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to CAL.05	P
CAL.13 (29E-07E)	20%	0.5% Ru	0.3% K	γ-alumina	Similar to CAL.05	P

Table 2. List of Water-Gas Shift Catalysts and F-T Catalysts with WGS Function

CAT. NO.	wt% Co	wt% M	wt% Prom.	Support	Basis	Prepared
WGS.01	0	5.0% Cu	0	γ-alumina	single-step, aqu. IW	P
WGS.02	0	5.0% Cu	10% Zn	γ-alumina	single-step, aqu. IW	P
WGS.03	0	5.0% Cu	4.0% Cr	γ-alumina	single-step, aqu. IW	P
WGS.04	0	0	4.0% Cr	γ-alumina	single-step, aqu. IW	P
WGS.05	0	0	4.0% Mn	γ-alumina	single-step, aqu. IW	P
WGS.06	0	5.0% Cu	4.0% Mn	γ-alumina	single-step, aqu. IW	P
WGS.07	0	4.0% Fe	0	γ-alumina	single-step, aqu. IW	P
WGS.08	0	4.0% Fe	4.0% Cr	γ-alumina	single-step, aqu. IW	P
WGS.09	0	5.0% Cu	4.0% Cr	γ-alumina	Similar to WGS.03	P
CoW.01	20%	5.0% Cu	10% Zn	γ-alumina	multiple-steps, aqu. IW, Cu,Zn pre-impr.	P
CoW.02	20%	5.0% Cu	4.0% Cr	γ-alumina	multiple-steps, aqu. IW, Cu,Cr pre-impr.	P
CoW.03	10%	5.0% Cu	4.0% Cr	γ-alumina	similar to CoW.02 (10% Co only)	P
CoW.04	10%	10% Cu	8.0% Cr	γ-alumina	similar to CoW.03; 10% Cu and 8% Cr	P
CoW.05	20%	5.0% Cu	4.0% Cr	γ-alumina	similar to CoW.02 with support calcined at 750°C	P
CoW.06	20%	5.0% Cu	4.0% Cr	Silica	multiple-steps, aqu. IW, Cu,Cr pre-impr.	P
CoW.07	20%	5.0% Cu	4.0% Cr	Silica	similar to CoW.06, but with support calcined at 750°C	P
CoW.08	30%	5.0% Cu	4.0% Cr	γ-alumina	Similar to CoW.05 , but with 30% Co	P
CoW.09	20%	10.0% Cu	8.0% Cr	Silica	similar to CoW.06, but with 10% Cu and 8% Cr	P
CoW.10	10% Co, 10% Fe	0.5% Ru	0	γ-alumina	Single Step, IW	P
CoW.11	10% Co, 10% Fe	0.5% Ru	0.5% K	γ-alumina	Single Step, IW	P
CoW.12	10% Co, 10% Fe	0.5% Ru	0	Silica	Single Step, IW	P

Table 3. Summary of Physical Properties

CATALYST	Composition	BET Surface Area (m^2/g)	Pore Volume (cc/g)	Average Pore Dia. (Å)	Average Part. Size (μm)
Vista-B Al_2O_3	(0-400 mesh)	299	1.69	269	24
Vista-B Al_2O_3	Calcined 500°C	240	0.49	82	
Vista-B Al_2O_3	Calcined 600°C	206	0.49	95	
Vista-B Al_2O_3	Calcined 600°C	174	0.47	109	
Condea Al_2O_3	(as received)	219	0.53	97	77
Davison SiO_2	(0-400 mesh)	219	0.51	89	121
Degussa P25 TiO_2	(as received)	47	0.40	335	6
Degussa P25 TiO_2	Dried 60°C, Calc. 350°C/16hrs	46	0.48	419	51
Degussa P25 TiO_2	Dried 60°C, Calc. 650°C/16hrs	12	0.17	573	212
Co.001	20Co/1Re/ $1La_2O_3$/0.13K/A	191	0.31	66	42 40
Co.002	20Co/0.43Ru/ $1La_2O_3$/A	149	0.33	89	74
Co.003	20Co/0.5Ru/ $1La_2O_3$/A	122	0.26	87	77
Co.004	20Co/0.43Ru/ $1La_2O_3$/A				78
Co.005	20Co/A	173	0.34	81	65 86
Co.006	12Co/0.75Re/T	16	-	-	121
Co.007	20Co/T	11	0.10	372	
Co.008	20Co/S	181	1.06	234	
Co.009	20Co/0.5/A				
Co.010	20Co/A				
Co.011	20Co/S	211	1.07	203	107
Co.012	20Co/S	211	-	-	105
Co.013	20Co/T				
Co.014	12Co/0.5Ru/T	15	0.12	328	111

Table 3. Summary of Physical Properties (contd.)

CATALYST	Composition	BET Surface Area (m^2/g)	Pore Volume (cc/g)	Average Pore Dia. (Å)	Average Part. Size (μm)
Co.015	20Co/0.43Ru/ $1La_2O_3$/A	141	-	-	67
Co.016	20Co/0.43Ru/ $1La_2O_3$/A	116	-	-	79
Co.017	20Co/0.5Ru/ $1La_2O_3$/A	123	-	-	73
Co.018	20Co/0.5Ru/A	158	-	-	69
Co.019	20Co/0.5Ru/S				110
Co.021	20Co/0.7Zr/S	213	1.12	210	74
Co.023	20Co/1.4Zr/S	213	-	-	
Co.024	20Co/8.5Zr/S	215	1.08	202	
Co.025	20Co/8.5Zr/S	208	0.97	187	87
Co.026	20Co/S(59)	184	-	-	
Co.027	20Co/S(59)	189	-	-	
Co.028	20Co/0.5Ru/0.5K/A	161	0.33	82	80
Co.029	30Co/0.5Ru/0.5K/A	140	-	-	76
Co.031	20Co/1.4Zr/S				75
Co.032	20Co/8.5Zr/A	155	0.30	77	
Co.034	20Co/8.5Zr/A	150	0.31	83	
Co.035	20Co/8.5Zr/S	207	1.21	233	89
Co.036	20Co/8.5Zr/S	209	-	-	
Co.037	12Co/T(A)	38	-	-	
Co.039	12Co/T(R)	13	-	-	
Co.040	12Co/T				130
Co.041	20Co/0.5Ru/8.5Zr/S	214	-	-	-
Co.044	20Co/15Zr/S				92
Co.047	20Co/0.5Ru/0.3K/A	162	0.31-	78	83
Co.048	20Co/0.5Ru/0.3K/ 8.5Zr/S				82

Table 3. Summary of Physical Properties (contd.)

CATALYST	Composition	BET Surface Area (m^2/g)	Pore Volume (cc/g)	Average Pore Dia. (Å)	Average Part. Size (μm)
Co.049	20Co/0.5Ru/0.3K/A				81
Co.053	20Co/0.5Ru/A				75
Co.054	20Co/0.3K/8.5Zr/S				101
Co.055	20Co/1Re/ $1La_2O_3$/A				86
Co.056	20Co/8.5La_2O_3/S				100
CAL.01	20Co/0.5Ru/A	178	0.34	76	
CAL.02	20Co/0.5Ru/A	158	-	-	74
CAL.03	20Co/0.5Ru/A	158	-	-	
CAL.04	20Co/0.5Ru/0.3K/A	151			72
CAL.05	20Co/0.5Ru/0.3K/A	163			73
CAL.06	20Co/0.5Ru/0.3K/A	162			72
CAL.07	20Co/0.5Ru/0.3K/A	-			
CAL.08	20Co/0.5Ru/0.3K/A	-			63
CAL.09	20Co/0.5Ru/0.3K/A				63
CAL.10	20Co/0.5Ru/0.3K/A	142	-	-	83

Table 4. H_2 Chemisorption[a] and TPR Results

Catalyst	H_2 Chemisorption[a]				TPR	
	Total (μ mol H_2/g cat)	Irrev. (μ mol H_2/g cat)	Average d_p[b] (nm)	% Disp.	%Co Red.[c] (TPR calc. catal.)	% Red.[d] (stand. red.)
Co.001	174±5	157±5		10.2		
Co.002	155	130		9.1		
Co.003	165	140		9.6		
Co.004[f] (1)	205	185	6.9	12.1	91	
(1)	147	-	9.6	7.4	-	
(1)	167	-	8.4	8.4	-	
(2)	126	-	11.1	6.3	64	
(3)	132	116	10.6	6.6	55	
(4)	144	123	9.8	7.2	46	
(5)	136	122	10.3	6.8	41	
Co.005	48	42	20	2.8	89	58
Co.005a	129	110	11	7.6	92	84
Co.006	44	32	19	4	80	
Co.007	33	23	36	2.0	78	78
Co.008						
Co.009	133	109	13	7.8	98	
Co.010						
Co.010a	124	100	12.5	7.3	91	89
Co.011	82	70	15.6	4.8	75	75
Co.012	89	74	15	5.2	80	80
Co.013	21	17	79	1.2	97	
Co.014	38	30	21	3.7	79	
Co.015[g] (1)	146	124	11.7	8.6	94	94
(2)	181	-	7.8	9.1	-	
(2)	194	-	7.2	9.7	-	
Co.016	163	146	10.5	9.6	96	96
Co.017	202	183	8.5	11.9	97	97
Co.018	185	165	9.2	11	97	94
Co.018Cl[h]					95	
Co.019	112	92		6.6		

Table 4. H_2 Chemisorption[a] and TPR Results (contd.)

Catalyst	H_2 Chemisorption[a]				TPR	
	Total (μ mol H_2/g cat)	Irrev. (μ mol H_2/g cat)	Average d_p[b] (nm)	% Disp.	%Co Red.[c] (TPR calc. catal.)	% Red.[d] (stand. red.)
Co.020						
Co.020a	153	126	10	9.1	88	
Co.020b	134	113	11	7.9	86	
Co.020c	115	100	13	6.8	88	
Co.021	74	50		4.3		
Co.022	141	122		8.3	80	
Co.023	158	136		9.3	81	
Co.024	87	72		5.1	91	
Co.025	93	77		5.5	75	
Co.026						
Co.027						
Co.028	170	148		10		
Co.029	175	155		7		
Co.030						
Co.031	71	51	20	4.2	82	
Co.032	55	39	26	3.2	85	
Co.033	43	32	31	2.5	79	
Co.034	114	91	14	6.7	96	
Co.035	125	115	11	7.2	82	
Co.036	122	98		7.2		
Co.037	21	3	48	2	99	
Co.038	45	35	21	4.3	91	
Co.039	19	16	40	1.8	72	
Co.040	14	11	53	1.4		
Co.041	70	55		4		
Co.043	137	109		8	86	

Table 4. H_2 Chemisorption[a] and TPR Results (contd.)

Catalyst		H_2 Chemisorption[a]				TPR	
		Total (μ mol H_2/g cat)	Irrev. (μ mol H_2/g cat)	Average d_p[b] (nm)	% Disp.	%Co Red.[c] (TPR calc. catal.)	% Red.[d] (stand. red.)
C0.047		146	-	9.6	7.3		
Co.053[i]	(1)	168	139	8	8.4	60	
	(2)	101	76	14	5.2	82	
	(3)	138	117	10	6.9	47	
Co.054						57	
Co.055[j]	(1)	165	139	8.5	8.3	78	
	(2)	179	163	8	9.0	50	
	(3)	103	84	14	5.2	76	
	(4)	192	165	7	9.6	-	
Co.056						58	
Co.60		65		14.4	2.1		
Co.61		277		7.6	9.2		
CAL.01		169	-	8.3(5.8[e])	4.4[e]	54	
CAL.02		-	-	(6.3[e])	5.1[e]	55	
CAL.03		-	-	5.7[e]	4.2[e]	85	
CAL.04		93		15.1(5.5[e]	3.5[e]		
CAL.05		100		14.1(5.6[e]	4.4[e]		
CAL.06				5.7[e]	4.2[e]		
CAL.10				7.2[e]	3.7[e]		
CAL.11		171		8.3	8.5		
CAL.12		146		9.6	7.3		
CAL.13		180		7.8	9.0		

(a) static H_2 chemisorption at 100°C
(b) Est. assuming $H_{tot}/Co_s = 1$, 5.46×10^{-20} m^2/Co_s, and $d_p = 5/S_{Co}/\rho$
S_{Co} is based on amt. Co reducible during standard reduction
(c) % Co reducible from TPR of calcined catalysts up to 900°C
(d) % Co reduced after standard reduction procedure
(e) Based on CO chemisorption
(f) (1)=uncalcined; (2)=flow calcined in air and reduced in H_2; (3)=ROR (4)=calcined in He; (5)=calcined in nitrogen
(g) (1)=flow calcined in air; (2)=uncalcined
(h) Co.018Cl = Chlorinated Co.018

Table 4. H_2 Chemisorption[a] and TPR Results (contd.)

(i) (1)=flow calcined in air; (2)=uncalcined; (3)=ROR
(j) (1)=calcined in air; (2)=calcined in nitrogen; (3)=uncalcined; (4)=ROR

Table 5. Summary of Fixed Bed Reaction Results

Catalyst	Run	Prep	CO Conv. (%)	Rate g CH2/ g cat/hr	R-C5+ g CH2/ g cat/hr	R (CO) mol/mol Co/s	wt% CH4	alpha	C3-C5 Ole/ Par	CO2 (%)	CO2 g/g cat/hr	E act. kcal/ mol	Comment
Co.001	4	(1)	2.6	0.116	0.056	6.8E-04	19.6	0.76	8.61	0.4	0.061		NSH**
Co.002	4	(2)	6.7	0.258	0.082	1.5E-03	26.1	0.64	1.97	0.1	0.012		NS
Co.003	1	(3)	5.5	0.185	0.044	1.1E-03	30.8	0.57	4.22			28.9	old startup
Co.004	1	(2) s	4.3	0.291	0.086	1.7E-03	30.4	0.62	2.77	0.1	0.025	25.9	NSH
"	2	u	11.2	0.517	0.155	3.0E-03	28.9	0.61	1.02	0.1	0.038		NSH
"	2h	u	47.6	0.548	0.211	3.2E-03	21.9	0.64	0 .40	2.3	0.090		NSH, high conv. study
"	2a	f	3.8	0.177	0.063	1.0E-03	25.5	0.65	3.02	0.1	0.024		NSH,calc.after run2,T surge
"	3	u	6.7	0.499	0.153	2.9E-03	27.8	0.61	1.45	0.1	0.036		NSH
"	3h	u	27.0	0.506	0.164	3.0E-03	27.3	0.62	0.46	0.8	0.048		NSH, high conv. study
"	4	u	1.8	0.427	0.241	2.5E-03	24.0	0.79	2.40	0.1	0.078		NSH, 10 atm
"	5	f	4.5	0.288	0.150	1.7E-03	19.4	0.75	7.84	0.1	0.03		NSH
"	6	n	6.9	0.466	0.151	2.7E-03	27.8	0.61	1.60	0.2	0.044		NSH
"	7	ROR	3.9	0.225	0.072	1.3E-03	28.8	0.61	3.01	0.2	0.042		NSH
"	8	He	5.8	0.399	0.144	2.3E-03	27.2	0.66	2.13	0.1	0.028		NSH
Co.005	2	(1)	3.3	0.087	0.037	5.1E-04	21.4	0.66	3.40	0.1	0.005		NS
"	2a		2.5	0.066	0.021	3.9E-04	25.9	0.59	4.92	0.1	0.004		CO:H2:Ar = 1:2:2
"	2b		2.4	0.064	0.021	3.7E-04	26.3	0.60	6.22	0.1	0.006		+ H2O (eq. 7.5% CO conv.)
"	3		3.3	0.077	0.024	4.5E-04	28.4	0.62	2.29	0.1	0.013		NSH
"	4		4.0	0.069	0.021	4.0E-04	30.0	0.62	2.16	0.2	0.009	25.1	NSH
"	5		3.9	0.171	0.084	1.0E-03	26.8	0.76	2.59	0.1	0.018		NSH, 10 atm
"	6		2.1	0.129	0.044	7.6E-04	25.7	0.64	5.53	0.1	0.017		NSH
"	7		6.7	0.084	0.040	4.9E-04	18.8	0.70	1.95	0.1	0.003		S2
"	8		2.7	0.154	0.067	9.0E-04	22.6	0.71	3.01	0.1	0.019		D (1:2), NSH
"	8a		2.5	0.140	0.059	8.4E-04	23.4	0.72	3.65	0.1	0.019		Ar added to rxn mix
"	8b		4.2	0.239	0.045	1.4E-03	40.0	0.60	2.42	0.1	0.032		Rxn @ 240 °C
"	8c		3.5	0.196	0.026	1.1E-03	49.6	0.59	3.38	0.1	0.049		Rxn @ 260 °C
"	8d		2.5	0.140	0.059	8.4E-04	23.4	0.72	3.65	0.1	0.019		Rxn @ 280 °C
"	9		1.5	0.082	0.025	4.8E-04	27.7	0.60	2.90	0.1	0.014		D (1:4), NSH
"	9a		1.4	0.075	0.020	4.4E-04	29.9	0.61	3.14	0.1	0.016		Ar added to rxn mix
"	9b		1.4	0.078	0.004	4.5E-04	62.9	0.58	5.07	0.3	0.055		Rxn @ 280 °C
"	10		1.9	0.106	0.045	6.2E-04	23.0	0.70	4.13	0.1	0.016		D (1:2), NSH
"	10a		1.6	0.090	0.024	5.3E-04	25.3	0.68	4.50	0.1	0.017		Ar added to rxn mix
"	10b		1.8	0.100	0.005	5.9E-04	48.0	0.65	5.00	0.2	0.037		Rxn @ 280 °C
"	10c		0.4	0.024	0.010	2.3E-04	25.9	0.76	1.98	0.1	0.013	13.8	at 220 after rxn @280
Co.005a	1	(4a)	3.2	0.227	0.067	1.3E-03	30.0	0.60	3.05	0.1	0.034		NSH
Co.005b	1	(1)	2.7	0.045	0.024	2.6E-04	16.0	0.74	0.61	0.4	0.023		S2,1/4WGS.03+3/4Co.005
Co.005c	1	(1)	5.7	0.071	0.031	4.1E-04	20.3	0.68	0.21	1.8	0.076		S2,1/2WGS.03+1/2Co.005
Co.006	1	(5)	2.7	0.052	0.007	5.1E-04	45.0	0.49	1.90	0.1	0.006		NSH
Co.007	1	(5)	3.2	0.024	0.003	7.0E-03	49.8	0.50	0.72	0.2	0.004		NSH
Co.009	1	(1)	4.9	0.346	0.090	2.0 E -0	31.1	0.57	1.69	0.1	0.020		NSH
"	2		4.9	0.338	0.091	2.0 E -0	31.1	0.58	1.64	0.1	0.026		NSH
Co.010a	1	(4b) s	3.5	0.246	0.076	1.4E-03	29.5	0.62	2.58	0.2	0.040		NSH
"	2		4.1	0.262	0.080	1.5E-03	30.0	0.61	2.31	0.1	0.022		NSH
Co.011	2	(6b)	2.9	0.094	0.037	5.5E-04	22.4	0.61	4.83	0.3	0.030		NSH

Table 5. Summary of Fixed Bed Reaction Results (contd.)

Catalyst	Run	Prep	CO Conv (%)	Rate g CH2/ g cat/hr	R-C6+ g CH2/ g cat/hr	R (CO) mol/mol Co/s	wt% CH4	alpha	C3-C5 Ole/ Par	CO2 (%)	CO2 g/g cat/hr	E act. kcal/ mol	Comment
Co.012	1	(1)	3.8	0.083	0.027	4.8E-04	26.3	0.64	4.40			22.5	slow CO startup (60 min)
"	2		4.4	0.085	0.030	5.0E-04	29.1	0.64	1.93	0.3	0.018		NSH
"	3		2.1	0.081	0.026	4.7E-04	28.6	0.66	3.57	0.4	0.049		NSH
"	4		2.5	0.105	0.035	6.2E-04	28.4	0.61	4.94	0.4	0.023		NSH
Co.014	1	(1)	1.5	0.028	0.009	2.8E-04	32.3	0.63	4.70	0.1	0.003		NSH
"	2		2.6	0.034	0.013	3.3E-04	27.7	0.69	10.8	0.1	0.011	26.0	NSH
Co.015	1	(4) s	6.8	0.211	0.063	1.2E-03	26.7	0.60	3.30	0.1	0.011		slow CO startup (120 min)
"	2	f	7.0	0.388	0.135	2.3E-03	26.4	0.64	1.39	0.1	0.011		NSH
"	3	u	6.7	0.375	0.123	2.2E-03	28.2	0.63	1.62	0.2	0.011		NSH
Co.016	1	(4a) s	5.2	0.161	0.035	9.4E-04	33.6	0.56	6.85				slow CO startup (30 min)
"	2	f	5.1	0.291	0.112	1.7E-03	25.1	0.68	2.48	0.1	0.01		NSH
Co.017	2	(1) s	4.6	0.139	0.066	8.2E-04	22.0	0.69	3.72	0.1	0.012		NS
"	2a	s	3.7	0.111	0.043	6.5E-04	25.9	0.64	4.19	0.1	0.011		CO:H2:Ar = 1:2:2
"	2b	s	3.4	0.102	0.039	6.0E-04	26.9	0.65	4.39	0.1	0.013		+ H2O (eq. 7.5% CO conv.)
"	3	f	4.9	0.274	0.111	1.6E-03	23.0	0.67	2.41	0.2	0.030		NSH, calc. flow air
Co.018	2	s	3.4	0.170	0.068	1.0E-03	27.2	0.69	2.24	0.1	0.013		NS
"	2a	s	2.7	0.133	0.041	7.8E-04	33.2	0.64	2.52	0.1	0.011		CO:H2:Ar = 1:2:2
Co.018	2b	s	3.0	0.147	0.045	8.6E-04	33.6	0.63	2.41	0.1	0.015		+ H2O (eq. 7.5% CO conv.)
"	3	s	4.1	0.290	0.086	1.7E-03	30.0	0.62	2.34	0.1	0.022		NSH
"	4	s	3.6	0.340	0.180	2.0E-03	25.4	0.80	1.92	0.1	0.041		NSH, 10 atm
"	5	f	7.5	0.470	0.136	2.8E-03	29.0	0.60	1.93	0.3	0.055		NSH
Co.018Cl	1	(1)	4.5	0.320	0.075	1.9E-03	33.5	0.57	1.45	0.1	0.018		NSH
Co.019	1	(1)s	4.4	0.088	0.047	5.2E-04	15.2	0.74	7.61				NS
"	2	s	2.2	0.085	0.046	4.9E-04	18.9	0.73	8.59	0.3	0.040		NSH
"	3	f	3.4	0.142	0.071	8.3E-04	19.3	0.72	6.74	0.2	0.025		NSH
Co.020a	1	(4) s	4.6	0.343	0.085	2.0E-03	33.5	0.57	1.70	0.1	0.024		NSH
"	2		4.4	0.315	0.086	1.8E-03	31.2	0.59	1.96	0.1	0.028		NSH
Co.020b	1	(4b) s	4.4	0.311	0.084	1.8E-03	31.7	0.58	1.81	0.2	0.051		NSH
Co.020c	1	(4a) s	4.0	0.287	0.083	1.7E-03	30.4	0.60	2.38	0.1	0.017		NSH
Co.021	1	(6b)	3.4	0.109	0.032	6.4E-04	27.3	0.62	2.78	0.1	0.012	28.2	NSH
"	2		3.6	0.114	0.035	6.7E-04	28.0	0.56	2.69	0.1	0.012		NSH
Co.022	1	(6c)	3.8	0.121	0.037	7.1E-04	26.7	0.55	2.91	0.1	0.015	30.1	NSH
Co.023	1	(6c)	3.8	0.123	0.038	7.2E-04	28.3	0.56	3.18	0.2	0.023	29.5	NSH
Co.024	1	(7)	5.1	0.165	0.047	9.7E-04	32.8	0.62	2.08	0.5	0.055		NSH
"	2		5.7	0.182	0.060	1.1E-03	28.7	0.62	2.25	0.3	0.035		NSH
Co.025	1	(4)	5.0	0.160	0.062	9.4E-04	23.5	0.63	4.13	0.2	0.019	26.9	NSH
Co.026	1	(1)	4.4	0.129	0.043	5.0E-04	26.9	0.62	2.65	0.2	0.022		NSH
"	1h		22.9	0.170	0.072	6.6E-04	22.6	0.67	0.64	1.5	0.037		NSH, high conv. study
Co.027	1	(1)	4.2	0.169	0.068	6.6E-04	23.0	0.65	3.44	0.2	0.026		NSH
"	1h		17.8	0.180	0.085	7.0E-04	19.4	0.71	0.96	1.2	0.011		NSH, high conv. study
Co.028	1	(4)	3.8	0.146	0.076	5.7E-04	18.2	0.76	7.63	0.2	0.031		NSH
"	2		4.3	0.167	0.105	6.5E-04	14.7	0.80	13.2	0.2	0.030	28.4	NSH
"	3		4.5	0.206	0.126	8.0E-04	15.5	0.79	13.4	0.2	0.037		NSH, re-calc. in flow air
Co.029	1	(4)	2.8	0.173	0.105	6.7E-04	15.3	0.79	25.9	0.2	0.026		NSH

Table 5. Summary of Fixed Bed Reaction Results (contd.)

Catalyst	Run	Prep	CO Conv (%)	Rate g CH2/ g cat/hr	R-C6+ g CH2/ g cat/hr	R (Co) mol/mol Co/s	wt% CH4	alpha	C3-C5 Ole/ Par	CO2 (%)	CO2 g/g cat/hr	E act. kcal/ mol	Comment
Co.031	1	(1)	1.9	0.060	0.022	3.5E-04	26.1	0.64	4.65	0.3	0.031		NSH
Co.032	1	(1)	3.3	0.183	0.079	1.1E-03	22.0	0.70	5.28	0.1	0.022		NSH
Co.033	1	(1)	1.3	0.073	0.027	4.3E-04	24.1	0.67	7.36	0.1	0.020		NSH
Co.034	1	(4)	5.0	0.275	0.107	1.6E-03	24.0	0.67	4.29	0.1	0.018		NSH
Co.035	2	(6)	4.6	0.147	0.068	8.6E-04	22.0	0.69	4.84	0.2	0.019		NSH
Co.036	2	(6c)	3.9	0.125	0.045	7.3E-04	28.9	0.67	4.20	0.1	0.013		NSH
Co.037	1	(4a)	2.7	0.053	0.011	5.2E-04	32.8	0.59	2.82				NSH
Co.038	1	(4a)	4.5	0.051	0.018	4.9E-04	25.1	0.68	4.63	0.3	0.013	24.2	NSH
Co.039	1	(5)	1.1	0.021	0.004	2.0E-04	57.2	0.64	0.84	0.2	0.010	25.6	NSH, cracking in the line
"	2		3.9	0.049	0.007	4.7E-04	42.4	0.48	0.95	0.2	0.009		NSH
Co.040	1	(4a)	1.9	0.037	0.004	3.7E-04	45.2	0.53	1.79	0.2	0.007		NSH
"	2		2.8	0.033	0.004	3.3E-04	44.6	0.46	1.12	0.2	0.007		NSH
Co.041	1	(4)	3.5	0.136	0.042	8.0E-04	40.7	0.69	1.47	0.6	0.079		NSH, cracking in the line
Co.043	1	(4a)	4.6	0.104	0.062	6.1E-04	15.3	0.78	12.1	0.6	0.048		NSH, 2.5 hr on-stream
"	2		3.7	0.078	0.045	4.6E-04	16.3	0.78	7.75	0.5	0.035	35.1	NSH
Co.044	1	(4)	3.1	0.179	0.081	1.0E-03	22.7	0.73	5.16	0.3	0.020		NSH
Co.045	1	(4)	2.6	0.161	0.076	9.4E-04	22.2	0.73	6.89	0.3	0.022		NSH
Co.047	1	(4)	6.4	0.263	0.128	1.5E-03	21.3	0.73	7.20	0.3	0.040	26.6	NSH
Co.048	1	(4)	3.5	0.162	0.094	9.5E-04	16.3	0.77	17.1	0.2	0.027	28.0	NSH
Co.049	1	(4)	7.1	0.366	0.153	2.1E-03	23.4	0.69	5.63	0.3	0.043		NSH
"	2		6.0	0.388	0.160	2.3E-03	23.3	0.68	5.93	0.3	0.056		NSH, re-calcined in flow air
"	3	f	6.7	0.410	0.158	2.4E-03	25.2	0.69	4.64	0.3	0.059		NSH
"	3h	f	44.9	0.457	0.178	2.7E-03	26.5	0.67	0.67	3.8	0.131		NSH,HCS
Co.053	1	(1)	7.0	0.408	0.127	2.4E-03	27.3	0.62	3.07	0.2	0.049		NSH
"	1h		28.5	0.417	0.145	2.4E-03	26.8	0.64	0.79	1.6	0.081		NSH, high conv. study
"	2	f	6.6	0.433	0.174	2.5E-03	23.4	0.63	2.35	0.2	0.052		NSH
"	3		7.8	0.453	0.143	2.7E-03	27.6	0.62	1.67	0.1	0.027		NSH
"	3h		31.5	0.457	0.164	2.7E-03	25.4	0.65	0.52	0.9	0.044		NSH, high conv. study
"	4	u	6.1	0.426	0.142	2.5E-03	28.3	0.65	1.41	0.1	0.030		NSH
"	5	ROR	5.6	0.360	0.118	2.1E-03	27.9	0.64	1.49	0.2	0.034		NSH, ROR
"	6	f	8.2	0.485	0.163	2.8E-03	28.9	0.64	1.25	0.1	0.030		NSH
"	7	f	9.4	0.552	0.147	3.2E-03	34.3	0.60	1.17	0.1	0.044		NSH, Rxn @ 227 °C
"	7a	f	1.7	0.099	0.018	5.8E-04	38.1	0.60	8.37	0.2	0.028		xn @245 °C, T surge 280 °C
"	7b	f	2.0	0.119	0.031	7.0E-04	32.1	0.62	4.20	0.1	0.021		cal(5 hr) & red after run 7
"	8	f	7.7	0.450	0.144	2.6E-03	30.3	0.65	1.27	0.1	0.036		NSH
"	8a	f	6.3	0.368	0.103	2.2E-03	32.8	0.65	1.44	0.1	0.047		Ar added to the rxn mix.
"	8b	f	3.0	0.177	0.037	1.0E-03	37.3	0.65	3.79	0.1	0.033		xn @ 240 °C , T surge 275 °
"	9	f	4.3	0.470	0.225	2.8E-03	21.6	0.69	1.49	0.2	0.046		D (1:2), NSH
"	9a	f	7.5	0.411	0.067	2.4E-03	46.9	0.62	3.65	0.2	0.070		Ar added to the rxn mix.
"	9b	f	11.9	0.647	0.116	3.8E-03	42.7	0.59	1.10	0.1	0.046		Rxn @ 240 °C
"	10		5.6	0.304	0.091	1.8E-03	29.2	0.60	1.56	0.2	0.008		D(1:2) , NSH
"	10a		11.9	0.647	0.116	3.8E-03	42.7	0.59	1.10	0.2	0.046		Rxn @ 240 °C
"	10b		7.5	0.411	0.067	2.4E-03	46.9	0.62	3.65	0.4	0.070		Rxn @ 260 °C
"	10c		3.0	0.163	0.035	9.6E-04	38.8	0.69	10.0	0.3	0.054		Rxn @ 280 °C
"	11		5.4	0.289	0.102	1.7E-03	26.9	0.64	1.55	0.1	0.022		D (1:2) ,NSH

Table 5. Summary of Fixed Bed Reaction Results (contd.)

Catalyst	Run	Prep	CO Conv (%)	Rate g CH2/ g cat/hr	R-C6+ g CH2/ g cat/hr	R (Co) mol/mol Co/s	wt% CH4	alpha	C3-C5 Ole/ Par	CO2 (%)	CO2 g/g cat/hr	E act. Kcal/ mol	Comment
Co.053	11a		3.8	0.205	0.047	1.2E-03	38.7	0.69	9.14	0.3	0.060		Rxn @ 280 °C
Co.054	1	(1)	1.2	0.041	0.023	2.4E-04	17.8	0.79	16.3	0.2	0.014		NSH
Co.055	1	(1) f	9.1	0.490	0.159	2.9E-03	28.9	0.63	1.31	0.2	0.034		NSH
"	2	u	4.9	0.290	0.105	1.7E-03	25.7	0.65	1.49	0.2	0.022		NSH, T surge
"	3	u	11.0	0.611	0.193	3.6E-03	29.4	0.60	1.02	0.2	0.033		NSH
"	4	u	5.9	0.380	0.124	2.2E-03	28.3	0.60	1.94	0.2	0.047		NSH
"	5	u	6.6	0.409	0.135	2.4E-03	29.6	0.59	1.83	0.2	0.030		NSH
"	6	ROR	7.5	0.469	0.145	2.7E-03	30.9	0.63	1.21	0.2	0.023		NSH
"	7	n	7.5	0.466	0.119	2.7E-03	33.5	0.60	1.11	0.2	0.031		NSH
Co.056	1	(1)	2.4	0.137	0.054	8.0E-04	23.9	0.69	8.22	0.1	0.029		NSH
"	2	u	2.2	0.137	0.054	8.0E-04	23.4	0.68	9.44	0.1	0.033		NSH
Co.057	1	(1)	2.8	0.171	0.078	1.0E-03	23.4	0.73	4.65	0.1	0.029		NSH
Co.060	1	(2)	3.8	0.244	0.097	9.5E-04	25.0	0.69	3.82	0.1	0.023		NSH
Co.061	1	(2)	9.4	0.556	0.188	2.2E-03	29.2	0.67	1.42	0.1	0.035		NSH
CAL.01	1	(1)	4.8	0.181	0.068	1.1E-03	24.4	0.66	5.86	0.3	0.036		NSH, temp. surge (startup)
"	2		7.4	0.491	0.142	2.9E-03	28.7	0.61	2.06	0.4	0.083		NSH
"	3		2.5	0.164	0.053	9.6E-04	25.6	0.63	4.97	0.2	0.052		NSH, HT, re-reduced
"	4		7.3	0.483	0.103	2.8E-03	35.8	0.57	1.21	0.2	0.098		NSH, HT, re-calcined
CAL.02	1	(1)	6.1	0.379	0.121	2.2E-03	27.3	0.63	3.04	0.2	0.040		NSH
CAL.03	1	(1)	7.3	0.459	0.133	2.7E-03	29.0	0.60	2.59	0.2	0.048		NSH
CAL.04	1	(1)	4.1	0.234	0.123	1.4E-03	19.1	0.71	8.98	0.2	0.026		NSH
CAL.05	1	(1)	4.7	0.274	0.134	1.6E-03	20.8	0.75	6.85	0.2	0.026		NSH
CAL.06	1	(1)	5.8	0.267	0.135	1.6E-03	20.7	0.74	5.50	0.2	0.021		NSH
CAL. 10	1	(1)	3.5	0.196	0.097	1.1E-03	23.5	0.74	1.75	0.2	0.05		NSH
CAL.11	1	(1)	5.2	0.281	0.147	1.6E-03	20.0	0.75	4.71	0.2	0.029		NSH
CAL.12	1	(1)	5.2	0.288	0.143	1.7E-03	21.6	0.73	3.89	0.2	0.035		NSH
CAL.13	1	(1)	4.6	0.258	0.142	1.5E-03	18.0	0.77	3.38	0.2	0.024		NSH
CoW.01	1	(4a)	1.2	0.016	0.003	9.5E-05	30.2	0.58	3.78	0.2	0.006		NSH, reduced at 230 °C
"	1		0.5	0.007	0.001	3.4E-05	42.1	0.51	0.95	0.1	0.003		NSH, re-reduced at 350 °C
"	2		0.2	0.006	0.000	3.4E-05	40.9	0.51	11.3	0.1	0.006		NSH, reduced at 350 °C
CoW.02	1	(4a)	0.3	0.009	0.002	5.4E-05	25.6	0.60	4.94	0.1	0.008		NSH, reduced at 230 °C
CoW.03	1	(4a)	·										NSH, negligible activity
CoW.04	1	(4a)											S2, negligible activity
CoW.05	1	(4c)	2.8	0.035	0.006	2.1E-04	33.1	0.55	0.66	0.2	0.008		S2, reduced at 350 °C
"	2	u	4.7	0.058	0.011	3.4E-04	34.8	0.50	0.85	0.2	0.009		S2
CoW.06	1	(4a)	3.3	0.041	0.012	2.4E-04	26.0	0.59	2.21	0.2	0.007		S2, reduced at 250 °C
"	2	u	16.6	0.207	0.004	1.2E-03	68.7	0.32	0.37	0.3	0.073		S2
CoW.06	2		17.0	0.207	0.004	1.2E-03	68.7	0.32	0.37	1.7	0.07		S2, rxn. at 280 °C
UOP	1	(1)	7.8	0.298	0.104	1.7E-03	22.6	0.61	1.29	0.2	0.023		NSH

Table 5. Summary of Fixed Bed Reaction Results (contd.)

Reaction Conditions: T = 220°C, H2:CO = 2, 1 atm

All the catalysts are reduced and passivated before loading into reactor, then rereduced in-situ

All catalysts are calcined at UPARC (static) : except where specified in prep. column

s : calcined at Pitt, static

f : calcined at Pitt, flow

u : uncalcined

n : Nitrogen calcined

In some cases, "re-calcined" means calcination of the calcined catalyst from UPARC for a longer period

(1) single step, aqueous incipient wetness
(2) Two step impregnation: aqueous incipient wetness of Co + acetone/ethanol impregnation of Ru, La
(3) three step, with calcination after each step, acetone incipient wetness
(4) two step, aqueous incipient wetness, (a) intermediate calcination, (b) intermediate reduction,
(c) intermediate calcination 750 °C
(5) single step, acetone impregnation
(6) single step, aqueous kneading, (a) = 150%, (b) = 110% of pore volume
(6c) aqueous kneading for Co, calcined, then aqueous incipient wetness for Zr
(7) Two step impregnation :organic incipient wetness + aqueous incipient wetness
NS New startup
NSH New startup, heated inlet
S2 was done in the second system
~ Davison Grade 59 Silica, if not specified, S refers Davison Drade 952 Silica
# corrected overheated line on 3/6/1994
D (x:y) Catalyst bed dilution with x parts cat. and y parts -alumina
Co.018Cl Chlorinated Co.018

Table 6

SUMMARY OF M3 SBCR RUN RESULTS

)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
)Conversion is total CO conversion over the period (%).
)Conversion and selectivities are calculated using N2 as an internal
standard in the GC analysis of the offgas.
)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
)Alpha: Based on GC analysis of offgas and liquid product.

m	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
35	C0.041	26.0	1	23	39	240	450	2.0	20	35.7	1.00	13.6	2.1	82.9	1.41	0.79	0.82	1.09	0.74	18.2	G.C.Calib
35	C0.041	26.0	2	54	63	250	450	2.0	20	42.1	1.17	27.3	4.6	64.4	3.78	0.65	--	0.49	0.41	--	
35	C0.041	26.0	3	78	87	260	450	2.0	20	45.1	1.24	41.7	6.8	44.9	6.58	0.51	--	0.35	0.37	--	
35	C0.041	26.0	4	102	111	260	450	2.0	20	46.7	0.77	39.1	4.6	49.9	6.40	0.56	--	0.66	0.52	--	
35	C0.041	26.0	5	126	135	260	450	2.0	20	49.6	0.61	39.4	4.0	49.6	7.00	0.57	--	0.70	0.52	--	
35	C0.041	26.0	6	150	159	260	450	2.0	20	47.9	0.95	33.1	3.9	58.7	4.32	0.64	--	0.75	0.52	--	
35	C0.041	26.0	7	174	183	260	450	2.0	20	49.7	1.24	30.9	4.4	61.3	3.50	0.66	--	0.71	0.49	--	
35	C0.041	26.0	8	198	206	240	450	2.0	20	19.6	0.55	17.3	2.6	79.1	0.93	0.71	--	2.08	1.63	--	

Feed Gas Rates

Per No	N2 SLH	H2 SLH	CO SLH	Total SLH
1	568	225	112	905
2	568	225	112	905
3	568	225	112	905
4	341	135	68	544
5	253	100	50	403
6	163	160	80	403
7	103	200	100	403
8	571	225	112	908

Table 7

SUMMARY OF M4 SBCR RUN RESULTS

)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
)Conversion is total CO conversion over the period (%).
)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
)Alpha: Based on GC analysis of offgas and liquid product.

un	Cat.	Cat.	Per	Time	Time	Temp	Pres	H2:	Synfl	Conv.	Prod.	Selectivities				Alpha	Alpha	Olefin/Paraf		Olefins	Comments
o	No	wt,g	No	Start	Stop	C	psi	CO	cc/hr	%	Rate	%CH4	%C2	%C3+	%CO2	GC	Liq	C3	C4	C6-18,%	
30	Co.011	15.9	1	23	40	240	450	2.0	20	8.0	0.36	5.8	3.9	87.8	2.49	0.71	0.89	5.75	3.00	22.4	G.C.Calib
30	Co.011	15.9	2	54	64	250	450	2.0	20	15.8	0.72	10.0	3.0	84.8	2.28	0.74	--	4.22	2.40	--	
30	Co.011	15.9	3	78	87	260	450	2.0	20	23.6	1.06	18.1	3.7	74.5	3.72	0.67	--	2.21	1.54	--	
30	Co.011	15.9	4	102	111	270	450	2.0	20	28.3	1.26	26.5	3.4	64.9	5.23	0.60	--	1.67	1.14	--	G.C.Calib
30	Co.011	15.9	5	126	135	278	450	2.0	20	28.5	1.27	34.5	4.0	55.1	6.43	0.53	--	1.84	1.26	--	
30	Co.011	15.9	6	150	159	280	450	2.0	20	36.0	0.95	40.3	4.5	47.9	7.32	0.48	--	1.77	1.20	--	
30	Co.011	15.9	7	174	183	280	450	2.0	20	38.5	0.77	43.7	4.7	43.7	7.90	0.45	--	1.93	1.29	--	
30	Co.011	15.9	8	198	207	280	450	2.0	20	36.0	1.15	38.5	4.5	50.9	6.07	0.52	--	2.18	1.43	--	
30	Co.011	15.9	9	222	230	240	450	2.0	20	4.4	0.20	1.9	4.0	85.5	3.63	0.66	--	6.00	3.67	--	

	Feed Gas Rates			
Per No	N2 SLH	H2 SLH	CO SLH	Total SLH
1	558	225	112	895
2	558	225	112	895
3	558	225	112	895
4	558	225	112	895
5	558	225	112	895
6	338	135	67	540
7	250	100	50	400
8	160	160	80	400
9	558	225	112	895

Table 8

DATE: 03/31/95

COMPARISON OF CONVERSION AND SELECTIVITY OF

COBALT BASED F-T CATALYSTS AT STARTUP CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Catalyst Prom%	Metal%	Composit. Suppt
M-4	SBCR												
3	Co.002	15.2	29.4	1.42	17.3	2.3	79.4	1.01	0.73	0.82	1.0La	0.43Ru	Al
4	Co.024	15.4	25.5	1.21	8.6	2.0	89.0	0.43	0.79	0.84	8.5Zr	0.0	Si
5	C0.035	15.4	24.8	1.18	8.5	2.1	89.0	0.47	0.78	0.84	8.5Zr	0.0	Si
6	C0.028	15.4	21.2	1.00	6.1	1.6	91.3	1.01	0.81	0.83	0.5K	0.5Ru	Al
7	C0.043	15.4	13.0	0.61	3.7	1.8	93.4	1.06	0.79	0.85	8.5Zr 0.5K	0.5Ru	Si
8	CO.006	15.0	2.7	0.13	0.1	0.2	98.0	1.75	0.67	0.85	0.0	0.75Re	Ti
9	CO.048	15.4	19.1	0.90	9.9	1.6	87.4	1.10	0.77	0.88	8.5Zr 0.3K	0.5Ru	Si
10	CAL.02	15.9	34.5	1.58	12.9	2.0	83.9	1.23	0.75	0.81	0.0	0.5Ru	Al
11	CAL.03	15.6	29.7	1.39	13.5	2.1	83.4	1.08	0.74	0.86	0.0	0.5Ru	Al
12	CO.053	15.9	34.2	1.56	12.6	2.0	84.2	1.23	0.75	0.83	0.0	0.5Ru	Al
13	CO.054	15.7	10.4	0.48	4.7	1.8	92.3	1.17	0.78	0.86	8.5Zr 0.3K	0.0	Si
14	BlendA	20.0	29.3	1.41	10.1	1.6	86.3	2.02	0.77	0.86	5.0Cu	4.0Cr	Al
15	Co.034	13.0	27.5	1.54	10.4	1.6	87.2	0.80	0.78	0.84	8.5Zr	0.0	Al
16	CAL.04	16.1	26.3	1.34	7.1	1.3	90.3	1.38	0.80	0.85	0.3K	0.5Ru	Al
17	CAL.08	15.0	16.9	0.93	5.9	0.8	91.7	1.36	0.82	0.88	0.3K	0.5Ru	Al
18	CAL.07	15.0	20.6	1.03	7.7	1.2	90.0	1.09	0.81	0.88	0.3K	0.5Ru	Al
19	CAL.05	15.7	26.6	1.22	7.3	1.3	90.2	1.19	0.82	0.86	0.3K	0.5Ru	Al
20	CAL.06	15.0	5.6	0.26	3.1	2.1	92.0	2.86	0.80	0.90	0.3K	0.5Ru	Al
21	CO.004	15.9	39.3	1.80	15.2	2.3	81.2	1.38	0.74	0.80	1.0La	0.43Ru	Al
22	BlendB	30.5	35.6	1.64	12.7	1.6	79.4	6.29	0.75	0.81	5.0Cu	4.0Cr	Al
23	CAL.09	15.0	17.4	0.84	0.02	1.2	97.9	0.95	0.84	0.88	0.3K	0.5Ru	Al
24	Co.053	28.5	50.4	1.28	14.1	2.1	81.8	2.03	0.75	0.79	0.0	0.5Ru	Al
25	CO.056	15.0	11.4	0.55	7.8	3.6	87.2	1.43	0.67	0.87	8.5La	0.0	Si
26	CAL.10	15.6	21.9	1.01	5.4	1.5	91.9	1.25	0.79	0.85	0.3K	0.5Ru	Al
27	Co.050	14.6	20.4	1.01	6.8	1.9	90.2	1.04	0.78	0.87	8.5Zr 0.1K	0.5Ru	Si

Note: Catalysts for all runs except Run 8 screened thru 150 x 400 mesh.
Catalyst for Run 8 screened thru 100 x 400 mesh.

Blend A contains 15.0 gm of Cat. No. Co.005 plus 5.0 gm of Cat. No. WGS.03.
Cat. Nos. CAL.07 and CAL.08 were prereduced and wax coated.
H2 to CO ratio for Runs 16 and 17 was 1.76/1.0.
Cat. No. CAL.06 was H2 reduced and air stabilized.
Blend B contains 15.0 gm of Cat. No. Co.005 plus 15.0 gm of Cat. No. WGS.03.
Cat. No. CAL.09 was prereduced and coated with Soya.
Cat. No. CAL.10 was prepared on Condea Alumina.

Table 8
(Continued)

DATE: 03/31/95

COMPARISON OF CONVERSION AND SELECTIVITY OF

COBALT BASED F-T CATALYSTS AT STARTUP CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Catalyst Prom%	Metal%	Composit. Suppt
M-4	SBCR												
28	Co.057	15.8	18.7	0.86	5.3	1.5	92.2	0.98	0.81	0.85	1.0La	1.0Re	Si
29	Co.061	45.4	29.0	0.46	14.4	2.6	81.6	1.53	0.72	0.80	0.0	0.5Ru	Al
30	Co.011	15.9	8.0	0.36	5.8	3.9	87.8	2.49	0.71	0.89	0.0	0.0	Si
31	CAL.12	15.9	27.6	1.26	7.9	1.0	90.0	1.11	0.79	0.84	0.3K	0.5Ru	Al
32	CAL.11	15.9	30.6	1.40	7.8	1.4	89.6	1.18	0.80	0.84	0.3K	0.5Ru	Al
33	CAL.13	15.9	28.1	1.28	6.4	1.4	90.9	1.29	0.81	0.85	0.3K	0.5Ru	Al

Note: Catalysts for all runs screened thru 150 x 400 mesh.
Catalyst No. Co.061 contains 30 wt.% cobalt.

Table 9

DATE: 03/31/95

COMPARISON OF CONVERSION AND SELECTIVITY OF

COBALT BASED F-T CATALYSTS AT STARTUP CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Catalyst Prom%	Metal%	Composit. Suppt
M-3	SBCR												
5	CO.003	15.1	31.7	1.53	16.7	2.4	79.8	1.16	0.71	--	1.0La	0.5Ru	Al
6	CO.011	15.3	14.3	0.67	7.6	1.6	89.4	1.42	0.78	0.83	0.0	0.0	Si
7	CO.012	15.8	13.9	0.63	6.1	1.5	90.6	1.74	0.80	0.89	0.0	0.0	Si
8	CO.015	15.0	28.3	1.37	12.7	2.0	84.1	1.24	0.76	0.80	1.0La	0.43Ru	Al
9	CO.011	15.0	18.5	0.89	8.8	1.7	88.8	0.77	0.78	0.83	0.0	0.0	Si
11	CO.017	15.0	27.2	1.32	11.2	1.8	85.9	1.14	0.77	0.80	1.0La	0.5Ru	Al
12	CO.018	15.6	33.8	1.56	9.7	2.0	86.6	1.68	0.75	0.85	0.0	0.5Ru	Al
13	CO.016	14.7	26.4	1.31	(1)	1.7	89.3	0.68	0.78	0.81	1.0La	0.43Ru	Al
14	CO.019	15.2	13.9	0.66	(2)	1.7	97.2	0.70	0.80	0.86	0.0	0.5Ru	Si
15	CO.005	14.7	27.1	1.34	7.9	1.6	89.7	0.82	0.79	0.82	0.0	0.0	Al
16	CO.002	15.4	30.1	1.42	12.5	2.5	83.9	1.09	0.75	0.80	1.0La	0.43Ru	Al
17	CO.025	15.6	26.6	1.24	10.7	2.1	86.4	0.82	0.76	0.82	8.5Zr	0.0	Si
18	CO.004	15.0	33.9	1.64	15.3	2.4	80.9	1.37	0.74	0.79	1.0La	0.43Ru	Al
19	CO.021	15.6	23.2	1.08	9.4	2.0	88.0	0.73	0.77	0.82	0.7Zr	0.0	Si
20	CO.041	15.8	25.3	1.16	11.0	2.1	86.0	0.88	0.76	0.84	8.5Zr	0.5Ru	Si
21	CO.014	15.1	8.5	0.40	8.3	3.5	85.8	2.43	0.74	0.83	0.0	0.5Ru	Ti
22	CO.040	14.5	1.8	0.09	0.0	4.0	94.1	1.89	0.71	0.82	0.0	0.0	Ti
23	CO.047	15.8	28.2	1.29	7.7	1.5	89.3	1.47	0.79	0.84	0.3K	0.5Ru	Al
24	CO.049	15.6	30.6	1.41	10.9	1.8	85.7	1.66	0.76	0.82	0.1K	0.5Ru	Al
25	CO.047	15.6	28.1	1.30	8.8	1.6	88.1	1.50	0.78	0.85	0.3K	0.5Ru	Al
26	CO.031	15.9	30.9	1.41	12.1	1.9	84.9	1.12	0.75	0.83	1.4Zr	0.0	Al
27	CO.029	15.9	28.3	1.27	8.3	1.6	87.9	2.21	0.77	0.84	0.5K	0.5Ru	Al
28	COW.01	15.0	1.1	0.05	0.0	12.	83.9	4.23	0.58	--	5.0Cu	10.0Zn	Al
29	CO.053	25.2	42.0	1.19	15.8	2.3	79.5	2.42	0.73	--	0.0	0.5Ru	Al
30	CO.053	29.6	41.8	1.02	22.6	2.9	71.5	3.05	0.66	0.77	0.0	0.5Ru	Al
31	CO.055	15.0	30.0	1.46	23.7	3.7	70.2	2.30	0.61	0.81	1.0La	1.0Re	Al
32	CO.044	16.4	20.9	0.93	6.7	1.9	90.8	0.56	0.77	0.83	15.0Zr	0.0	Si
33	CO.053	31.4	41.4	0.94	23.2	3.1	69.6	4.06	0.65	0.76	0.0	0.5Ru	Al
34	CO.060	15.6	31.4	1.46	14.0	2.3	82.2	1.48	0.75	0.79	0.0	0.0	Al
35	CO.041	26.0	35.7	1.00	13.6	2.1	82.9	1.41	0.79	0.82	8.5Zr	0.5Ru	Si
36	CO.032	15.9	24.0	1.10	9.1	1.8	88.2	0.83	0.77	0.83	8.5Zr	0.0	Al
37	CO.045	15.9	14.8	0.67	8.0	1.7	89.4	0.91	0.76	0.84	4.0Zr	0.0	Si
38	Co.058	15.9	28.0	1.28	11.9	2.1	85.1	0.91	0.75	0.85	1.0La	0.0	Al
39	Co.064	15.9	34.2	1.56	13.6	2.3	82.6	1.55	0.73	0.85	8.5Zr	0.5Ru	Al

Note: Catalyst Run 9 screened thru 170 x 400 mesh.
Catalysts For Runs 11 through 28 (except Runs 21 and 22) screened thru 150x 400 mesh.
Catalysts for Runs 21 and 22 screened thru 100 x 400 mesh.
Catalyst No. CO.029 contained 30 wt% cobalt.

G.C.Problems
(1) Weak TCD filaments in G.C. CH4 peaks smaller than expected.
(2) Internal valve in G.C. leaked. CH4 peak undetected.

Table 10

DATE: 03/31/95

COMPARISON OF CONVERSION AND SELECTIVITY OF

CALSICAT PRODUCED CATALYSTS AT STARTUP CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-563 SLH, H2-225 SLH, CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C1+ (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Catalyst Prom%	Catalyst Metal%	Composit. Suppt
M-4 SBCR													
10	CAL.02	15.9	34.5	1.58	12.9	2.0	83.9	1.23	0.75	0.81	0.0	0.5Ru	Al
11	CAL.03	15.6	29.7	1.39	13.5	2.1	83.4	1.08	0.74	0.86	0.0	0.5Ru	Al
16	CAL.04	16.1	26.3	1.34	7.1	1.3	90.3	1.38	0.80	0.85	0.3K	0.5Ru	Al
17	CAL.08	15.0	16.9	0.93	5.9	0.8	91.7	1.36	0.82	0.88	0.3K	0.5Ru	Al
18	CAL.07	15.0	20.6	1.03	7.7	1.2	90.0	1.09	0.81	0.88	0.3K	0.5Ru	Al
19	CAL.05	15.7	26.6	1.22	7.3	1.3	90.2	1.19	0.82	0.86	0.3K	0.5Ru	Al
20	CAL.06	15.0	5.6	0.26	3.1	2.1	92.0	2.86	0.80	0.90	0.3K	0.5Ru	Al
23	CAL.09	15.0	17.4	0.84	0.1	1.2	97.9	0.95	0.83	0.88	0.3K	0.5Ru	Al
26	CAL.10	15.6	21.9	1.01	5.4	1.5	91.9	1.25	0.79	0.85	0.3K	0.5Ru	Al
31	CAL.12	15.9	27.6	1.26	7.9	1.0	90.0	1.11	0.79	0.84	0.3K	0.5Ru	Al
32	CAL.11	15.9	30.6	1.40	7.8	1.4	89.6	1.18	0.80	0.84	0.3K	0.5Ru	Al
33	Cal.13	15.9	28.1	1.28	6.4	1.4	90.9	1.29	0.81	0.85	0.3K	0.5Ru	Al
M-3 SBCR													
12	C0.018	15.6	33.8	1.56	9.7	2.0	86.6	1.68	0.75	0.85	0.0	0.5Ru	Al
23	CO.047	15.8	28.2	1.29	7.7	1.5	89.3	1.47	0.79	0.84	0.3K	0.5Ru	Al

Note: Catalysts for all runs except Runs 17,18,& 20 screened thru 150 x 400 mesh.
Catalyst CAL.04 was calcined in air; Catalyst CAL.05 processed in N2.
Cat. No. CAL.06 was H2 reduced and air stabilized before charging.
Cat. Nos. CAL.08 and CAL.07 were prereduced and wax coated. CAL.08 was calcined in N2 ; CAL.07 was reduced in H2 without prior calcination.
H2 to CO ratio for Runs 16 and 17 was 1.76/1.
Cat. Nos. Co.018 & Co.047 were prepared by Pitt. Shown for comparison.
Cat. No. CAL.09 was prereduced and coated with Soya.
Cat. No. CAL.10 was prepared on Condea Alumina.

Table 11

SBCR CATALYST EXTRACTIONS

Catalyst No. (Support)	Run No.	Charge (H_2 Reduced) wt, gm	Recovered (Oxidized) wt, gm	Charge Particle Size, mvd, microns	Charge Particle Size at 10% microns	Recovered Particle Size, mvd, microns	Recovered Particle Size at 10% microns	Reduction in Particle Size, %
Co.001 (Al)	1	14.5	12.63	42.02	24.25	41.06	23.62	2.3
Co.001 (Al)	2	16.5	15.18	42.02	24.25	40.09	22.86	4.6
Co.005 (Al)	3	19.5	18.41	85.66	30.46	64.53	31.27	24.7
Co.002 (Al)	4	20.1	20.4	73.61	32.86	71.19	33.50	3.3
Co.003 (Al)	5	15.1	14.54	76.81	34.40	72.57	34.25	5.5
Co.011 (Si)	6	15.3	16.03	107.09 (1)	53.19	94.02	40.44	12.2
Co.012 (Si)	7	15.8	14.73	105.22 (1)	51.33	101.37	44.44	3.7
Co.015 (Al)	8	15.0	15.52	75.63 (1)	33.15	74.68	32.68	1.3
Co.011 (Si)	9	15.0	15.92	79.88 (2)	48.31	72.44	36.31	9.3
Co.016 (Al)	10	15.5	15.72	64.60 (2)	32.16	64.38	32.78	0.3
Co.017 (Al)	11	15.0	15.09	73.14 (3)	36.29	69.95	35.62	4.4
Co.018 (Al)	12	15.6	16.97	62.89 (3)	32.56	68.16	34.74	--
Co.016 (Al)	13	14.7	13.30	67.69 (3)	35.05	64.79	34.20	4.3
Co.019 (Si)	14	15.2	15.00	92.63 (3)	42.73	84.39	36.52	8.9
Co.005 (Al)	15	14.7	15.30	80.62 (3)	45.07	71.90	36.79	10.8
Co.002 (Al)	16	15.4	14.98	73.61 (3)	32.86	67.62	32.67	8.1
Co.002 (Al)	1 (M4)	15.0	11.00	73.61 (3)	32.86	66.26	35.75	10.0
Co.025 (Si)	17	15.6	14.60	87.19 (3)	47.35	78.31	36.27	10.2
Co.004 (Al)	18	15.0	15.25	78.12 (3)	44.15	66.86	33.83	14.4
Co.021 (Si)	19	15.6	16.06	86.18 (3)	46.54	77.95	35.59	9.55
Co.041 (Si)	20	15.8	17.02	87.48 (3)	49.26	68.74	26.72	17.0
Co.021 (Si)	3 (M4)	15.2	15.1	73.61 (3)	24.46	71.38	32.33	3.03
Co.024 (Al)	4 (M4)	15.4	(4)	--	--	--	--	--
Co.035 (Si)	5 (M4)	15.4	14.08	89.14 (3)	49.29	74.76	31.67	19.2
Co.028 (Al)	6 (M4)	15.4	15.7	80.83 (3)	44.81	71.83	36.34	11.1

(1) Screened through 100x400 mesh screens. (2) Screened through 170x400 mesh screens.
(3) Screened through 150x400 mesh screens. (4) Did not filter, too waxy

Note: The charge weights are in the hydrogen-reduced state and the recovered weights are in the oxidized state. The particle size is reported as the mean volume diameter (mvd) as measured by a Microtrac particle size analyzer.

Table 11
(Continued)

SBCR CATALYST EXTRACTIONS

Catalyst No. (Support)	Run No.	Charge (H_2 Reduced) wt, gm	Recovered (Oxidized) wt, gm	Charge Particle Size, mvd, microns	Charge Particle Size at 10% microns	Recovered Particle Size, mvd. microns	Recovered Particle Size at 10% microns	Reduction in Particle Size, %
Co.014 (Ti)	21	15.1	15.1	111.70 (1)	32.65	106.66	33.49	4.51
Co.040 (Ti)	22	14.5	8.5	(5)	(5)	130.40	51.40	--
Co.047 (Al)	23	15.8	16.95	83.42 (3)	44.41	76.46	39.02	8.34
Co.049 (Al)	24	15.6	16.54	81.3 (3)	42.39	70.11	35.87	13.8
Co.047 (Al)	25	15.6	16.69	79.36 (3)	41.72	69.09	36.16	12.94
Co.031 (Al)	26	15.9	15.37	75.48 (3)	38.34	68.42	35.39	9.35
Co.029 (Al)	27	15.9	18.28	76.39 (3)	39.56	68.72	36.04	10.04
Co.043 (Si)	7 (M4)	15.4	15.1	(5)	(5)	85.51	40.20	--
Co.006 (Ti)	8 (M4)	15.0	9.09	121.38 (1)	52.80	99.31	38.62	18.2
Co.048 (Si)	9 (M4)	15.4	15.85	82.40 (3)	40.94	70.69	25.53	14.2
CAL.02 (Al)	10 (M4)	15.9	16.42	74.40 (3)	37.79	65.89	34.14	11.44
Co.053 (Al)	12 (M4)	15.9	16.95	82.02 (3)	43.10	69.53	35.76	15.23
Co.054 (Si)	13 (M4)	15.7	17.09	101.17 (3)	57.54	82.37	37.89	18.58
Blend A (Al)	14 (M4)	20.0	14.61	86.23 (3)	46.36	77.43	42.81	10.21
Co.034 (Al)	15 (M4)	13.0	9.52	(5)	(5)	88.26	45.28	--
CAL.04 (Al)	16 (M4)	16.1	21.78	71.54 (3)	36.28	66.50	32.82	7.05
CAL.08 (Al)	17 (M4)	15.0 (6)	14.27	63.12	25.60	62.80	26.03	0.51
CAL.07 (Al)	18 (M4)	14.5 (6)	13.37	--	--	67.02	28.12	--
CAL.05 (Al)	19 (M4)	15.7	5.62	72.75	36.90	71.62	36.55	1.55
CAL.06 (Al)	20 (M4)	15.0	(7)	72.62	37.33	--	--	--
Co.053 (Al)	29 (M3)	25.2	25.8	75.63	40.80	71.09	38.20	6.00
Co.004 (Al)	21 (M4)	15.9	15.04	81.38	41.82	72.88	37.61	10.44

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(1) Screened through 100x400 mesh screens.
(3) Screened through 150x400 mesh screens.
(5) Insufficient feed sample.
(6) Wax coated.
(7) Lost catalyst.

Table 11
(Continued)

SBCR CATALYST EXTRACTIONS

Catalyst No. (Support)	Run No.	Charge (H_2 Reduced) wt, gm	Recovered (Oxidized) wt. gm	Charge Particle Size, mvd, microns	Charge Particle Size at 10% microns	Recovered Particle Size, mvd, microns	Recovered Particle Size at 10% microns	Reduction in Particle Size, %
Blend B (Al)	22 (M4)	30.5	31.75	77.85	43.10	73.74	38.80	5.28
CAL.09 (Al)	23 (M4)	30.0 (6)	14.34	63.12	25.60	62.10	26.32	1.62
Co.053-3 (Al)	24 (M4)	28.5	27.85	75.63	40.80	70.69	35.03	6.53
Co.055 (Al)	31 (M3)	15.0	14.67	85.58	46.27	74.56	39.00	12.88
Co.056 (Si)	25 (M4)	15.0	14.93	99.93	54.62	88.48	43.26	11.46
Co.044 (Si)	32 (M3)	16.4	17.01	92 15	49.30	84.92	40.21	7.85
CAL.10 (Al)	26 (M4)	15.6	14.63	83.05	47.11	81.12	45.87	2.32
Co.053-4 (Al)	33 (M4)	31.4	31.9	84.09	44.40	73.50	37.10	12.6
Co.050 (Al)	27 (M4)	14.6	10.62	(5)	(5)	91.37	44.07	--
Co.060 (Al)	34 (M3)	15.6	15.8	87.45	47.08	80.89	43.42	7.50
Co.041 (Si)	35 (M3)	26.0	24.23	87.48	49.26	80.63	31.75	7.83
Co.057 (Si)	28 (M4)	15.8	14.64	98.85	55.78	82.94	36.71	16.10
Co.032 (Al)	36 (M3)	15.9	14.66	78.22	43.34	78.55	36.02	9.81
Co.045 (Si)	37 (M3)	15.9	15.67	95.67	53.59	68.84	22.06	28.04
Co.061 (Si)	29 (M4)	45 4	10	--	--	(7)	(7)	--
Co.011 (Si)	30 (M4)	15.9	15.82	83.99	40.60	54.04	13.72	35 66
Co.003 (Al)	50% Solids	135	130	78.93	39.94	73.02	36.97	7.49
CAL.12 (Al)	31 (M4)	15.9	11.86	72.75	38.67	72.85	40.91	0
CAL.11 (Al)	32 (M4)	15 9	17.87	71.92	38.83	69.91	36.68	2.8
Co.058 (Al)	38 (M3)	15.9	15.29	85.69	45.95	78.99	42 90	7.82
Co.064 (Al)	39 (M3)	15.9	14.86	83.74	44.86	70.37	35.17	16.0

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(5) Insufficient feed sample
(6) Wax coated
(7) Lost catalyst

APPENDIX A

Co Catalyst Formulations

Co.064: **20 wt% Co**
8.5 wt% Zr
0.5 wt% Ru
γ-alumina

Ru- and Zr-promoted alumina-supported catalyst similar otherwise to Co.041. **One-step impregnation of alumina with zirconium nitrate followed by one-step impregnation with cobalt nitrate and Ru nitrosil nitrate solution.**

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Zr Oxonitrate [$ZrO(NO_3)_2$] using an appropriate quantity to get incipient wetness with the desired loading of Zr.

Dry the Zr-loaded Al_2O_3 in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried support in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Impregnate the Zr-loaded Al_2O_3 with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$] and Ru nitrosil nitrate using an appropriate quantity to get incipient wetness with the desired loadings of Co and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

Co.065: **20 wt% Co**
8.5 wt% Zr
0.5 wt% Ru
0.3 wt% K
γ-alumina

Ru-, K- and Zr-promoted alumina-supported cobalt catalyst similar otherwise to Co.048. **One-step impregnation of alumina with zirconium nitrate followed by one-step impregnation with cobalt nitrate, potassium nitrate and Ru nitrosil nitrate solution.**

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Zr Oxonitrate [$ZrO(NO_3)_2$] using an appropriate quantity to get incipient wetness with the desired loading of Zr.

Dry the Zr-loaded Al_2O_3 in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried support in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Impregnate the Zr-loaded Al_2O_3 with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$], K nitrate and Ru nitrosil nitrate using an appropriate quantity to get incipient wetness with the desired loadings of Co, K and Ru.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

Calcine the dried catalyst in air by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

CAL.11-CAL13:

20 wt% Co
0.5 wt% Ru
0.3 wt% K
γ-alumina

Ru/K-promoted catalyst similar to Co.047 calcined in N_2 prepared by Calcicat for reproducibility study.

Preparation Procedure:

Calcine the γ-alumina at 500°C for 10 hrs. Use Vista B alumina. Presieve to >38 microns (400-0 mesh).

Impregnate the support with an aqueous solution of Co nitrate [$Co(NO_3)_2 \cdot 6H_2O$] an Ru nitrosil nitrate and K nitrate using an appropriate quantity to get incipient wetness (ca. 1.2 ml/g) with the desired loading of Co, Ru, and K.

Dry the catalyst precursor in an oven for 5 hrs at 115°C with moderate stirring.

The dried catalyst is then calcined in nitrogen by raising its temperature at a heating rate of ca. 1°C/min to 300°C and holding for 2 hrs.

Reduction Procedure before Reaction:

Reduce the catalyst in a pure hydrogen flow of 3000 cc/g/hr by heating at 1°C/min to 350°C and holding for 10 hrs.

APPENDIX B

Fixed Bed Reaction Data

Co.005 - Run #8

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

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) = 0.019
CO2 (% of CO) = 0.1
O/P = 3.01

CO conversion (%)	2.7
rate (g CH2/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 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	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 CH2/g cat/hr	0.15	0.15	0.15	0.16	0.16	0.15
CO2 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 %

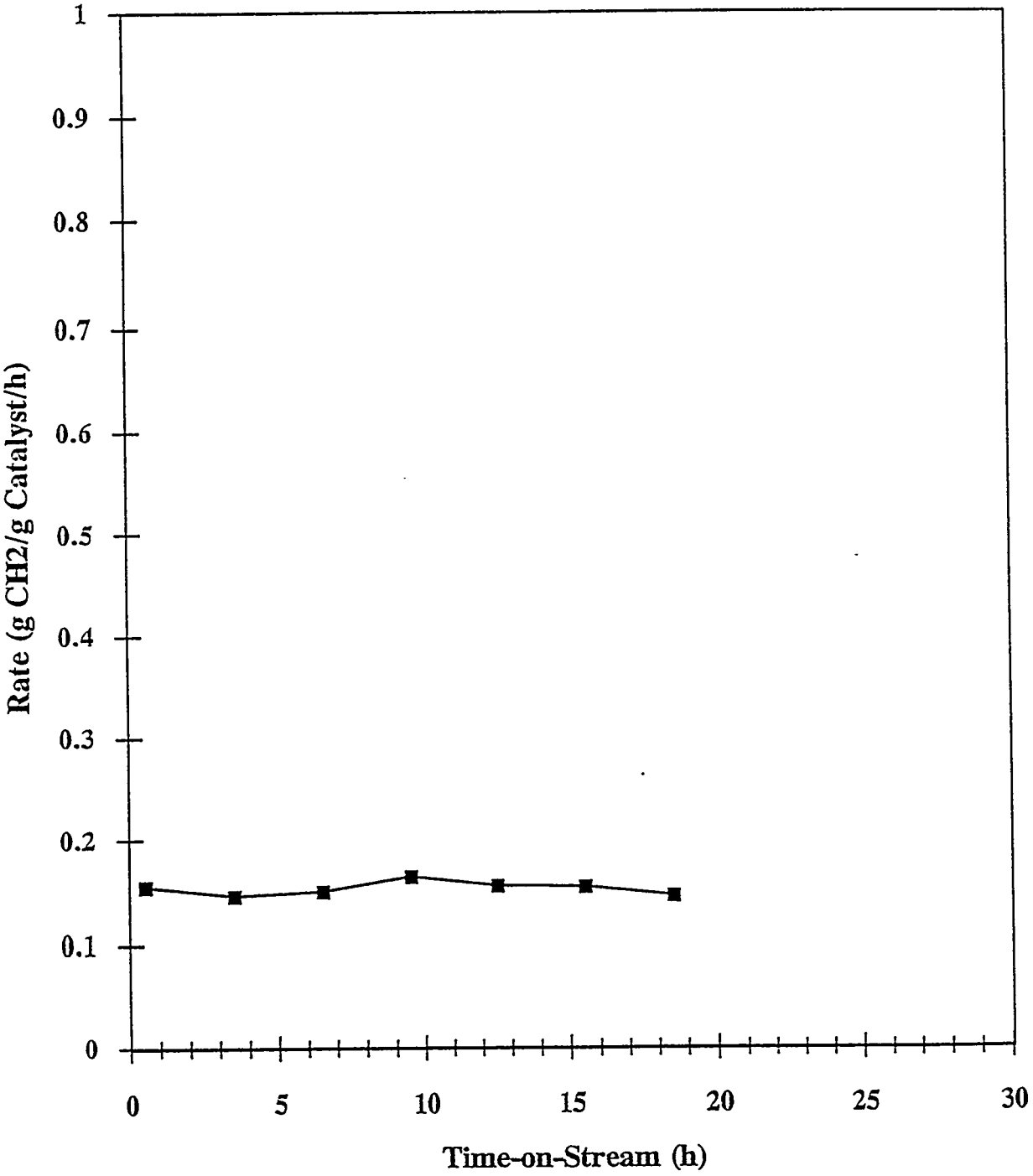
C1	23.84
C2	4.85
C3	10.47
C4	10.91
C5	11.38
C6	9.09
C7	7.73
C8	5.79
C9	4.49
C10	3.49
C11	2.57
C12	1.91
C13	1.43
C14	1.14
C15	0.90
alpha chain growth probability	0.69

C1 - C50 estimated total product distribution, weight %

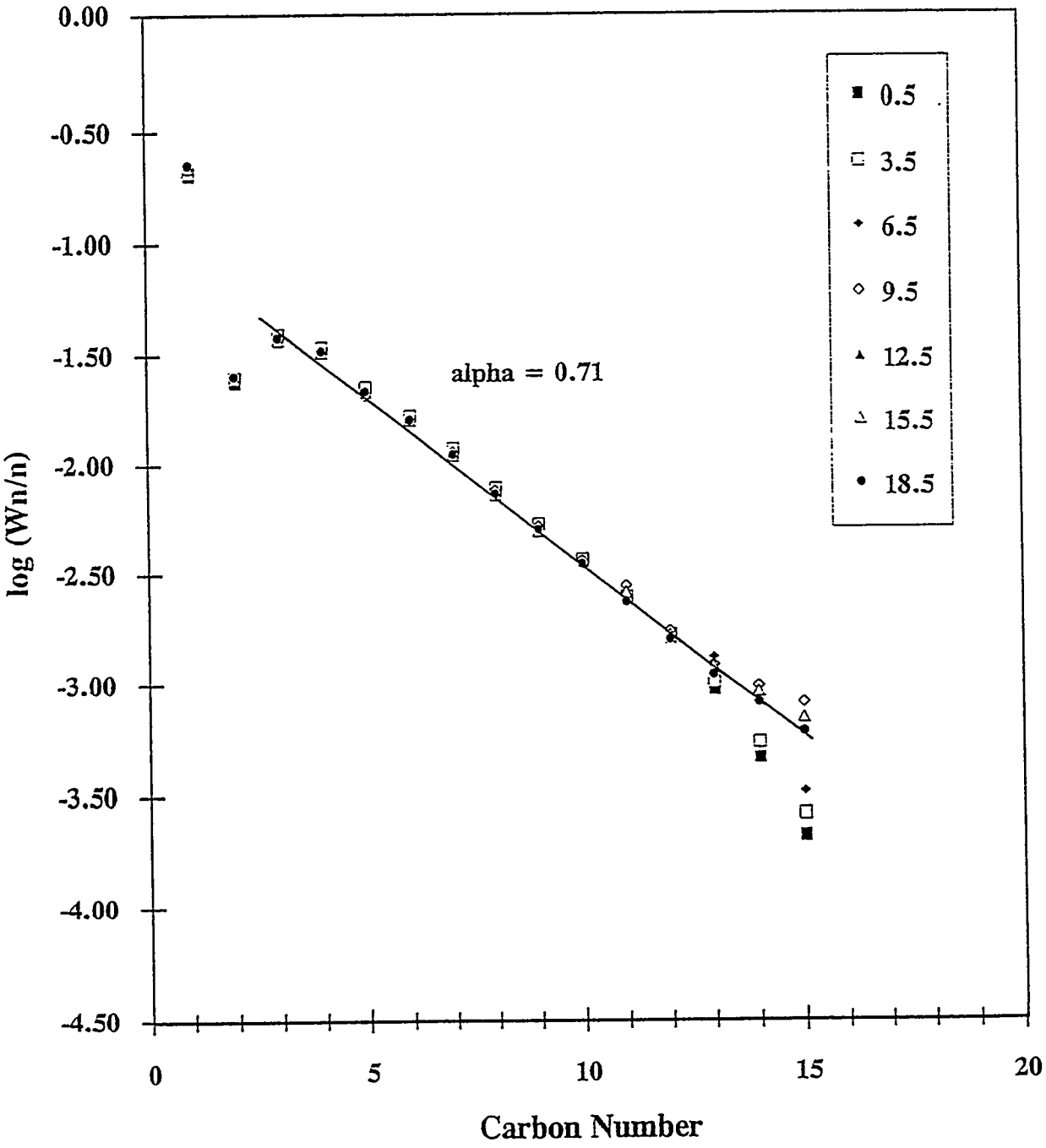
C1	23.1
C2 - C4	25.4
C5 - C12	45.5
C13 - C50	6.0

CO conversion, %	2.6
rate, g CH2/g cat/hr	0.14
CO2 formation, %	0.1

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



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



Co.005 - Run #8a

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

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) = 0.016
CO2 (% of CO) = 0.1
O/P = 3.65

CO conversion (%)	2.5
rate (g CH2/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				Al2O3

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) = 0.032
CO2 (% of CO) = 0.2
O/P = 2.42

CO conversion (%)	4.2
rate (g CH2/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 CH2/g cat/hr	0.14	0.28	0.27	0.26	0.26	0.25
CO2 formation, %	0.1	0.2	0.1	0.2	0.2	0.2

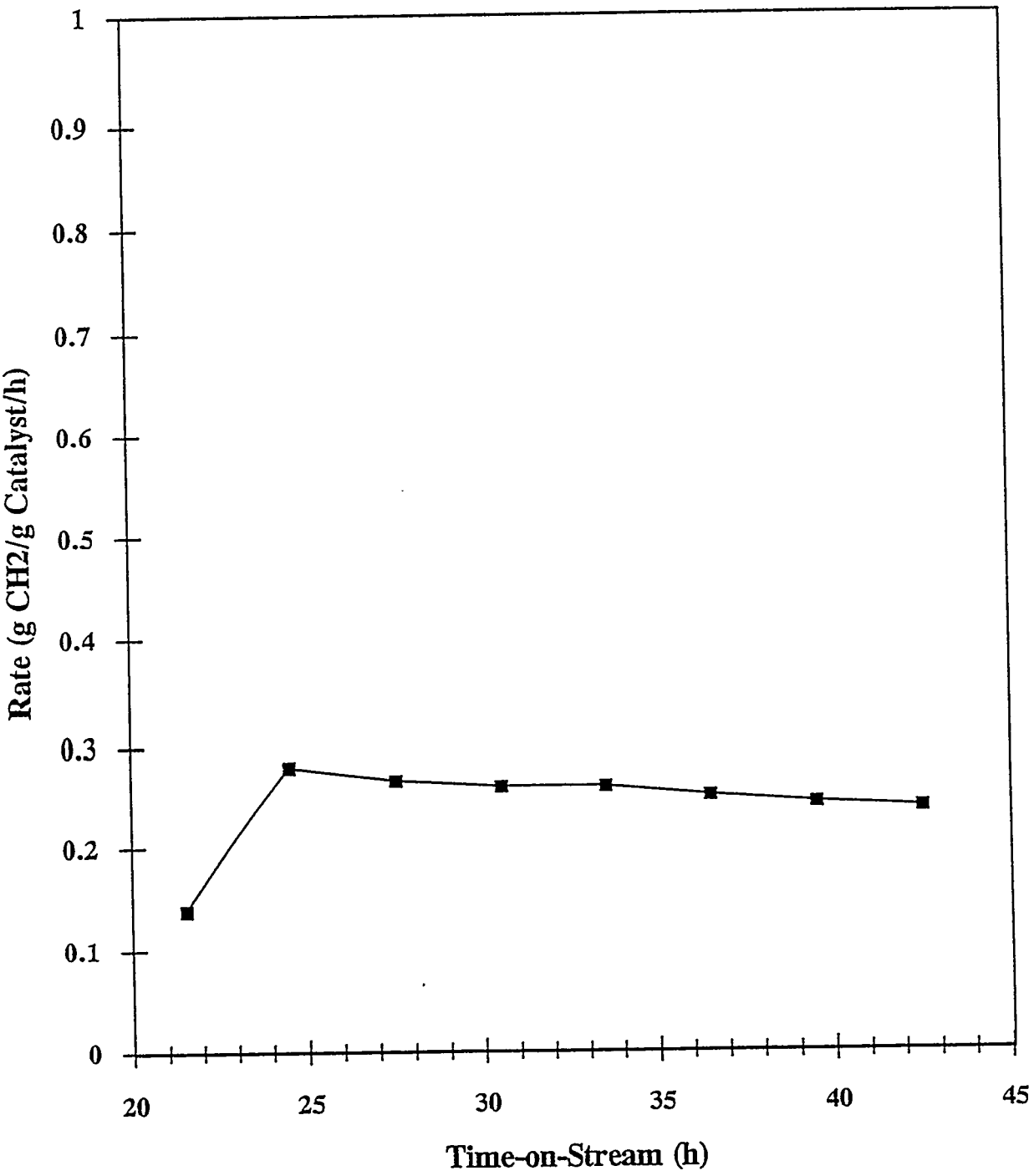
Performance of Co.005

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 CH2/g cat/hr	0.24	0.24
CO2 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				Al2O3

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 CH2/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 CH2/g cat/hr	0.24	0.45	0.40	0.37	0.30	0.24
CO2 formation, %	0.2	0.4	0.3	0.3	0.3	0.3

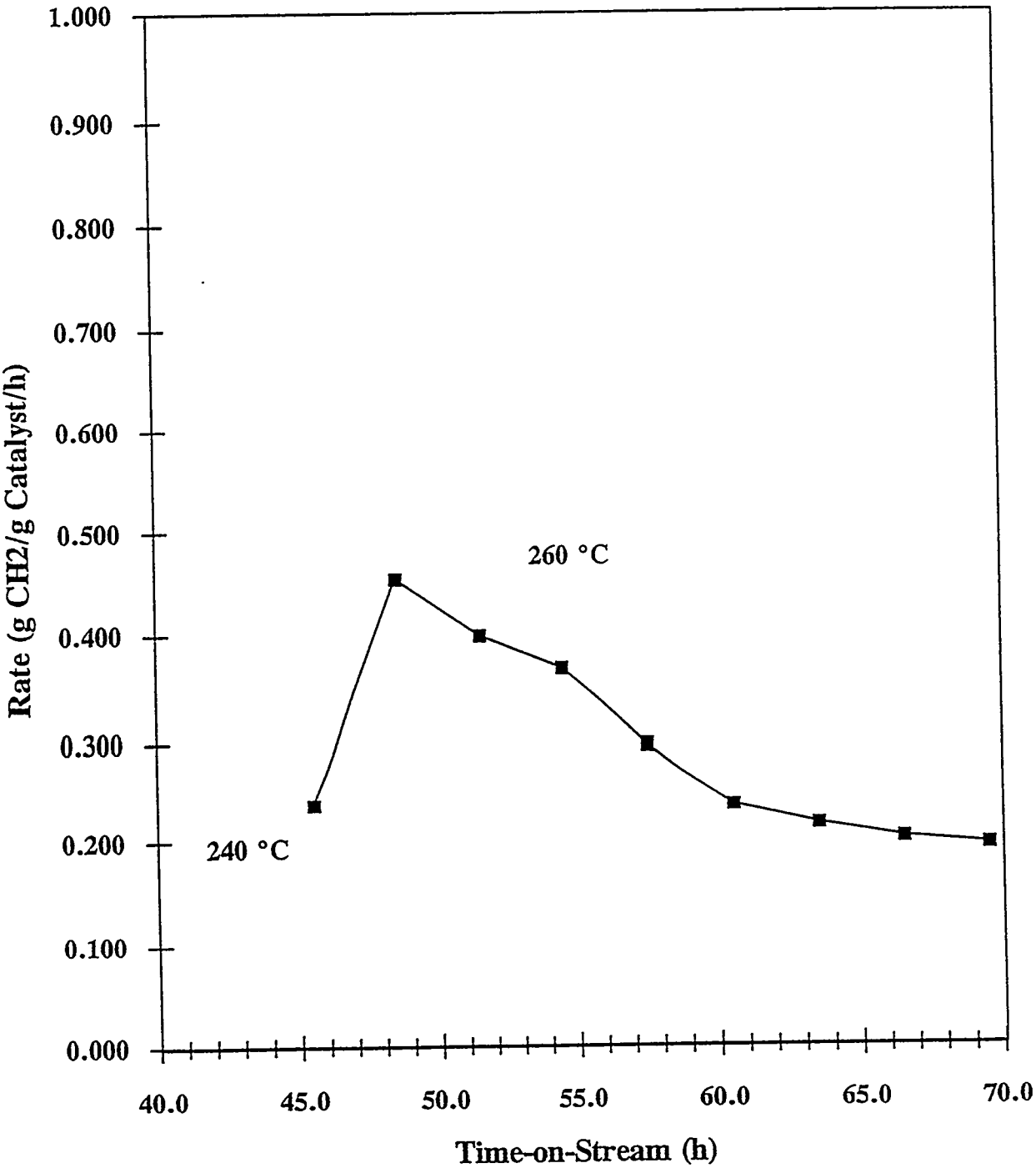
Performance of Co.005

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

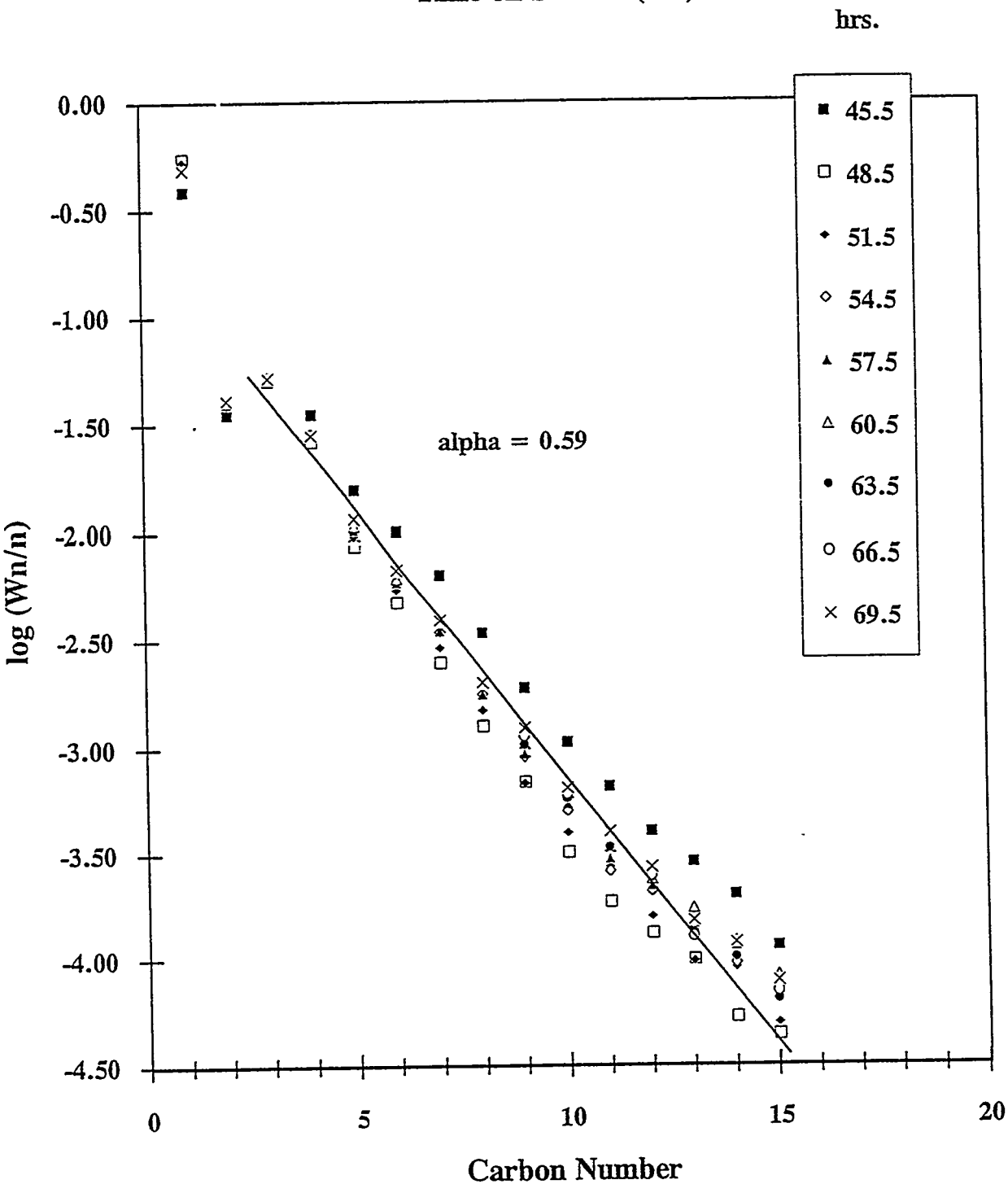
flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 12.9 1/hr, H2/CO ratio in feed = 2

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 CH2/g cat/hr	0.22	0.20	0.20
CO2 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)



Co.005 - Run #8d

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

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) = 0.029
CO2 (% of CO) = 0.2
O/P = 4.72

CO conversion (%)	1.5
rate (g CH2/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 CH2/g cat/hr	0.20	0.40	0.27	0.21	0.17	0.14
CO2 formation, %	0.3	0.6	0.4	0.3	0.3	0.2

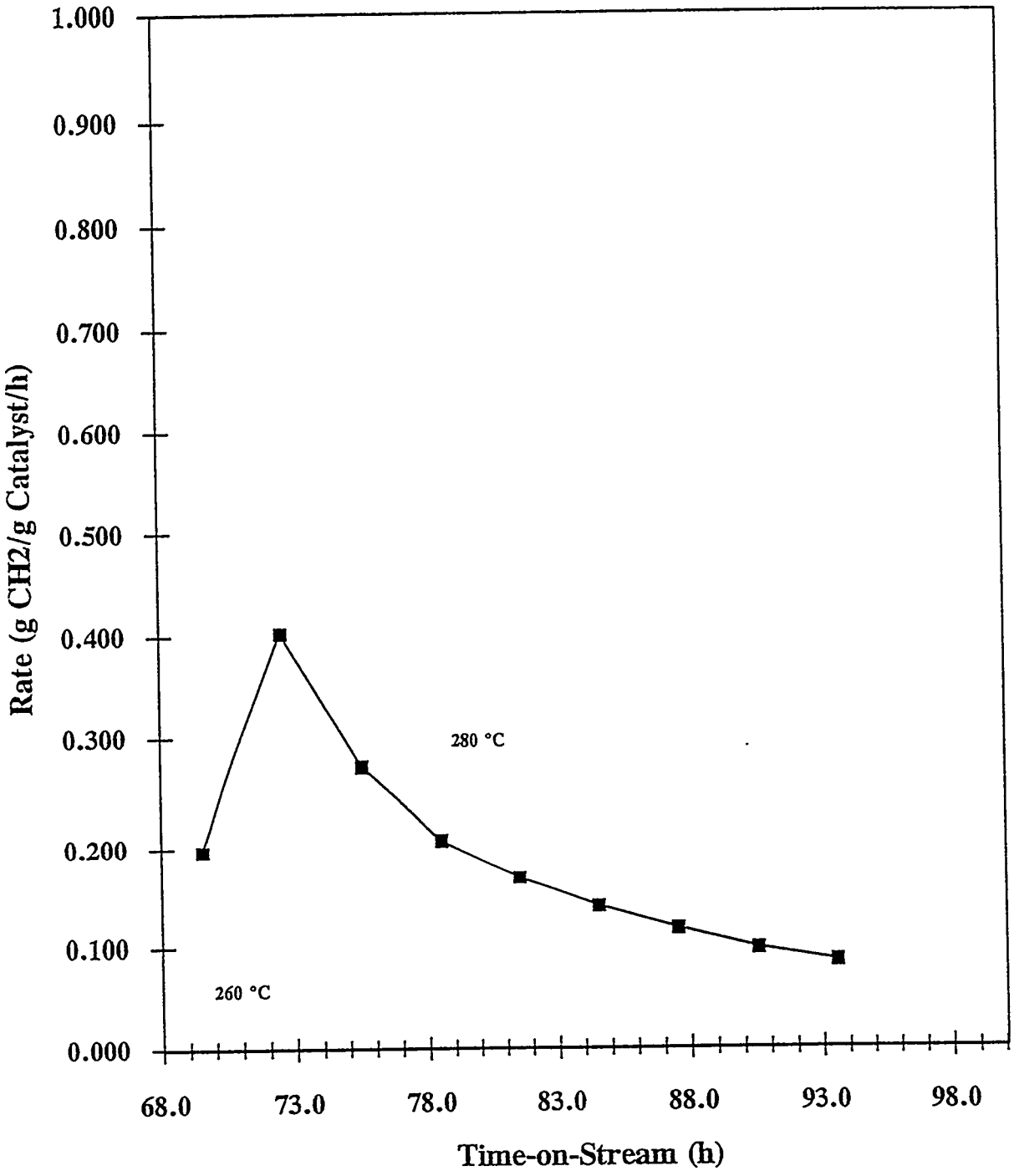
Performance of Co.005

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

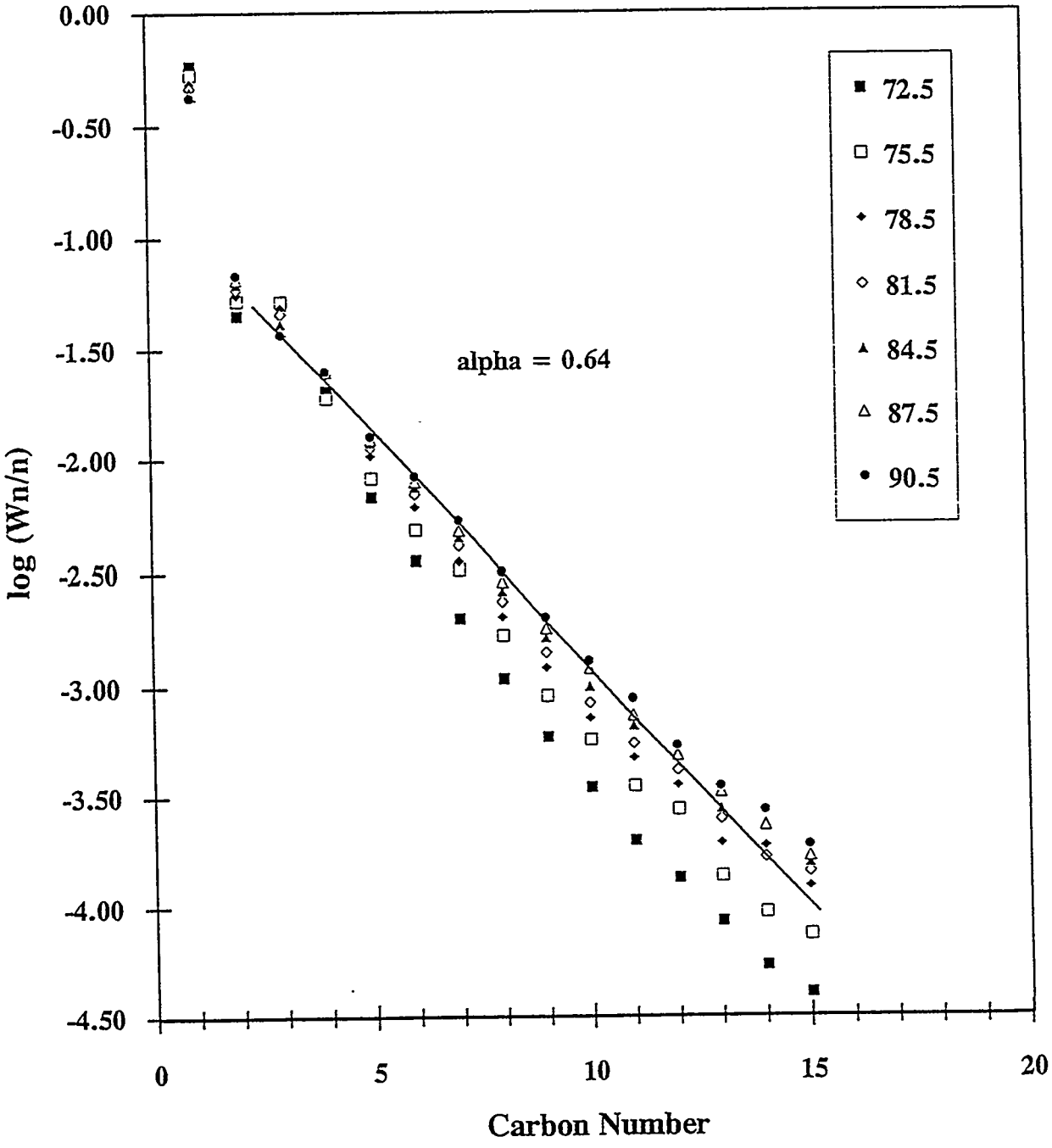
time on stream, hr	87.5	90.5	93.5
reaction temperature, °C	280	280	280
pressure, atm	1.0	1.0	1.0
flow, cc/min	120.0	120.0	120.0
C1 - C15 product distribution, weight %			
C1	44.29	43.67	41.49
C2	12.10	12.76	13.08
C3	13.22	13.41	13.22
C4	8.54	8.71	8.49
C5	6.37	6.69	6.50
C6	4.60	2.68	4.47
C7	3.34	3.69	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 CH2/g cat/hr	0.12	0.10	0.09
CO2 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				Al2O3

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 CH2/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 CH2/g cat/hr	0.10	0.09	0.09	0.09	0.09	0.08
CO2 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 %

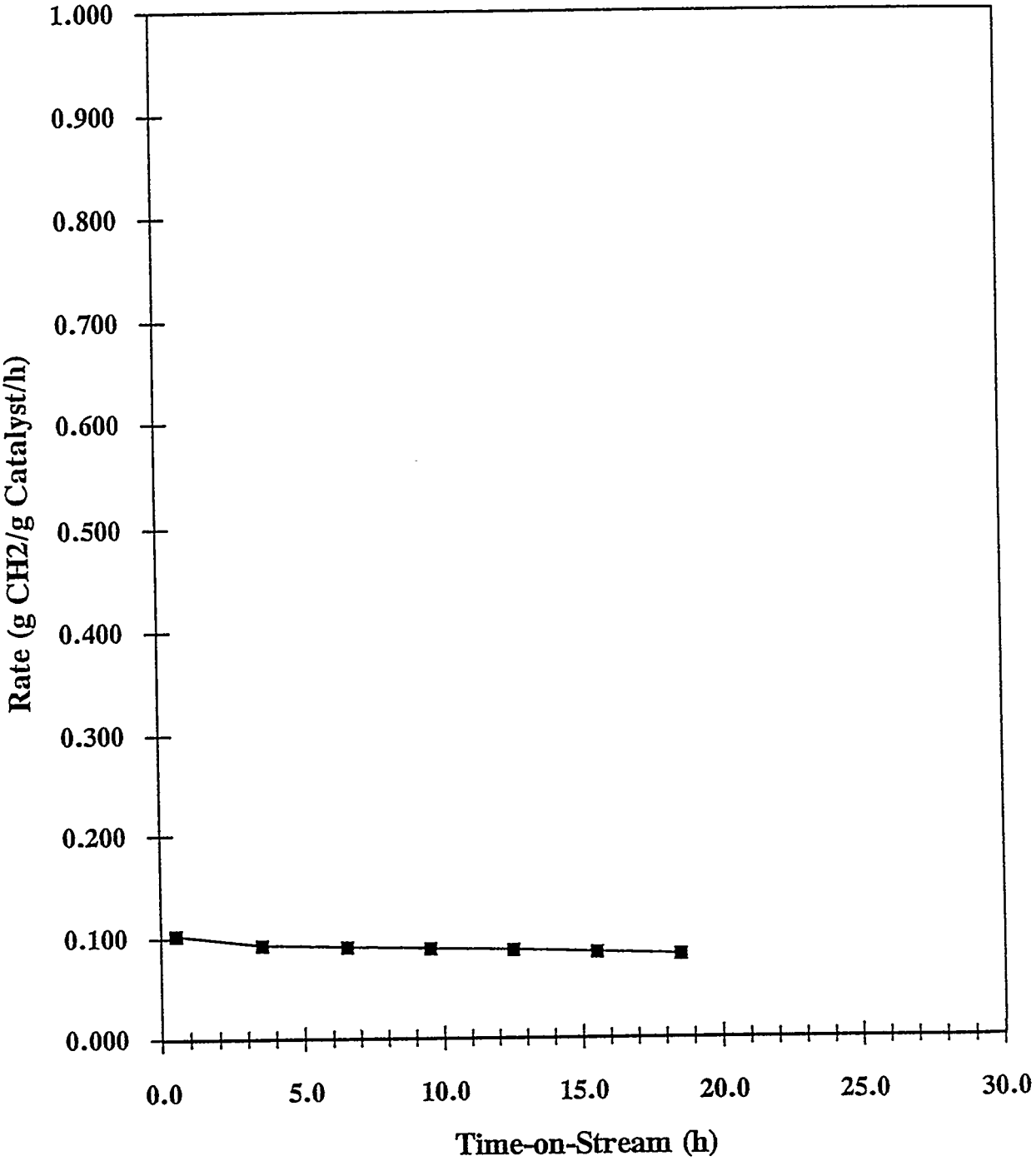
C1	27.53
C2	5.97
C3	12.40
C4	12.50
C5	11.56
C6	8.70
C7	7.11
C8	4.85
C9	3.39
C10	2.20
C11	1.63
C12	1.02
C13	0.58
C14	0.39
C15	0.19
alpha chain growth probability	0.60

C1 - C50 estimated total product distribution, weight %

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

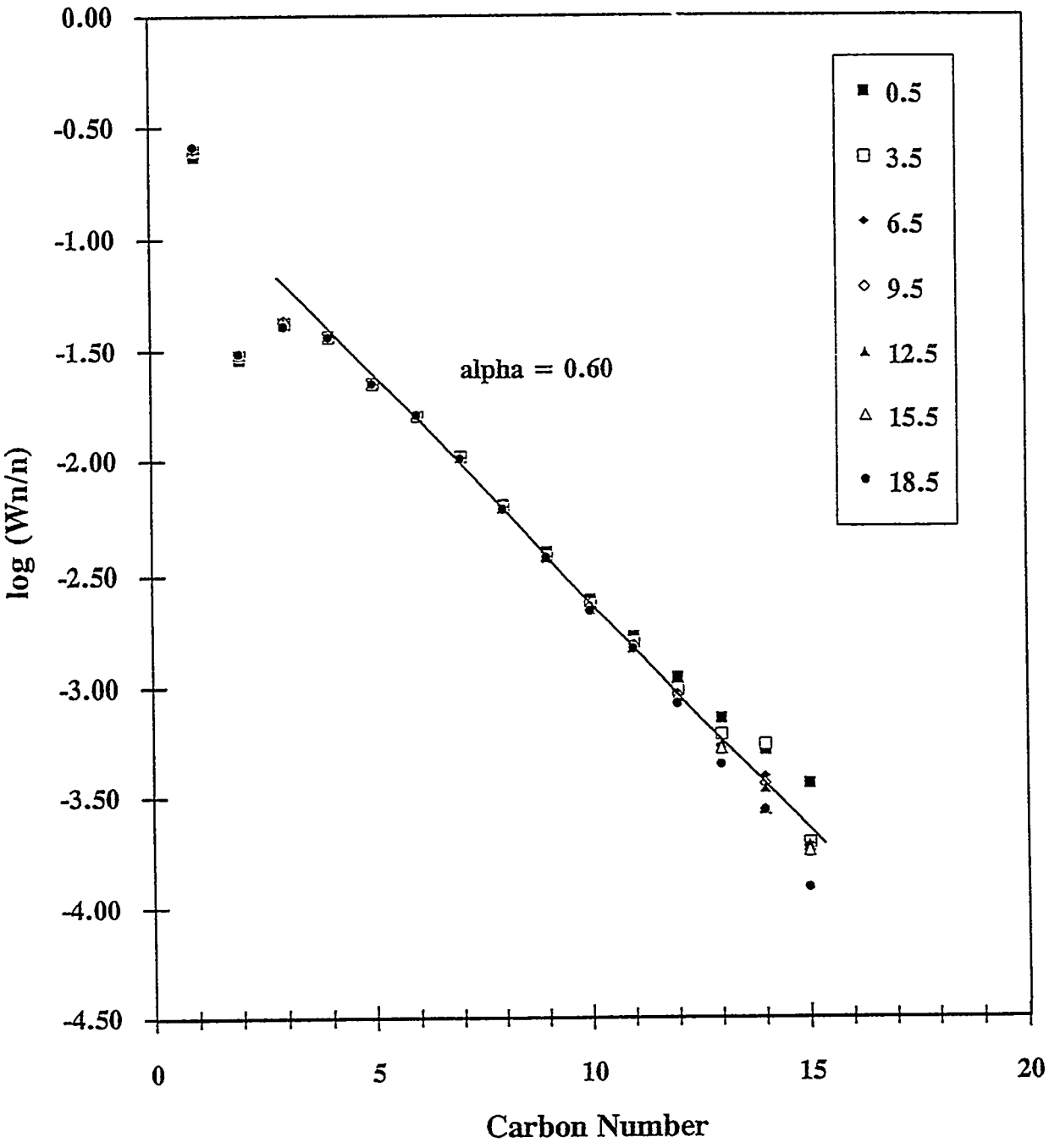
CO conversion, %	1.5
rate, g CH2/g cat/hr	0.08
CO2 formation, %	0.1

Time-on-Stream Plot for Co.005 - Run #9



Schulz-Flory Plot for Co.005 - Run #9
Time on Stream (hrs)

hrs.



Co.005 - Run #9a

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

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 = 24.5 hrs

CO2 (g/g cat/hr) = 0.016
CO2 (% of CO) = 0.1
O/P = 3.14

CO conversion (%)	1.4
rate (g CH2/g cat/hr)	0.07
alpha	0.61
C1 (wt%)	29.9
C2 - C4 (wt%)	32.5
C5 - C12 (wt%)	35.9
C13 + (wt%)	1.7

* 30 cc/min Ar added to the reaction mixture

Co.005 - Run #9b

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

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 280 °C
H2/CO = 2
weight of catalyst = 0.208 g
WHSV = 12.36 1/hr
time on stream = 42.5 hrs

CO2 (g/g cat/hr) = 0.055
CO2 (% of CO) = 0.3
O/P = 5.07

CO conversion (%)	1.4
rate (g CH2/g cat/hr)	0.08
alpha	0.58
C1 (wt%)	62.9
C2 - C4 (wt%)	27.4
C5 - C12 (wt%)	9.2
C13 + (wt%)	0.5

* 30 cc/min Ar added to the reaction mixture

Performance of Co.005

Dates: 03/06/95 - 03/07/95 Run #9b

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 12.4 1/hr, H2/CO ratio in feed = 2

time on stream, hr	21.5	24.5	30.5	33.5	36.5	39.5
reaction temperature, °C	220	220	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	30.55	30.37	68.04	65.68	62.09	59.69
C2	6.85	6.77	7.92	8.82	9.60	10.36
C3	13.78	13.57	11.68	13.90	14.40	14.48
C4	13.08	12.73	6.29	6.50	7.12	7.52
C5	12.01	12.10	3.03	3.19	3.88	4.46
C6	6.22	7.15	1.70	0.40	0.83	1.10
C7	6.77	6.68	0.71	0.87	1.13	1.29
C8	4.25	4.24	0.29	0.31	0.46	0.53
C9	2.68	2.62	0.16	0.13	0.16	0.18
C10	1.63	1.45	0.06	0.01	0.03	0.03
C11	0.92	1.08	0.03	0.04	0.06	0.07
C12	0.39	0.45	0.03	0.04	0.06	0.07
C13	0.28	0.32	0.01	0.04	0.06	0.07
C14	0.31	0.22	0.02	0.04	0.06	0.07
C15	0.28	0.26	0.04	0.04	0.07	0.08
alpha chain growth probability	0.62	0.61	0.55	0.55	0.57	0.58
C1 - C50 estimated total product distribution, weight %						
C1	29.9	29.9	67.6	65.3	61.6	59.1
C2 - C4	33.0	32.5	25.7	29.1	30.9	32.1
C5 - C12	35.2	35.9	6.4	5.4	7.1	8.3
C13 - C50	1.8	1.7	0.3	0.3	0.4	0.5
CO conversion, %	1.4	1.4	7.9	4.0	2.6	1.9
rate, g CH2/g cat/hr	0.07	0.07	0.43	0.22	0.14	0.10
CO2 formation, %	0.1	0.1	0.6	0.5	0.4	0.3

Performance of Co.005

Dates: 03/06/95 - 03/07/95 Run #9b

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 12.4 1/hr, H2/CO ratio in feed = 2

time on stream, hr	42.5	45.5	48.5
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 %

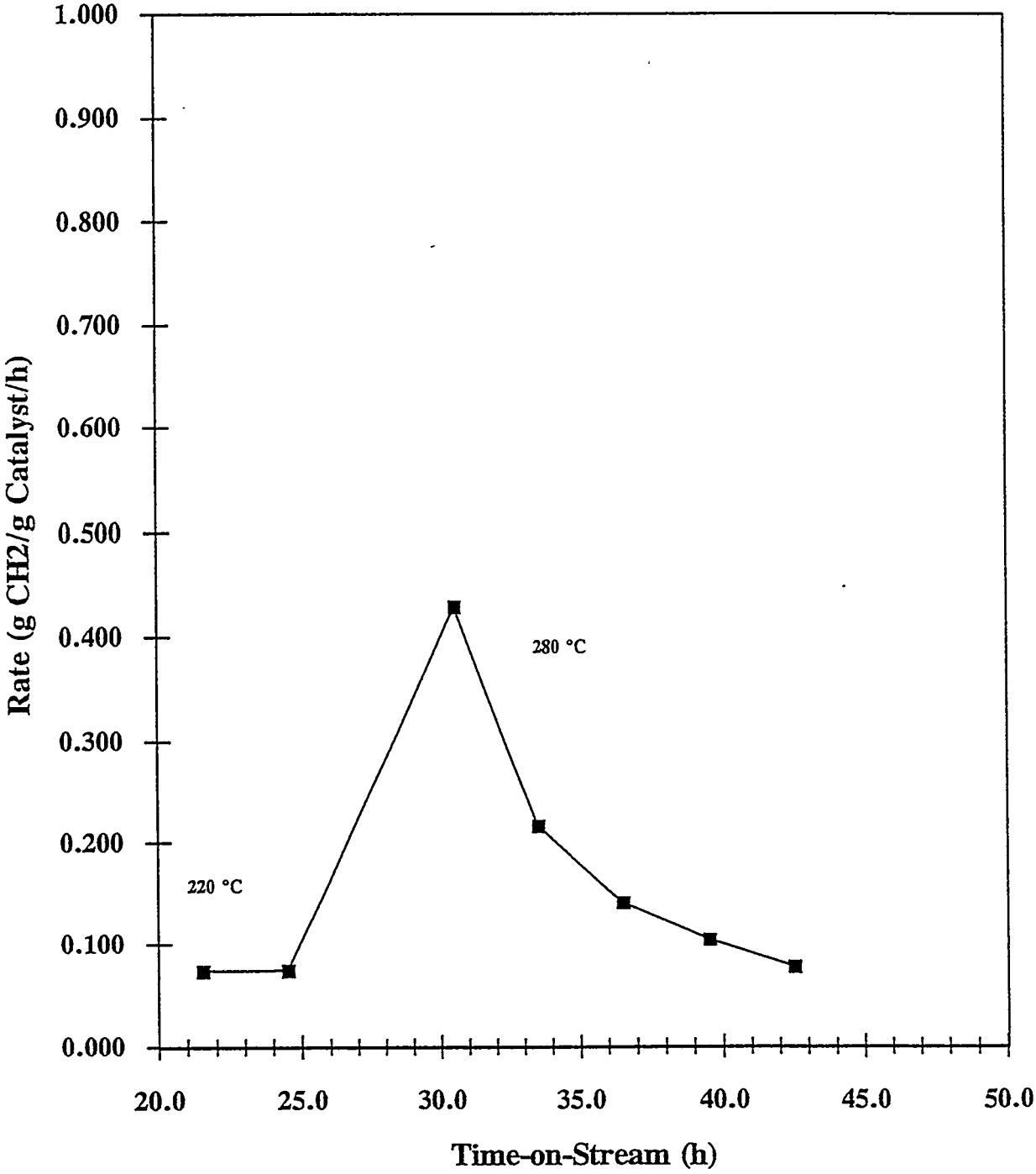
C1	63.57
C2	2.91
C3	16.08
C4	8.65
C5	4.83
C6	1.36
C7	1.40
C8	0.58
C9	0.20
C10	0.03
C11	0.08
C12	0.08
C13	0.08
C14	0.08
C15	0.08
alpha chain growth probability	0.58

C1 - C50 estimated total product distribution, weight %

C1	62.9
C2 - C4	27.4
C5 - C12	9.2
C13 - C50	0.5

CO conversion, %	1.4
rate, g CH2/g cat/hr	0.08
CO2 formation, %	0.3

Time-on-Stream Plot for Co.005 - Run #9b



Co.005 - Run #10

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

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.198 g
WHSV = 12.99 1/hr
time on stream = 24.5 hrs

CO2 (g/g cat/hr) = 0.016
CO2 (% of CO) = 0.1
O/P = 4.13

CO conversion (%)	1.9
rate (g CH2/g cat/hr)	0.11
alpha	0.70
C1 (wt%)	23.0
C2 - C4 (wt%)	25.6
C5 - C12 (wt%)	44.5
C13 + (wt%)	6.9

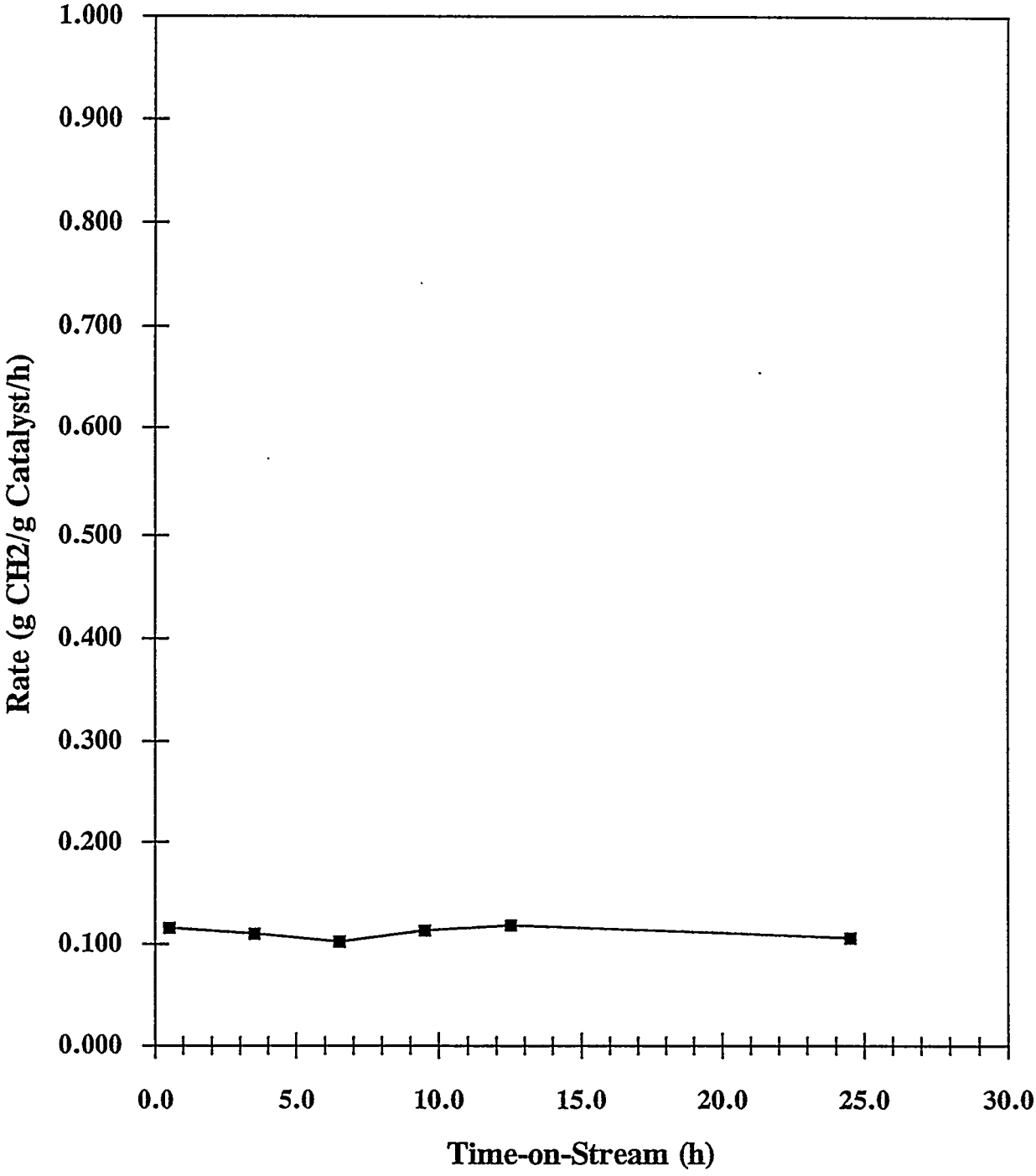
Performance of Co.005

Dates: 03/08/95 - 03/09/95 Run #10

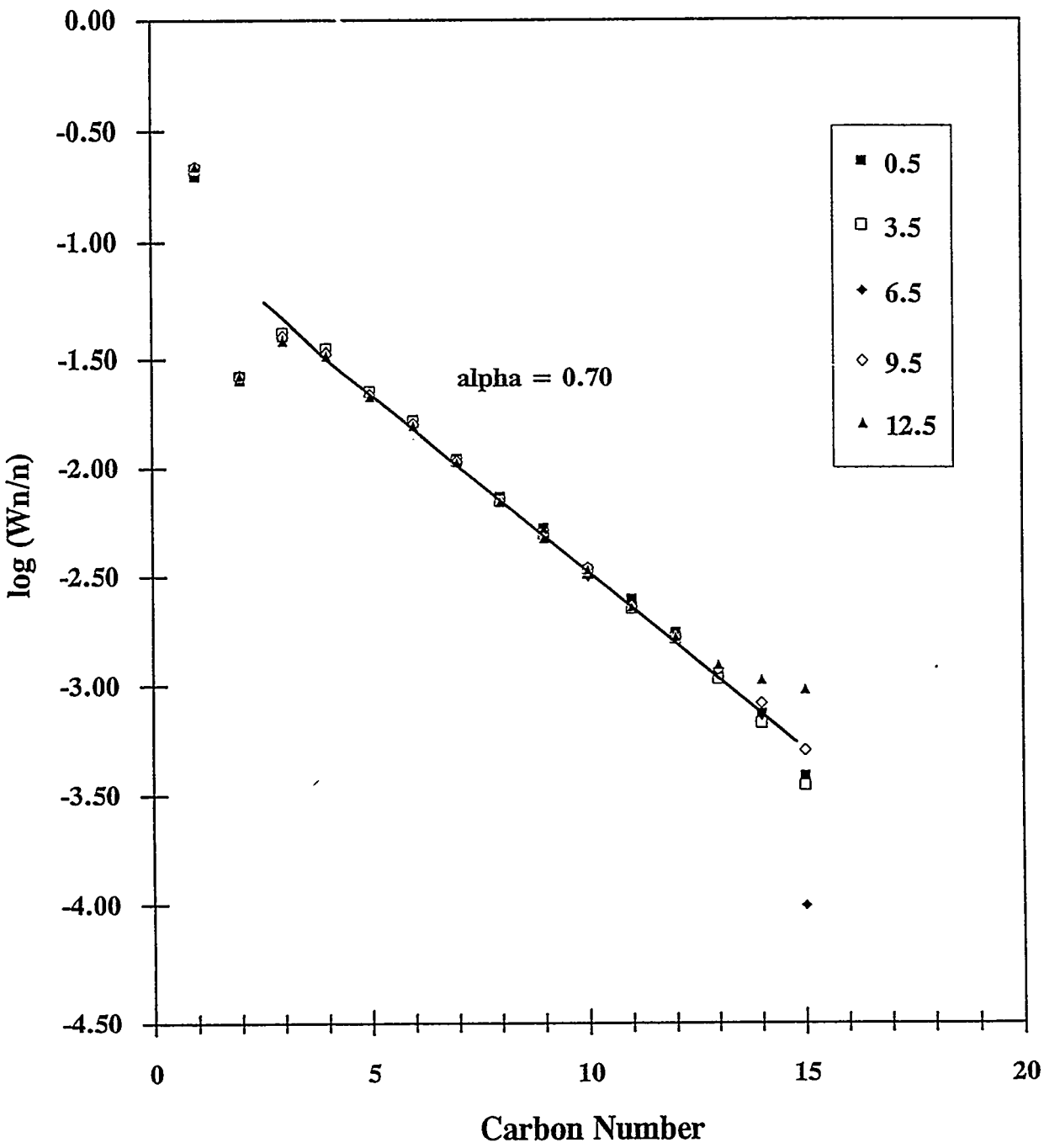
flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.0 1/hr, H2/CO ratio in feed = 2

time on stream, hr	0.5	3.5	6.5	9.5	12.5	24.5
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	21.43	23.17	23.74	23.67	23.91	24.18
C2	4.97	5.23	5.29	5.26	5.28	5.35
C3	10.81	11.06	10.87	10.57	10.53	10.59
C4	11.53	11.64	11.42	10.99	10.92	10.90
C5	11.86	11.75	11.73	11.40	11.30	11.40
C6	9.75	8.94	8.48	9.21	8.19	9.37
C7	7.72	7.54	7.63	7.47	7.48	7.45
C8	5.86	5.64	5.67	5.65	5.59	5.59
C9	4.74	4.45	4.56	4.28	4.29	4.16
C10	3.40	3.25	3.17	3.49	3.40	3.30
C11	2.73	2.49	2.60	2.53	2.53	2.44
C12	2.10	1.98	2.11	2.00	2.02	1.81
C13	1.47	1.40	1.57	1.55	1.63	1.37
C14	1.04	0.94	1.02	1.17	1.50	1.04
C15	0.58	0.53	0.15	0.76	1.44	1.04
alpha chain growth probability	0.67	0.66	0.59	0.68	0.73	0.70
C1 - C50 estimated total product distribution, weight %						
C1	21.5	23.2	25.0	23.3	22.1	23.0
C2 - C4	27.4	28.0	29.0	26.4	24.7	25.6
C5 - C12	47.2	45.2	45.0	45.2	43.6	44.5
C13 - C50	4.0	3.6	1.1	5.1	9.6	6.9
CO conversion, %	2.0	1.9	1.8	2.0	2.1	1.9
rate, g CH2/g cat/hr	0.12	0.11	0.10	0.11	0.12	0.11
CO2 formation, %	0.1	0.2	0.1	0.1	0.1	0.1

Time-on-Stream Plot for Co.005 - Run #10



Schulz-Flory Plot for Co.005 - Run #10
Time on Stream (hrs)



Co.005 - Run #10a

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

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.198 g
WHSV = 12.99 1/hr
time on stream = 27.5 hrs

CO2 (g/g cat/hr) = 0.017
CO2 (% of CO) = 0.1
O/P = 4.79

CO conversion (%)	1.6
rate (g CH2/g cat/hr)	0.09
alpha	0.68
C1 (wt%)	25.3
C2 - C4 (wt%)	28.2
C5 - C12 (wt%)	41.8
C13 + (wt%)	4.7

* 30 cc/min Ar added to the reaction mixture

Co.005 - Run #10b

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

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 280 °C
H2/CO = 2
weight of catalyst = 0.198 g
WHSV = 12.99 1/hr
time on stream = 50.5 hrs

CO2 (g/g cat/hr) = 0.037
CO2 (% of CO) = 0.2
O/P = 5.78

CO conversion (%)	1.8
rate (g CH2/g cat/hr)	0.10
alpha	0.65
C1 (wt%)	48.0
C2 - C4 (wt%)	31.9
C5 - C12 (wt%)	18.0
C13 + (wt%)	2.0

* 30 cc/min Ar added to the reaction mixture

Performance of Co.005

Dates: 03/09/95 - 03/10/95 Run #10b

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 13.0 1/hr, H2/CO ratio in feed = 2

time on stream, hr	27.5	33.5	36.5	39.5	45.5	47.5
reaction temperature, °C	220	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	26.12	61.96	61.60	56.71	51.95	50.01
C2	6.07	7.85	8.77	9.57	11.21	11.77
C3	11.62	13.70	14.20	13.90	13.61	13.45
C4	11.43	7.44	6.86	7.33	7.85	8.02
C5	11.12	3.92	3.81	4.55	5.41	5.72
C6	10.09	1.78	0.84	2.41	2.55	2.20
C7	6.85	1.14	1.29	1.76	2.29	2.60
C8	4.86	0.72	0.79	1.11	1.51	1.74
C9	3.49	0.45	0.53	0.80	0.98	1.46
C10	2.41	0.26	0.37	0.53	0.72	0.87
C11	1.84	0.22	0.26	0.39	0.55	0.67
C12	1.50	0.17	0.20	0.29	0.51	0.55
C13	1.03	0.13	0.17	0.25	0.34	0.39
C14	0.84	0.11	0.15	0.22	0.28	0.29
C15	0.72	0.14	0.17	0.19	0.25	0.28
alpha chain growth probability	0.68	0.61	0.62	0.63	0.64	0.64
C1 - C50 estimated total product distribution, weight %						
C1	25.3	61.1	60.6	55.9	51.1	49.2
C2 - C4	28.2	28.6	29.3	30.3	32.2	32.7
C5 - C12	41.8	9.4	8.9	12.5	15.1	16.3
C13 - C50	4.7	0.9	1.1	1.3	1.6	1.8
CO conversion, %	1.6	8.7	6.0	4.2	2.6	2.2
rate, g CH2/g cat/hr	0.09	0.50	0.34	0.24	0.15	0.12
CO2 formation, %	0.1	0.6	0.5	0.4	0.4	0.2

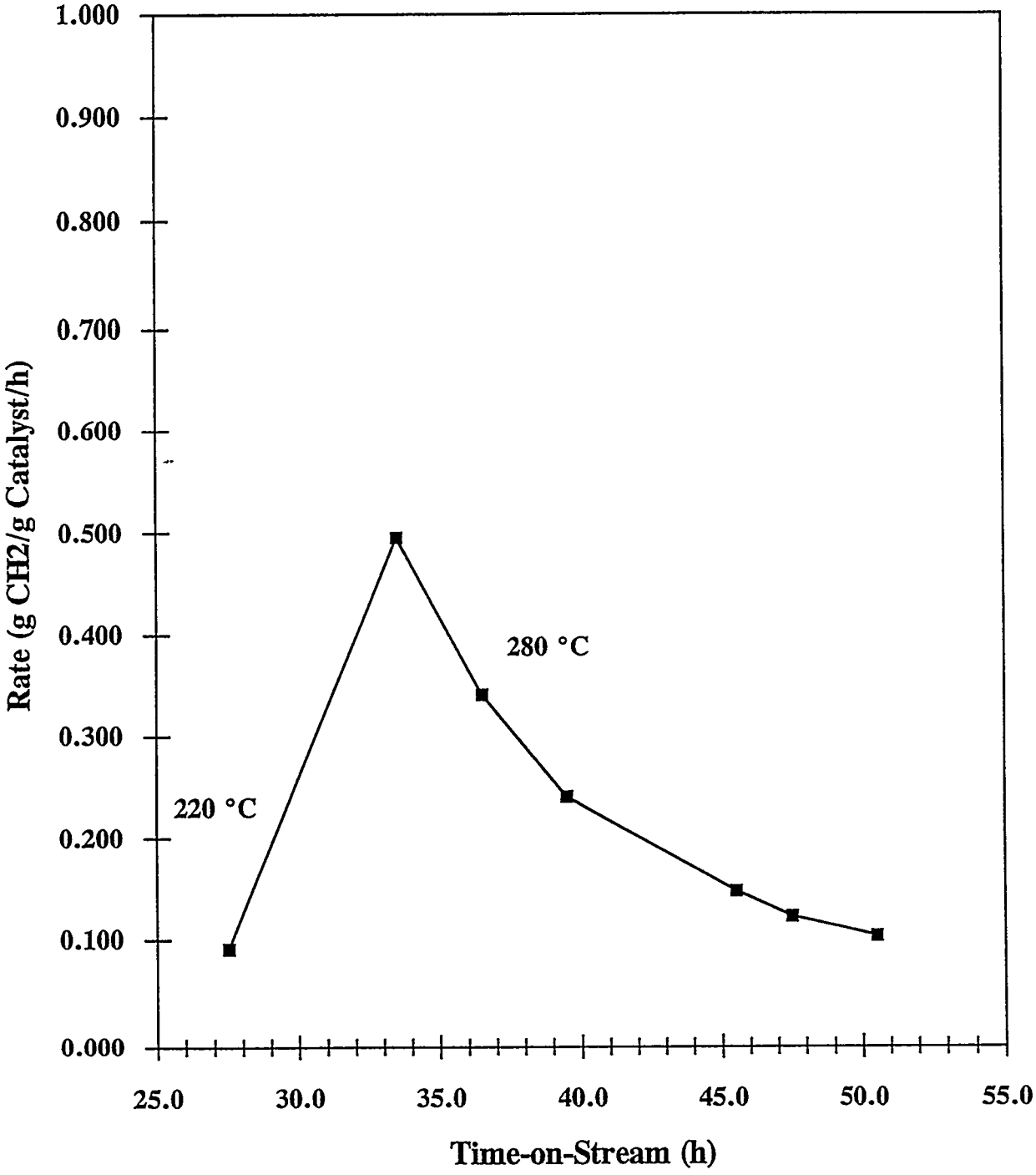
Performance of Co.005

Dates: 03/09/95 - 03/10/95 Run #10b

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 13.0 1/hr, H2/CO ratio in feed = 2

time on stream, hr	50.5	53.5
reaction temperature, °C	280	220
pressure, atm	1.0	1.0
flow, cc/min	120.0	120.0
C1 - C15 product distribution, weight %		
C1	48.74	27.61
C2	10.71	9.44
C3	13.53	9.28
C4	8.18	8.46
C5	5.98	8.65
C6	2.76	2.91
C7	2.82	6.62
C8	1.99	5.18
C9	1.51	4.46
C10	1.05	3.86
C11	0.81	3.44
C12	0.61	3.15
C13	0.57	2.75
C14	0.44	2.48
C15	0.31	1.72
alpha chain growth probability	0.65	0.76
C1 - C50 estimated total product distribution, weight %		
C1	48.0	25.9
C2 - C4	31.9	25.5
C5 - C12	18.0	36.2
C13 - C50	2.0	12.4
CO conversion, %	1.8	0.4
rate, g CH2/g cat/hr	0.10	0.02
CO2 formation, %	0.2	0.1

Time-on-Stream Plot for Co.005 - Run #10b



Co.005 - Run #10c

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

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.198 g
WHSV = 12.99 1/hr
time on stream = 53.5 hrs

CO2 (g/g cat/hr) = 0.013
CO2 (% of CO) = 0.1
O/P = 1.98

Ea = 13.8 kcal/mol

CO conversion (%)	0.4
rate (g CH2/g cat/hr)	0.02
alpha	0.76
C1 (wt%)	25.9
C2 - C4 (wt%)	25.5
C5 - C12 (wt%)	36.2
C13 + (wt%)	12.4

* Cooled down to 220 °C after the reaction at 280 °C

Co.053 - Run #7

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 227 °C
H2/CO = 2
weight of catalyst = 0.192 g
WHSV = 13.43 1/hr
time on stream = 24.5 hrs

CO2 (g/g cat/hr) = 0.044
CO2 (% of CO) = 0.2
O/P = 1.17

CO conversion (%)	9.4
rate (g CH2/g cat/hr)	0.55
alpha	0.60
C1 (wt%)	34.3
C2 - C4 (wt%)	30.1
C5 - C12 (wt%)	34.2
C13 + (wt%)	1.4

Performance of Co.053

Dates: 01/24/95 - 01/25/95 Run #7

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.4 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	227	227	227	227	227	227
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	36.41	36.34	36.40	36.38	35.69	36.08
C2	5.96	5.88	5.84	5.81	5.71	5.74
C3	13.30	13.31	13.34	13.32	13.37	13.36
C4	12.42	12.33	12.35	12.26	12.32	12.15
C5	10.52	10.53	10.56	10.51	10.74	10.60
C6	7.16	7.24	7.23	7.22	7.46	7.37
C7	5.16	5.21	5.60	5.56	5.73	5.67
C8	1.93	3.83	3.46	3.53	3.52	3.55
C9	3.85	2.03	2.04	2.10	2.17	2.12
C10	1.24	1.21	1.28	1.29	1.35	1.33
C11	0.86	0.77	0.74	0.96	0.82	0.93
C12	0.40	0.43	0.40	0.35	0.39	0.41
C13	0.31	0.30	0.27	0.26	0.26	0.25
C14	0.27	0.30	0.24	0.24	0.23	0.22
C15	0.21	0.28	0.25	0.22	0.23	0.21
alpha chain growth probability	0.60	0.62	0.61	0.60	0.61	0.60
C1 - C50 estimated total product distribution, weight %						
C1	35.9	35.6	35.7	35.9	35.1	35.6
C2 - C4	31.3	30.8	30.9	30.9	30.9	30.9
C5 - C12	31.4	31.7	31.7	31.7	32.5	32.2
C13 - C50	1.4	1.9	1.6	1.5	1.5	1.4
CO conversion, %	11.0	10.6	9.9	9.6	9.0	9.2
rate, g CH2/g cat/hr	0.64	0.62	0.58	0.57	0.53	0.54
CO2 formation, %	0.3	0.3	0.2	0.2	0.2	0.2

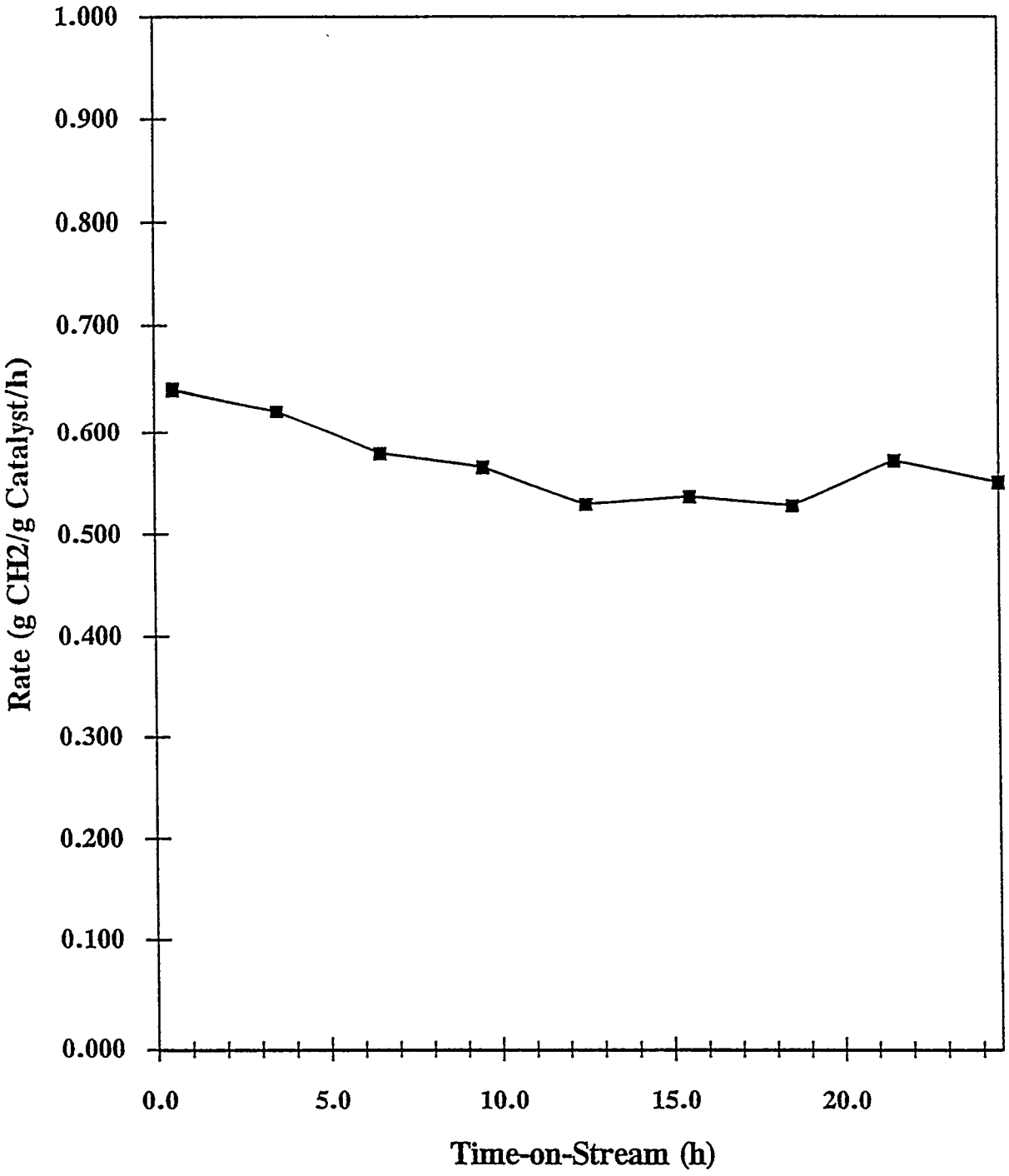
Performance of Co.053

Dates: 01/24/95 - 01/25/95 Run #7

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.4 1/hr, H2/CO ratio in feed = 2

time on stream, hr	18.5	21.5	24.5	27.5
reaction temperature, °C	227	227	227	245
pressure, atm	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	120.0
C1 - C15 product distribution, weight %				
C1	35.76	35.03	34.76	93.12
C2	5.69	5.57	5.53	1.38
C3	13.35	13.09	13.05	1.72
C4	12.22	12.01	11.96	1.29
C5	10.64	10.52	10.45	0.97
C6	7.48	7.49	7.39	0.45
C7	5.71	5.71	6.18	0.42
C8	3.54	3.56	4.41	0.27
C9	2.21	2.24	2.76	0.18
C10	1.35	1.41	1.56	0.07
C11	0.89	0.97	0.90	0.04
C12	0.42	0.45	0.26	0.03
C13	0.26	0.39	0.31	0.02
C14	0.24	0.77	0.27	0.02
C15	0.23	0.78	0.21	0.01
alpha chain growth probability	0.61	0.68	0.60	0.70
C1 - C50 estimated total product distribution, weight %				
C1	35.2	32.8	34.3	93.1
C2 - C4	30.8	28.7	30.1	4.4
C5 - C12	32.5	33.4	34.2	2.4
C13 - C50	1.5	5.0	1.4	0.1
CO conversion, %	9.0	9.7	9.4	19.9
rate, g CH2/g cat/hr	0.53	0.57	0.55	1.17
CO2 formation, %	0.2	0.2	0.2	13.6

Time-on-Stream Plot for Co053 - Run #7



Co.053 - Run #7a

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 245 °C
H2/CO = 2
weight of catalyst = 0.192 g
WHSV = 13.39 1/hr
time on stream = 42.5 hrs

CO2 (g/g cat/hr) = 0.028
CO2 (% of CO) = 0.1
O/P = 8.37

CO conversion (%)	1.7
rate (g CH2/g cat/hr)	0.10
alpha	0.60
C1 (wt%)	38.1
C2 - C4 (wt%)	35.7
C5 - C12 (wt%)	24.9
C13 + (wt%)	1.3

* Temperature surge to 285 ° C when it was set at 240 ° C

Performance of Co.053

Dates: 01/24/95 - 01/26/95 Run #7a

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 13.4 1/hr, H2/CO ratio in feed = 2

time on stream, hr	27.5	30.5	33.5	36.5	39.5	42.5
reaction temperature, °C	245	245	245	245	245	245
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	93.16	37.63	37.80	38.18	35.78	38.50
C2	1.38	9.27	9.37	9.52	8.94	9.69
C3	1.72	15.86	15.44	15.26	13.98	14.92
C4	1.29	12.39	11.96	11.80	18.01	11.55
C5	0.97	9.48	9.85	9.74	8.90	9.55
C6	0.45	4.39	4.21	4.25	3.98	4.46
C7	0.40	4.10	4.15	4.19	3.84	4.20
C8	0.26	2.87	3.06	3.07	2.74	2.84
C9	0.18	2.12	1.68	1.42	1.55	1.64
C10	0.06	0.64	0.71	0.71	0.67	0.75
C11	0.04	0.31	0.69	0.72	0.59	0.74
C12	0.03	0.28	0.33	0.43	0.39	0.44
C13	0.02	0.23	0.30	0.30	0.27	0.31
C14	0.02	0.21	0.23	0.21	0.19	0.20
C15	0.01	0.21	0.22	0.20	0.17	0.19
alpha chain growth probability	0.70	0.61	0.61	0.61	0.60	0.60
C1 - C50 estimated total product distribution, weight %						
C1	93.1	36.9	37.2	37.7	35.4	38.1
C2 - C4	4.4	36.8	36.2	36.1	40.5	35.7
C5 - C12	2.4	25.0	25.2	24.9	23.0	24.9
C13 - C50	0.1	1.4	1.4	1.3	1.1	1.3
CO conversion, %	19.9	1.9	1.8	1.8	1.9	1.7
rate, g CH2/g cat/hr	1.16	0.11	0.11	0.10	0.11	0.10
CO2 formation, %	13.6	0.3	0.2	0.1	0.2	0.1

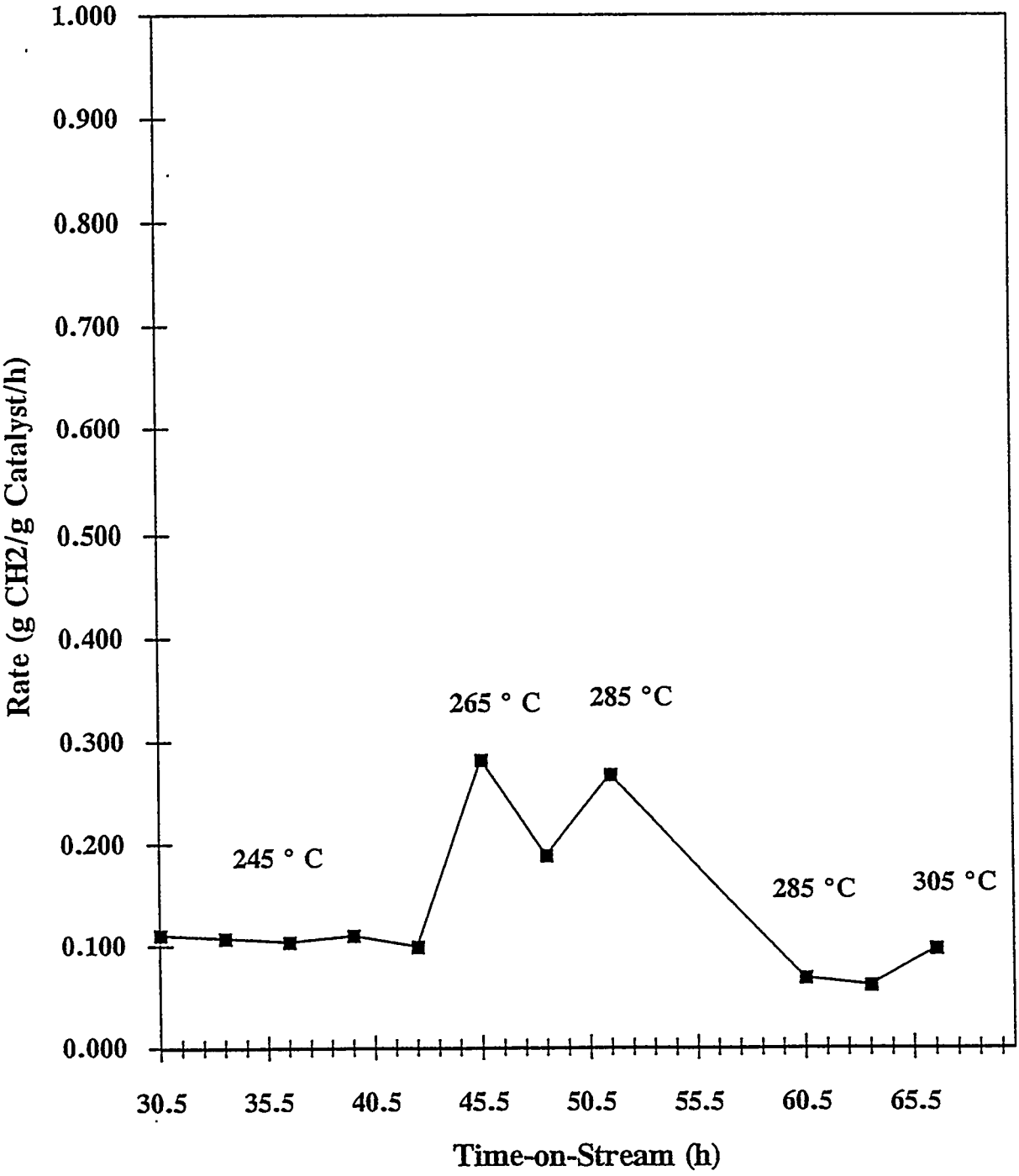
Performance of Co.053

Dates: 01/24/95 - 01/26/95 Run #7a

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 13.4 1/hr, H2/CO ratio in feed = 2

time on stream, hr	45.5	48.5	51.5	60.5	63.5	66.5
reaction temperature, °C	265	265	285	285	285	305
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	43.40	43.27	44.43	42.94	44.55	45.14
C2	9.71	10.60	12.32	17.99	18.35	18.94
C3	16.70	16.05	16.89	16.22	16.00	16.13
C4	11.23	10.78	9.99	9.19	8.96	8.15
C5	8.16	7.95	6.86	5.52	5.20	4.64
C6	2.80	3.31	2.76	2.76	2.40	1.66
C7	3.25	3.18	2.68	2.17	1.82	2.23
C8	2.29	2.15	1.74	1.48	1.34	1.43
C9	1.09	1.09	1.10	0.63	0.49	0.73
C10	0.64	0.49	0.73	0.37	0.26	0.38
C11	0.38	0.37	0.16	0.17	0.15	0.07
C12	0.16	0.30	0.12	0.12	0.11	0.08
C13	0.06	0.19	0.07	0.12	0.11	0.23
C14	0.06	0.15	0.08	0.11	0.09	0.12
C15	0.07	0.11	0.08	0.19	0.18	0.09
alpha chain growth probability	0.55	0.58	0.56	0.62	0.61	0.59
C1 - C50 estimated total product distribution, weight %						
C1	43.1	42.9	44.0	42.0	43.6	44.8
C2 - C4	37.4	37.1	38.8	42.5	42.4	42.8
C5 - C12	19.0	19.2	16.6	14.2	12.8	11.8
C13 - C50	0.5	0.8	0.5	1.3	1.2	0.6
CO conversion, %	4.8	3.2	4.6	1.2	1.0	24.9
rate, g CH2/g cat/hr	0.28	0.19	0.27	0.07	0.06	0.10
CO2 formation, %	0.4	0.3	0.5	0.3	0.2	1.2

Time-on-Stream Plot for Co053 - Run #7a



Co.053 - Run #7b

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.192 g
WHSV = 13.39 1/hr
time on stream = 18.5 hrs

CO2 (g/g cat/hr) = 0.021
CO2 (% of CO) = 0.1
O/P = 4.20

CO conversion (%)	2.0
rate (g CH2/g cat/hr)	0.12
alpha	0.62
C1 (wt%)	32.1
C2 - C4 (wt%)	31.5
C5 - C12 (wt%)	34.5
C13 + (wt%)	1.9

* Catalyst calcined and reduced insitu after run # 7 (high T study)

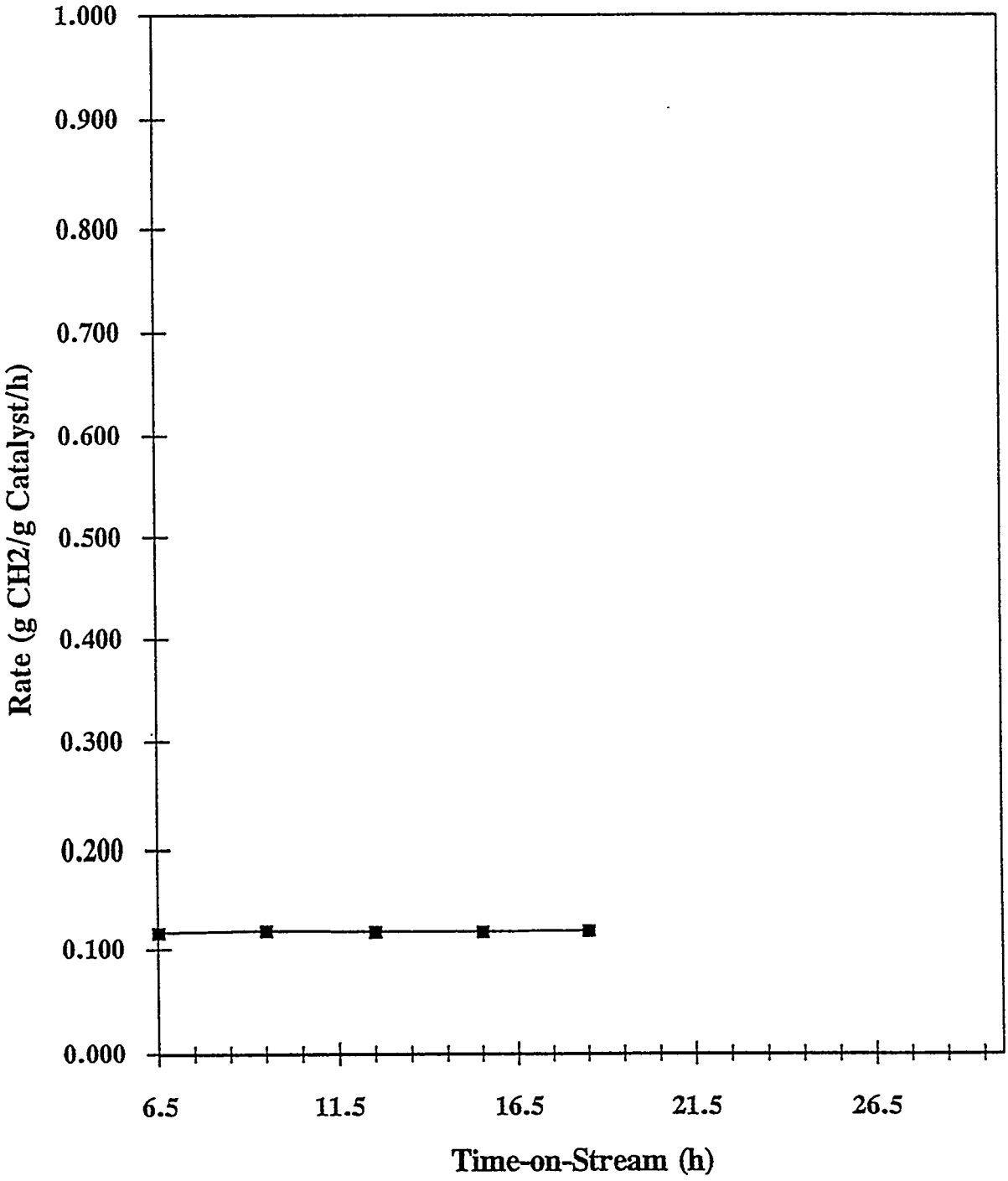
Performance of Co.053

Dates: 01/28/95 - 01/29/95 Run #7b

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.4 1/hr, H2/CO ratio in feed = 2

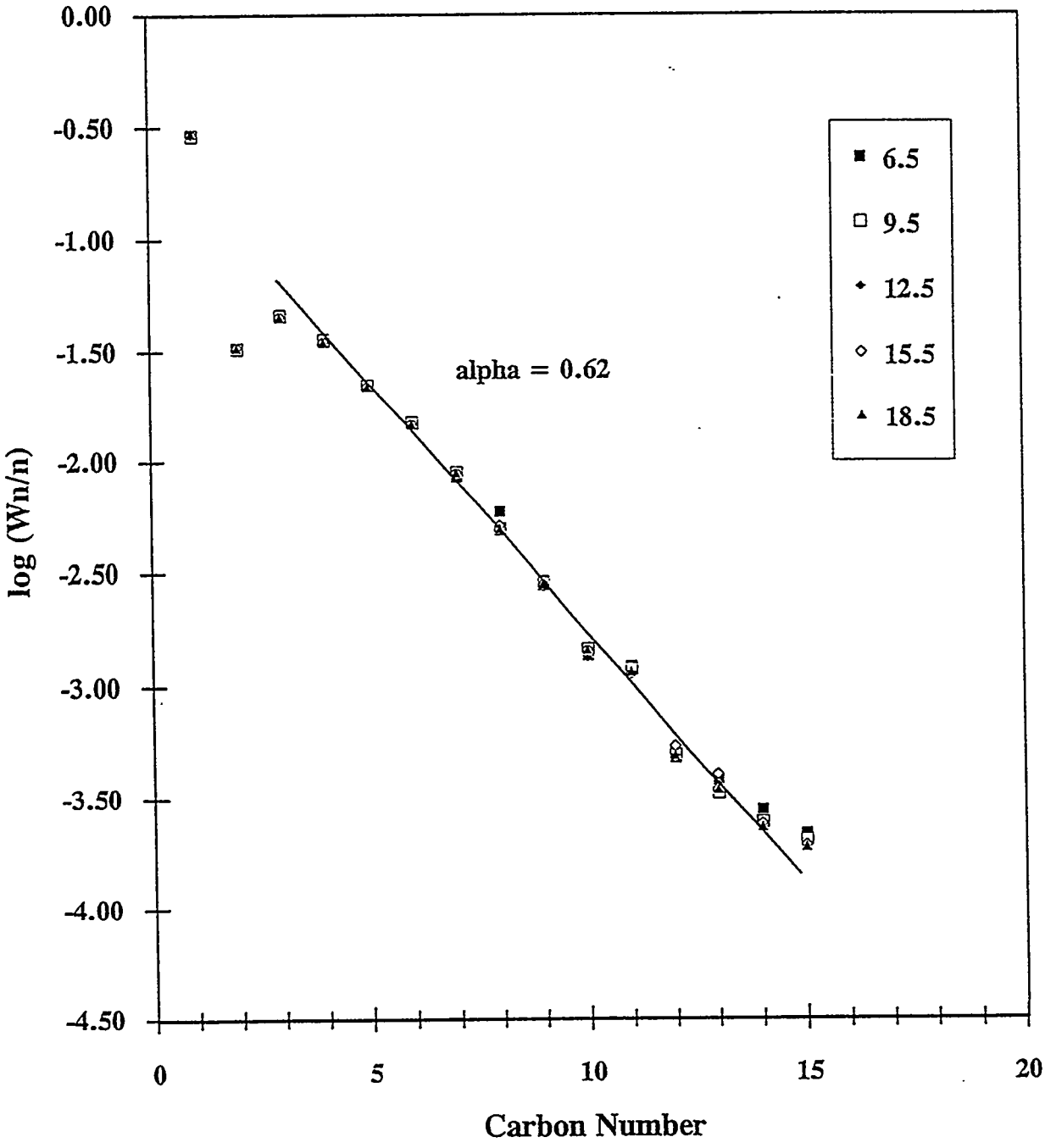
time on stream, hr	6.5	9.5	12.5	15.5	18.5
reaction temperature, °C	220	220	220	220	220
pressure, atm	1.0	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	90.0	90.0
C1 - C15 product distribution, weight %					
C1	31.24	31.95	32.21	32.27	32.52
C2	6.49	6.56	6.59	6.57	6.58
C3	13.24	13.30	13.24	13.15	13.02
C4	12.76	12.65	12.57	12.46	12.35
C5	12.01	11.90	11.80	11.74	11.63
C6	6.46	6.46	6.43	6.54	6.78
C7	5.96	6.24	6.25	6.20	6.22
C8	4.69	3.91	4.05	4.04	3.95
C9	2.62	2.55	2.56	2.52	2.55
C10	1.38	1.47	1.34	1.46	1.47
C11	1.36	1.32	1.26	1.25	1.28
C12	0.59	0.60	0.60	0.66	0.60
C13	0.50	0.43	0.47	0.53	0.45
C14	0.39	0.34	0.34	0.33	0.32
C15	0.32	0.30	0.29	0.29	0.28
alpha chain growth probability	0.63	0.62	0.62	0.62	0.62
C1 - C50 estimated total product distribution, weight %					
C1	30.8	31.5	31.8	31.9	32.1
C2 - C4	32.0	32.0	32.0	31.8	31.5
C5 - C12	35.1	34.5	34.3	34.4	34.5
C13 - C50	2.1	2.0	1.9	1.9	1.9
CO conversion, %	2.0	2.0	2.0	2.0	2.0
rate, g CH2/g cat/hr	0.12	0.12	0.12	0.12	0.12
CO2 formation, %	0.1	0.1	0.1	0.1	0.1

Time-on-Stream Plot for Co053 - Run #7b



Schulz-Flory Plot for Co.053 - Run #7b
Time on Stream (hrs)

hrs.



Co.053 - Run #8

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.192 g
WHSV = 13.39 1/hr
time on stream = 21.5 hrs

CO2 (g/g cat/hr) = 0.036
CO2 (% of CO) = 0.2
O/P = 1.27

CO conversion (%)	7.7
rate (g CH2/g cat/hr)	0.45
alpha	0.65
C1 (wt%)	30.3
C2 - C4 (wt%)	28.4
C5 - C12 (wt%)	38.1
C13 + (wt%)	3.2

Performance of Co.053

Dates: 01/31/95 - 02/03/95 Run #8

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.4 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	32.33	31.24	31.55	32.64	31.12	31.10
C2	5.46	5.21	5.22	5.40	5.13	5.13
C3	12.93	12.48	12.50	13.03	12.35	12.39
C4	12.68	12.12	12.12	6.92	11.85	11.89
C5	11.40	11.15	11.12	11.76	11.10	11.09
C6	8.22	8.21	8.21	8.81	8.28	8.33
C7	5.66	6.61	6.56	7.06	6.65	6.66
C8	4.53	4.32	4.39	4.76	4.50	4.48
C9	2.74	2.91	2.92	3.21	3.07	3.05
C10	1.76	1.92	1.86	2.17	2.04	2.01
C11	1.29	1.44	1.35	1.52	1.43	0.81
C12	0.60	0.87	0.83	0.97	0.97	1.54
C13	0.24	0.61	0.55	0.64	0.60	0.58
C14	0.10	0.52	0.44	0.59	0.48	0.49
C15	0.04	0.38	0.37	0.52	0.44	0.47
alpha chain growth probability	0.51	0.64	0.63	0.65	0.64	0.65
C1 - C50 estimated total product distribution, weight %						
C1	32.8	30.7	31.0	31.8	30.5	30.3
C2 - C4	31.5	29.3	29.3	24.7	28.7	28.6
C5 - C12	35.4	37.4	37.2	40.2	38.0	38.0
C13 - C50	0.3	2.5	2.4	3.4	2.8	3.1
CO conversion, %	9.6	8.9	8.5	7.7	8.0	7.8
rate, g CH2/g cat/hr	0.56	0.52	0.50	0.45	0.47	0.46
CO2 formation, %	0.2	0.3	0.4	0.6	0.5	0.2

Performance of Co.053

Dates: 01/31/95 - 02/03/95 Run #8

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.4 1/hr, H2/CO ratio in feed = 2

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

C1 - C15 product distribution, weight %

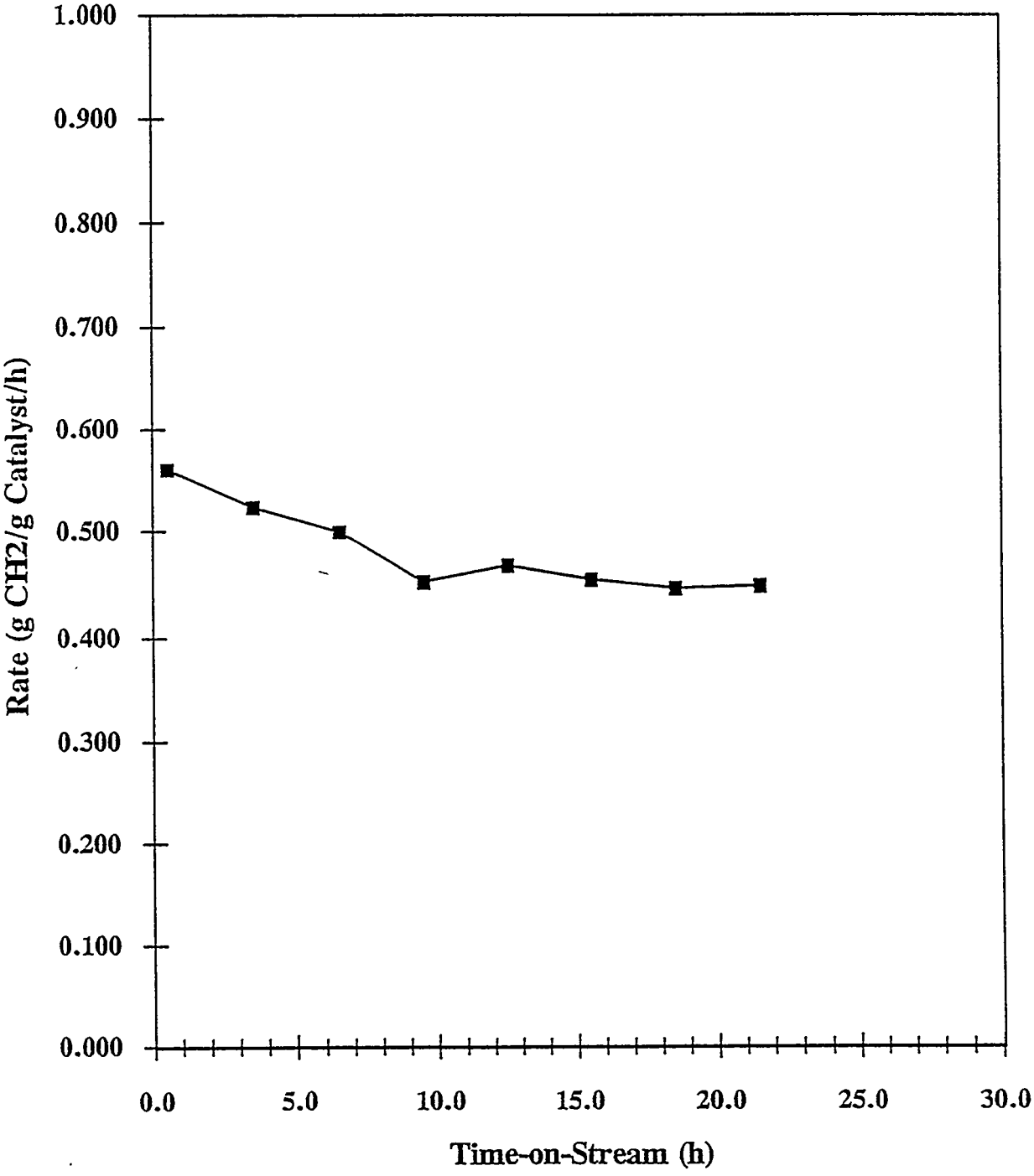
C1	31.14	31.14
C2	5.12	5.12
C3	12.37	12.36
C4	11.84	11.79
C5	11.09	11.02
C6	8.29	8.42
C7	6.70	6.69
C8	4.53	4.52
C9	3.10	3.05
C10	2.02	2.04
C11	1.46	1.40
C12	0.86	0.86
C13	0.55	0.58
C14	0.47	0.50
C15	0.48	0.49
alpha chain growth probability	0.65	0.65

C1 - C50 estimated total product distribution, weight %

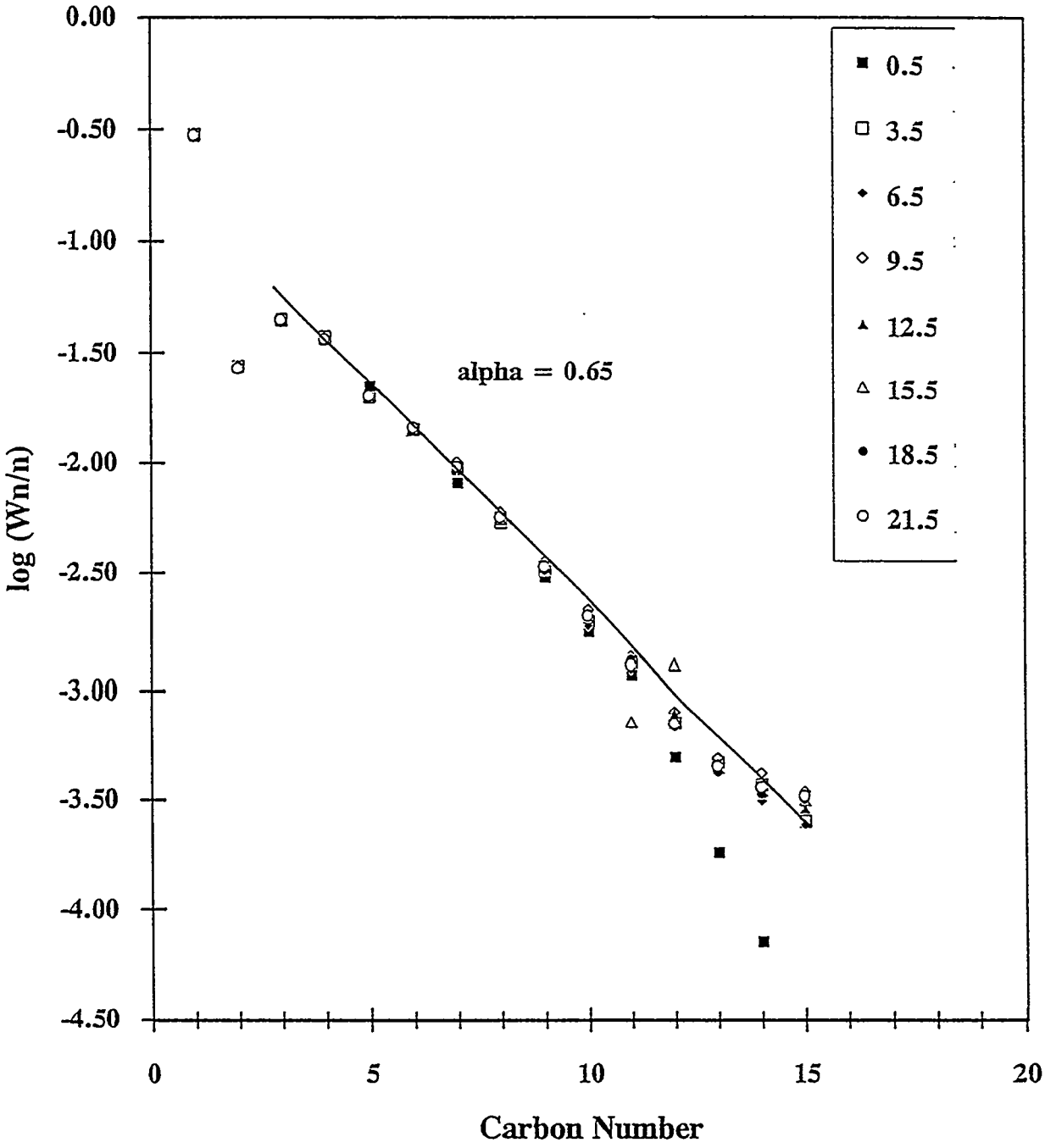
C1	30.3	30.3
C2 - C4	28.6	28.4
C5 - C12	38.0	38.1
C13 - C50	3.1	3.2

CO conversion, %	7.6	7.7
rate, g CH2/g cat/hr	0.45	0.45
CO2 formation, %	0.2	0.2

Time-on-Stream Plot for Co.053 - Run #8



Schulz-Flory Plot for Co.053 - Run #8
Time on Stream (hrs)



Co.053 - Run #8a

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.192 g
WHSV = 13.39 1/hr
time on stream = 24.5 hrs

CO2 (g/g cat/hr) = 0.047
CO2 (% of CO) = 0.2
O/P = 1.44

CO conversion (%)	6.3
rate (g CH2/g cat/hr)	0.37
alpha	0.65
C1 (wt%)	32.8
C2 - C4 (wt%)	30.2
C5 - C12 (wt%)	33.7
C13 + (wt%)	3.3

* 30 cc/min Ar added to the reaction mixture

Co.053 - Run #8b

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 240 °C
H2/CO = 2
weight of catalyst = 0.192 g
WHSV = 13.39 1/hr
time on stream = 42.5 hrs

CO2 (g/g cat/hr) = 0.033
CO2 (% of CO) = 0.2
O/P = 3.79

CO conversion (%)	3.0
rate (g CH2/g cat/hr)	0.18
alpha	0.65
C1 (wt%)	37.3
C2 - C4 (wt%)	33.5
C5 - C12 (wt%)	26.3
C13 + (wt%)	2.9

* Temperature surge to 275 °C when it was set at 240 °C

Performance of Co.053

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

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 13.4 l/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	260	260	260	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	49.30	47.42	45.60	48.44	44.35	42.15
C2	9.21	9.54	9.78	11.89	13.02	13.80
C3	15.68	15.62	15.71	15.96	15.68	15.49
C4	9.83	10.20	10.42	9.10	9.44	9.53
C5	6.70	7.25	7.66	6.07	6.73	7.01
C6	2.67	2.23	2.34	1.98	2.48	2.76
C7	2.72	2.81	3.00	2.32	3.11	2.81
C8	1.48	1.98	2.14	1.68	1.99	2.20
C9	0.86	1.02	1.15	0.86	1.23	1.35
C10	0.37	0.58	0.61	0.50	0.69	0.73
C11	0.37	0.41	0.52	0.33	0.56	0.70
C12	0.20	0.28	0.27	0.25	0.36	0.46
C13	0.19	0.20	0.26	0.20	0.27	0.33
C14	0.21	0.24	0.27	0.19	0.05	0.28
C15	0.22	0.23	0.26	0.22	0.04	0.40
alpha chain growth probability	0.62	0.62	0.63	0.63	0.53	0.66
C1 - C50 estimated total product distribution, weight %						
C1	48.3	46.5	44.6	47.4	44.6	40.9
C2 - C4	34.0	34.7	35.1	36.2	38.3	37.6
C5 - C12	16.3	17.4	18.6	14.9	16.8	18.9
C13 - C50	1.5	1.5	1.7	1.5	0.3	2.6
CO conversion, %	6.3	5.2	4.6	5.7	3.9	47.8
rate, g CH2/g cat/hr	0.37	0.30	0.27	0.33	0.23	0.19
CO2 formation, %	0.3	0.3	0.3	0.6	0.6	0.4

Performance of Co.053

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

flow rate = 120.0 cc/min, loading= 0.2 g, WHSV = 13.4 1/hr, H2/CO ratio in feed = 2

	a	b				
time on stream, hr	24.5	30.5	33.5	36.5	39.5	42.5
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	33.98	36.42	37.91	37.95	38.37	38.47
C2	5.62	7.59	7.92	7.98	8.07	8.13
C3	13.51	14.81	15.05	14.85	14.80	14.74
C4	12.15	11.89	12.08	11.89	11.78	11.72
C5	10.72	9.80	10.07	9.97	9.77	9.79
C6	7.48	5.83	2.79	2.97	3.05	3.21
C7	5.88	4.82	5.01	5.01	4.93	4.93
C8	3.73	2.90	3.01	3.08	3.07	3.05
C9	2.27	1.88	1.96	1.89	1.95	1.89
C10	1.35	1.05	1.16	1.27	1.22	1.14
C11	1.06	0.97	1.00	1.11	1.04	1.01
C12	0.68	0.53	0.58	0.66	0.60	0.60
C13	0.53	0.48	0.50	0.43	0.50	0.44
C14	0.52	0.45	0.40	0.40	0.38	0.45
C15	0.51	0.59	0.55	0.52	0.46	0.44
alpha chain growth probability	0.65	0.66	0.66	0.66	0.65	0.65
C1 - C50 estimated total product distribution, weight %						
C1	32.8	34.8	36.4	36.5	37.2	37.3
C2 - C4	30.2	32.7	33.6	33.4	33.6	33.5
C5 - C12	33.7	28.7	26.5	26.7	26.3	26.3
C13 - C50	3.3	3.8	3.6	3.4	3.0	2.9
CO conversion, %	6.3	3.5	3.3	3.1	3.1	3.0
rate, g CH2/g cat/hr	0.37	0.20	0.19	0.18	0.18	0.18
CO2 formation, %	0.2	0.2	0.2	0.3	0.2	0.2

(a) 30 cc/min Ar added to the reaction mixture. (b) Temperature surge to 275 °C

Co.053 - Run #9

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.102 g
WHSV = 25.21 1/hr
time on stream = 18.5 hrs

CO2 (g/g cat/hr) = 0.046
CO2 (% of CO) = 0.1
O/P = 1.49

CO conversion (%)	4.3
rate (g CH2/g cat/hr)	0.47
alpha	0.69
C1 (wt%)	21.6
C2 - C4 (wt%)	22.5
C5 - C12 (wt%)	48.6
C13 + (wt%)	7.3

Performance of Co.053

Dates: 02/07/95 - 02/08/95 Run #9

flow rate = 90.0 cc/min, loading= 0.1 g, WHSV = 25.2 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	24.26	25.48	23.10	25.81	22.96	26.11
C2	4.63	4.99	4.31	4.78	4.26	4.82
C3	11.43	11.31	10.07	11.09	9.85	11.14
C4	12.35	11.76	10.51	11.45	10.21	11.43
C5	12.43	11.83	10.61	11.56	10.33	11.44
C6	9.56	9.38	8.28	8.90	7.36	9.16
C7	7.89	7.73	10.02	7.57	10.26	7.56
C8	5.54	5.48	7.22	5.64	7.43	5.45
C9	4.01	3.92	5.19	3.95	5.32	3.91
C10	3.00	3.00	3.75	2.86	3.88	2.90
C11	1.95	1.99	2.65	1.99	2.70	2.02
C12	1.26	1.31	1.86	1.50	1.91	1.44
C13	0.88	0.83	1.16	1.01	1.32	1.00
C14	0.63	0.60	0.80	0.92	1.06	0.81
C15	0.18	0.38	0.48	0.97	1.14	0.81
alpha chain growth probability	0.59	0.64	0.64	0.70	0.69	0.68
C1 - C50 estimated total product distribution, weight %						
C1	24.7	25.4	23.1	24.4	21.6	25.1
C2 - C4	29.0	28.0	24.9	25.9	22.9	26.3
C5 - C12	45.1	44.1	48.7	43.4	48.1	43.3
C13 - C50	1.3	2.5	3.2	6.3	7.4	5.3
CO conversion, %	4.2	3.9	4.1	3.9	4.2	3.7
rate, g CH2/g cat/hr	0.46	0.43	0.45	0.43	0.47	0.41
CO2 formation, %	0.1	0.1	0.1	0.1	0.1	0.1

Performance of Co.053

Dates: 02/07/95 - 02/08/95 Run #9

flow rate = 90.0 cc/min, loading= 0.1 g, WHSV = 25.2 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 %

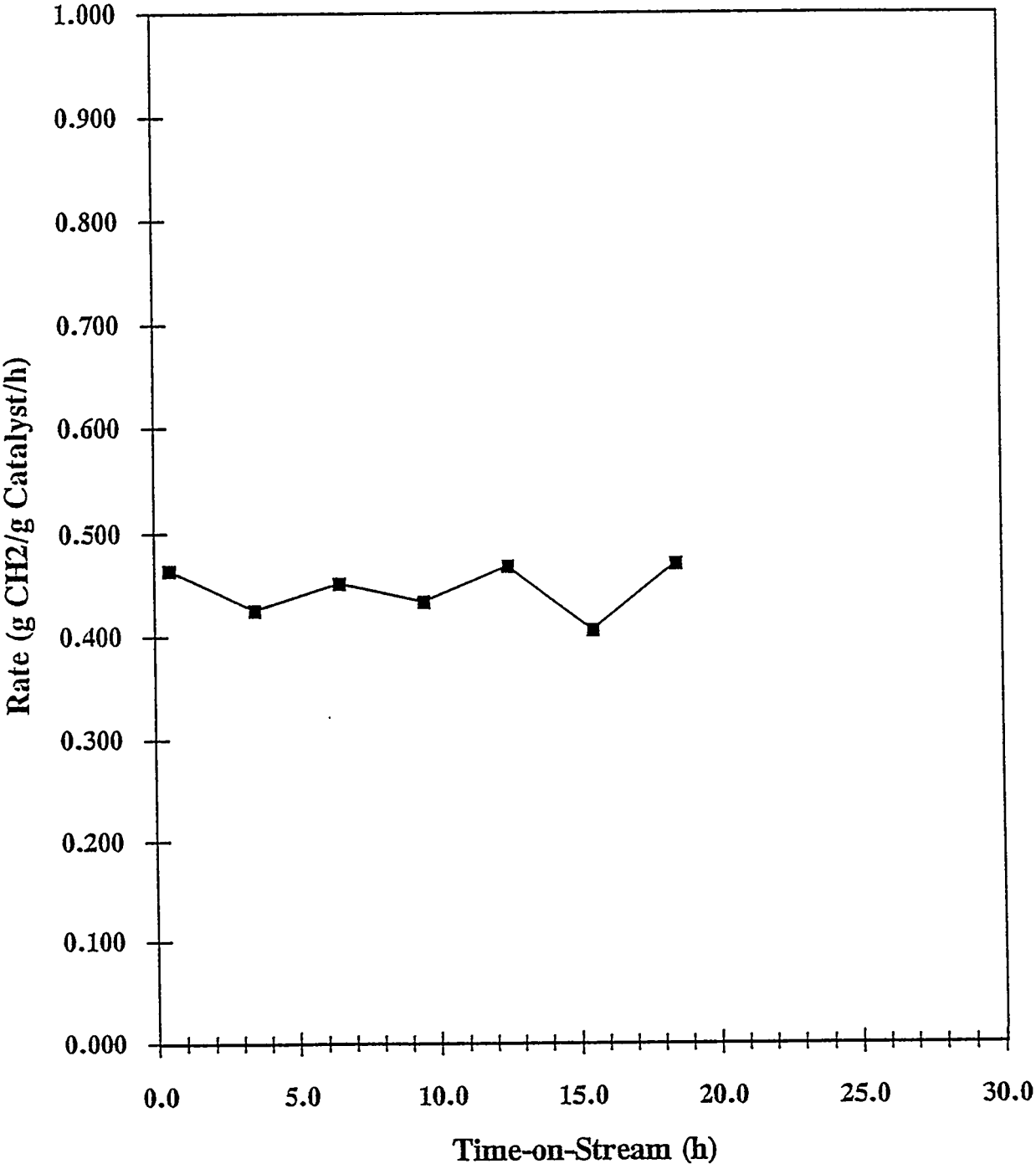
C1	22.91
C2	4.22
C3	9.74
C4	9.97
C5	10.11
C6	7.05
C7	10.67
C8	7.68
C9	5.57
C10	4.05
C11	2.71
C12	1.85
C13	1.29
C14	1.06
C15	1.13
alpha chain growth probability	0.69

C1 - C50 estimated total product distribution, weight %

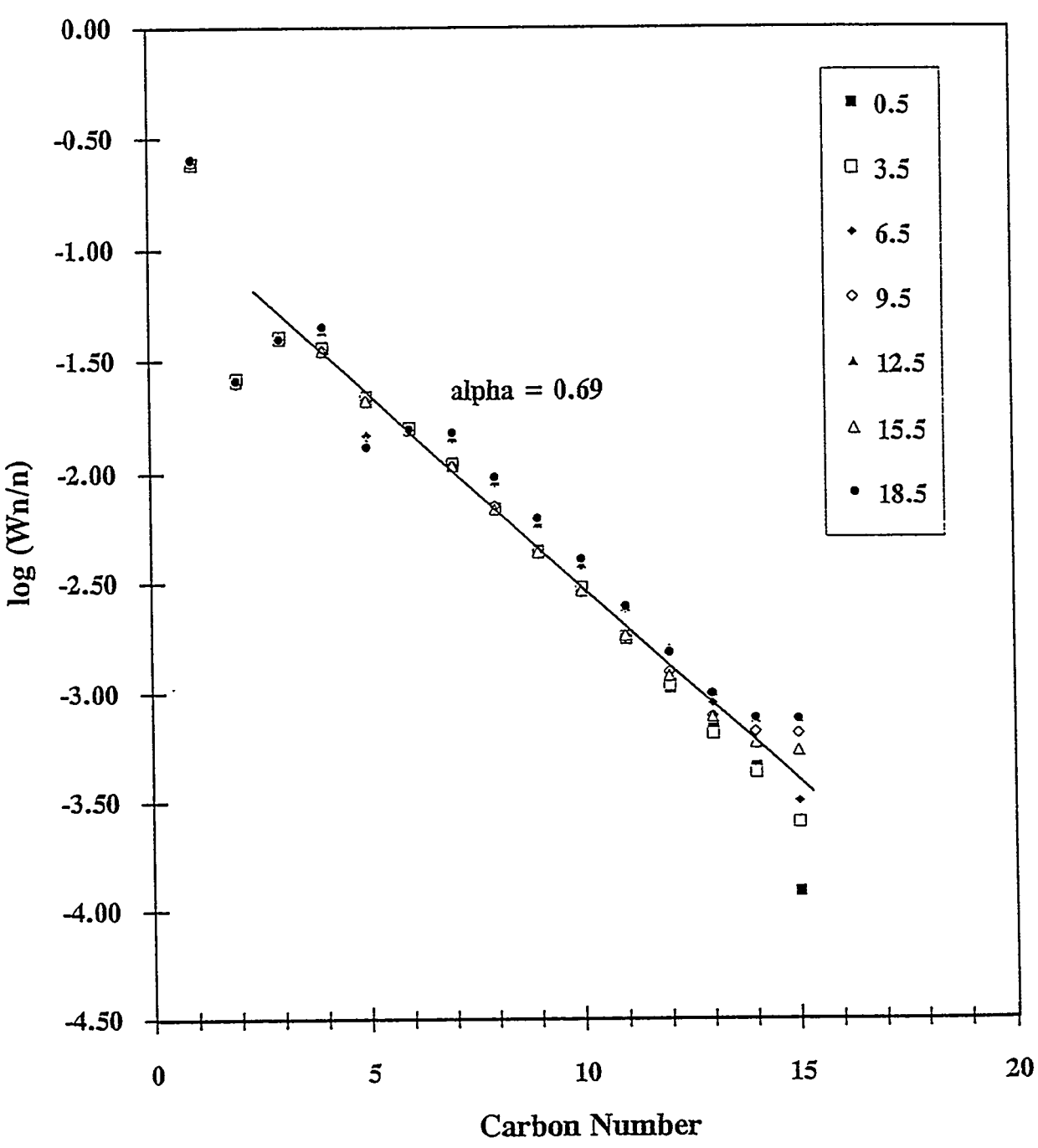
C1	21.6
C2 - C4	22.5
C5 - C12	48.6
C13 - C50	7.3

CO conversion, %	4.3
rate, g CH2/g cat/hr	0.47
CO2 formation, %	0.1

Time-on-Stream Plot for C0.053 - Run #9



Schulz-Flory Plot for Co.053 - Run #9
Time on Stream (hrs)



Co.053 - Run #9a

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA*

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.102 g
WHSV = 25.21 1/hr
time on stream = 21.5 hrs

CO2 (g/g cat/hr) = 0.067
CO2 (% of CO) = 0.2
O/P = 1.54

CO conversion (%)	3.1
rate (g CH2/g cat/hr)	0.35
alpha	0.67
C1 (wt%)	27.9
C2 - C4 (wt%)	28.5
C5 - C12 (wt%)	38.9
C13 + (wt%)	4.7

* 30 cc/min Ar added to the reaction mixture

Performance of Co.053

Dates: 02/07/95 - 02/08/95 Run #9a

flow rate = 120.0 cc/min, loading= 0.1 g, WHSV = 25.2 1/hr, H2/CO ratio in feed = 2

	a					
time on stream, hr	21.5	24.5	27.5	33.5	36.5	39.5
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	29.37	50.05	47.54	46.84	45.96	50.95
C2	5.52	7.49	7.21	7.20	7.12	7.89
C3	12.43	13.21	13.37	13.90	13.99	8.10
C4	12.00	10.01	10.90	11.23	11.28	12.57
C5	10.96	8.06	7.87	8.25	8.32	9.32
C6	9.25	4.97	6.31	4.54	4.92	1.72
C7	6.74	2.73	3.05	3.43	3.46	3.91
C8	4.50	1.44	1.61	1.90	1.94	2.27
C9	2.95	0.68	0.75	0.99	1.72	1.18
C10	2.02	0.45	0.50	0.56	0.35	0.74
C11	1.37	0.25	0.28	0.34	0.28	0.42
C12	0.82	0.18	0.20	0.25	0.18	0.33
C13	0.68	0.12	0.13	0.18	0.18	0.24
C14	0.67	0.18	0.04	0.15	0.13	0.20
C15	0.73	0.20	0.22	0.21	0.16	0.17
alpha chain growth probability	0.67	0.61	0.61	0.61	0.59	0.60
C1 - C50 estimated total product distribution, weight %						
C1	27.9	49.0	46.3	45.9	45.2	50.2
C2 - C4	28.5	30.1	30.7	31.7	31.8	28.1
C5 - C12	38.9	19.7	21.5	21.1	21.9	20.5
C13 - C50	4.7	1.3	1.4	1.4	1.1	1.1
CO conversion, %	3.1	7.3	6.8	6.2	6.0	5.3
rate, g CH2/g cat/hr	0.35	0.80	0.75	0.69	0.66	0.59
CO2 formation, %	0.2	0.2	0.3	0.2	0.2	0.2

(a) 30 cc/min Ar added to the reaction mixture

Performance of Co.053

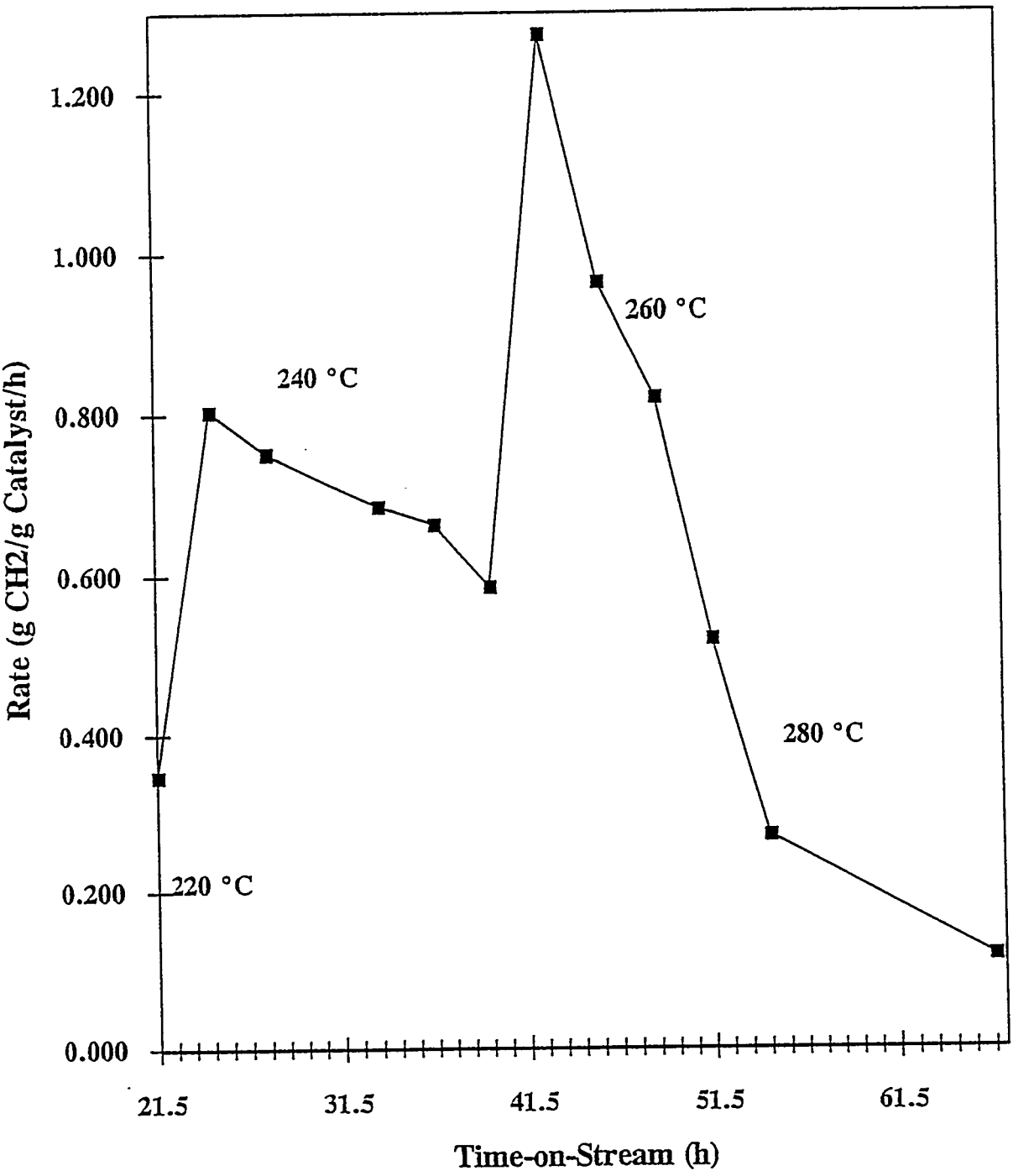
Dates: 02/07/95 - 02/08/95 Run #9a

flow rate = 120.0 cc/min, loading= 0.1 g, WHSV = 25.2 l/hr, H2/CO ratio in feed = 2

				b		
time on stream, hr	42.5	45.5	48.5	51.5	54.5	66.5
reaction temperature, °C	260	260	260	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	64.26	58.91	56.31	38.11	35.03	33.57
C2	8.00	7.84	7.76	11.05	13.19	14.89
C3	10.95	13.35	14.21	16.36	15.37	14.32
C4	7.23	8.47	8.96	10.58	10.19	9.37
C5	3.96	5.08	5.75	7.84	7.82	7.83
C6	1.58	2.57	2.11	5.00	4.27	2.59
C7	1.68	1.65	2.07	3.75	4.27	4.77
C8	0.97	0.81	1.08	2.50	2.97	3.62
C9	0.49	0.51	0.66	1.65	2.06	2.49
C10	0.33	0.30	0.33	1.16	1.50	1.96
C11	0.18	0.15	0.23	0.76	1:04	1.42
C12	0.13	0.10	0.20	0.44	0.90	1.18
C13	0.11	0.08	0.14	0.34	0.62	0.83
C14	0.06	0.08	0.10	0.24	0.40	0.60
C15	0.07	0.08	0.10	0.21	0.37	0.55
alpha chain growth probability	0.59	0.57	0.58	0.62	0.65	0.69
C1 - C50 estimated total product distribution, weight %						
C1	63.9	58.4	55.8	37.6	34.4	32.8
C2 - C4	26.0	29.4	30.6	37.5	38.1	37.7
C5 - C12	9.6	11.7	12.9	23.4	25.1	25.8
C13 - C50	0.5	0.5	0.7	1.4	2.4	3.7
CO conversion, %	11.5	8.7	7.4	4.7	2.5	16.0
rate, g CH2/g cat/hr	1.27	0.96	0.82	0.52	0.27	0.12
CO2 formation, %	1.2	0.7	0.5	0.6	0.4	0.2

(b) Temperature surge to 310 °C

Time-on-Stream Plot for Co.053 - Run #9a



Co.053 - Run #9b

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 240 °C
H2/CO = 2
weight of catalyst = 0.102 g
WHSV = 25.21 1/hr
time on stream = 39.5 hrs

CO2 (g/g cat/hr) = 0.087
CO2 (% of CO) = 0.2
O/P = 1.22

CO conversion (%)	5.3
rate (g CH2/g cat/hr)	0.59
alpha	0.60
C1 (wt%)	50.2
C2 - C4 (wt%)	28.1
C5 - C12 (wt%)	20.5
C13 + (wt%)	1.1

Co.053 - Run #10

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.206 g
WHSV = 12.48 1/hr
time on stream = 18.5 hrs

CO2 (g/g cat/hr) = 0.008
CO2 (% of CO) = 0.0
O/P = 1.56

CO conversion (%)	5.6
rate (g CH2/g cat/hr)	0.30
alpha	0.60
C1 (wt%)	29.2
C2 - C4 (wt%)	29.8
C5 - C12 (wt%)	39.5
C13 + (wt%)	1.5

Performance of Co.053

Dates: 03/13/95 - 03/14/95 Run #10

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 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	26.13	26.71	26.50	26.90	27.04	27.49
C2	4.57	4.73	4.63	4.66	4.64	4.67
C3	11.94	11.81	11.49	11.60	11.77	11.63
C4	12.17	11.95	11.56	11.55	10.77	11.60
C5	11.93	11.70	11.32	11.46	11.66	11.29
C6	9.27	9.12	8.84	8.99	9.07	8.99
C7	7.49	7.37	7.14	7.18	7.34	7.25
C8	5.43	5.37	5.17	5.19	5.31	5.30
C9	3.95	3.89	3.84	3.77	3.86	3.81
C10	2.72	2.70	2.78	2.70	2.77	2.61
C11	2.10	2.26	2.18	2.15	2.10	1.96
C12	1.27	1.29	1.56	1.48	1.48	1.30
C13	0.71	0.75	1.20	0.99	1.03	0.94
C14	0.26	0.26	1.09	0.76	0.66	0.67
C15	0.08	0.08	0.68	0.61	0.49	0.50
alpha chain growth probability	0.55	0.55	0.67	0.66	0.65	0.65
C1 - C50 estimated total product distribution, weight %						
C1	26.9	27.5	26.0	26.4	26.8	27.1
C2 - C4	29.5	29.4	27.1	27.3	26.9	27.5
C5 - C12	43.0	42.5	42.5	42.4	43.0	42.1
C13 - C50	0.6	0.6	4.5	4.0	3.3	3.3
CO conversion, %	6.9	6.3	6.5	6.2	6.1	6.0
rate, g CH2/g cat/hr	0.38	0.34	0.36	0.34	0.33	0.33
CO2 formation, %	0.2	0.1	0.1	0.1	0.1	0.1

Performance of Co.053

Dates: 03/13/95 - 03/14/95 Run #10

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 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 %

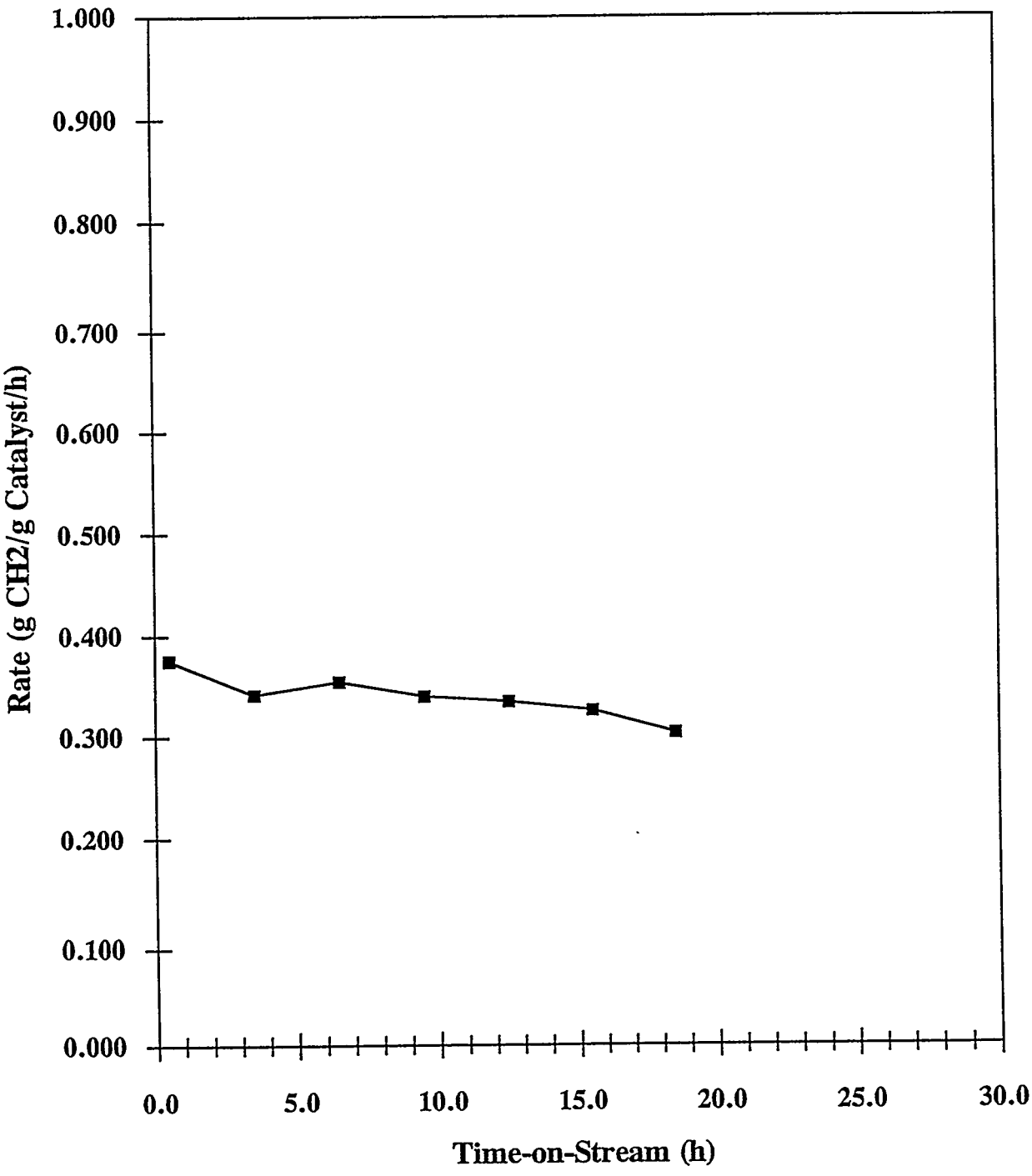
C1	28.62
C2	4.84
C3	12.13
C4	12.25
C5	11.92
C6	5.23
C7	7.48
C8	5.39
C9	4.00
C10	2.77
C11	2.13
C12	1.37
C13	0.97
C14	0.70
C15	0.21
alpha chain growth probability	0.60

C1 - C50 estimated total product distribution, weight %

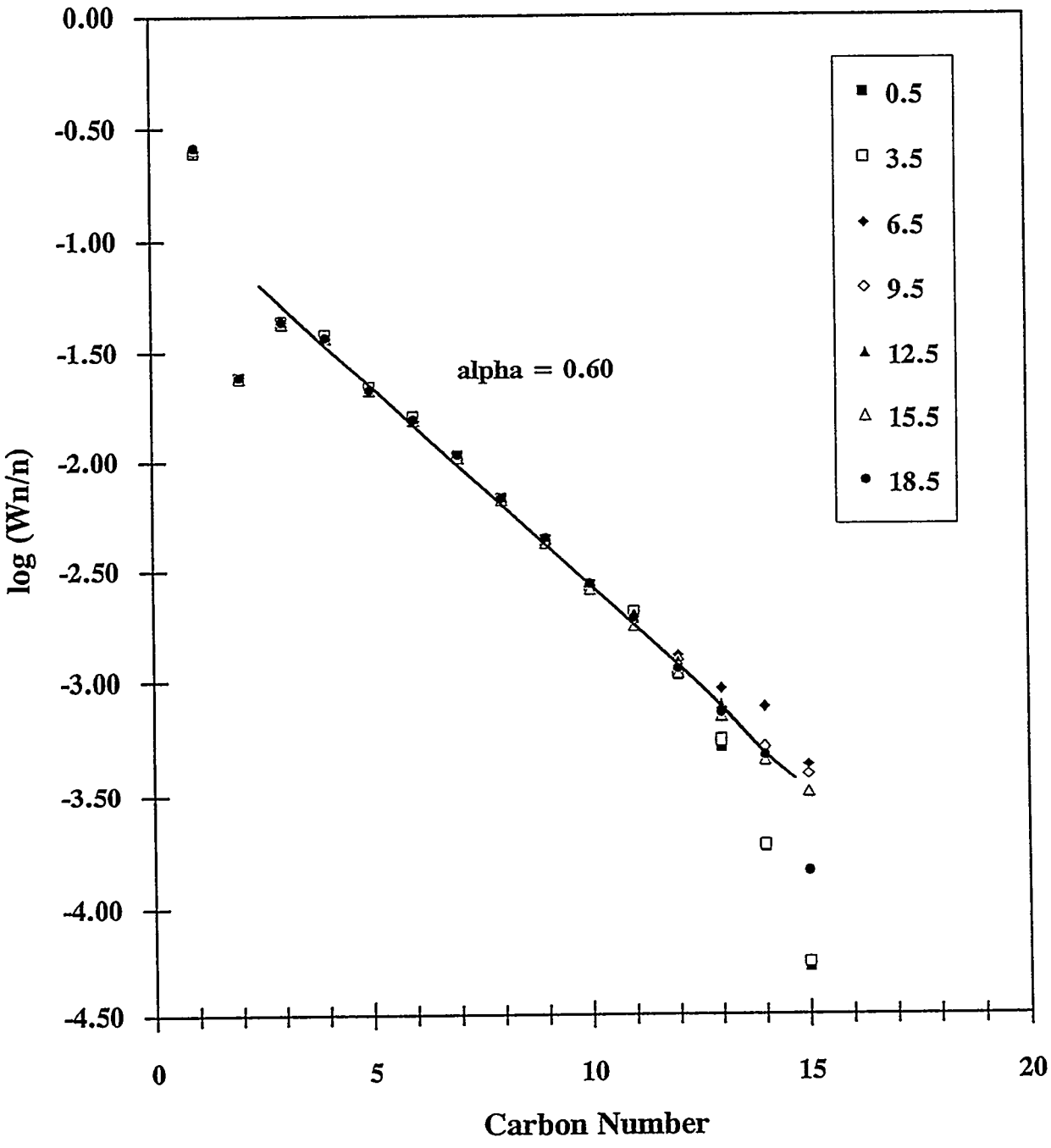
C1	29.2
C2 - C4	29.8
C5 - C12	39.5
C13 - C50	1.5

CO conversion, %	5.6
rate, g CH2/g cat/hr	0.30
CO2 formation, %	0.0

Time-on-Stream Plot for C0.053 - Run #10



Schulz-Flory Plot for Co.053 - Run #10
Time on Stream (hrs)



Co.053 - Run #10a

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 240 °C
H2/CO = 2
weight of catalyst = 0.206 g
WHSV = 12.48 1/hr
time on stream = 42.5 hrs

CO2 (g/g cat/hr) = 0.046
CO2 (% of CO) = 0.2
O/P = 1.10

CO conversion (%)	11.9
rate (g CH2/g cat/hr)	0.65
alpha	0.59
C1 (wt%)	42.7
C2 - C4 (wt%)	31.6
C5 - C12 (wt%)	24.7
C13 + (wt%)	1.0

Performance of Co.053

Dates: 03/14/95 - 03/15/95 Run #10a

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 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	240	240	240	240	240	240
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	47.60	42.79	44.77	44.59	45.47	44.49
C2	7.40	12.85	6.74	6.65	6.72	6.59
C3	13.11	12.60	13.65	13.70	13.66	13.83
C4	11.34	10.76	11.59	11.47	11.34	11.46
C5	8.01	7.93	8.61	8.68	8.45	8.58
C6	4.68	4.79	5.29	5.35	5.07	5.27
C7	3.22	3.34	3.72	3.73	3.70	3.74
C8	1.91	1.96	2.19	2.27	2.21	2.34
C9	1.10	1.15	1.31	1.33	1.32	1.40
C10	0.56	0.66	0.75	0.78	0.72	0.88
C11	0.39	0.53	0.60	0.61	0.52	0.62
C12	0.22	0.25	0.30	0.31	0.32	0.34
C13	0.14	0.14	0.18	0.22	0.23	0.21
C14	0.15	0.12	0.14	0.17	0.16	0.14
C15	0.15	0.13	0.15	0.15	0.12	0.12
alpha chain growth probability	0.59	0.58	0.59	0.59	0.57	0.58
C1 - C50 estimated total product distribution, weight %						
C1	46.9	42.3	44.3	44.1	45.1	44.2
C2 - C4	31.4	35.8	31.6	31.5	31.5	31.6
C5 - C12	20.7	21.0	23.1	23.4	22.6	23.4
C13 - C50	1.0	0.9	1.0	1.0	0.8	0.8
CO conversion, %	16.3	15.5	13.7	13.0	12.9	12.4
rate, g CH2/g cat/hr	0.89	0.85	0.75	0.71	0.71	0.67
CO2 formation, %	0.4	0.4	0.4	0.3	0.3	0.3

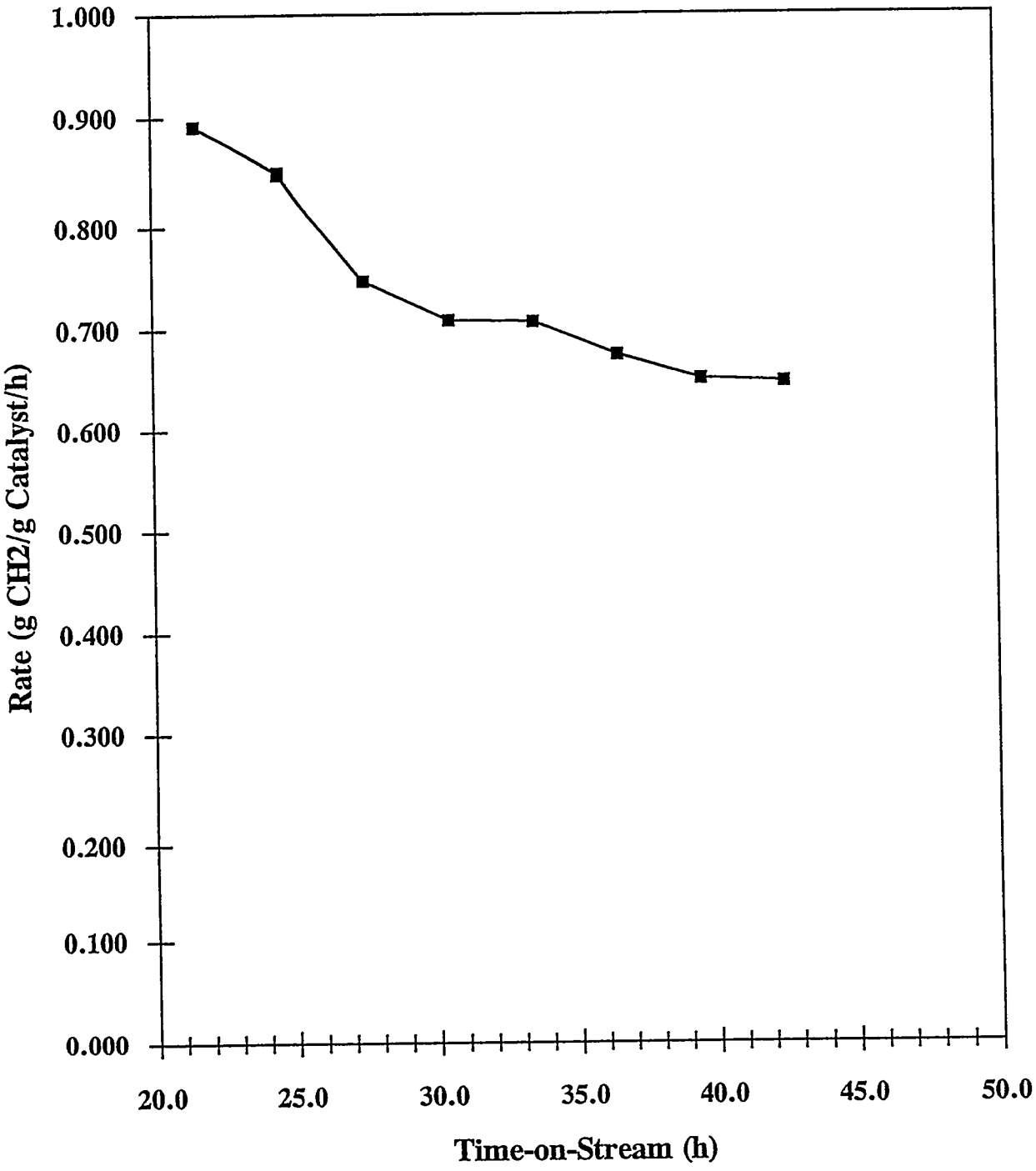
Performance of Co.053

Dates: 03/14/95 - 03/15/95 Run #10a

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 1/hr, H2/CO ratio in feed = 2

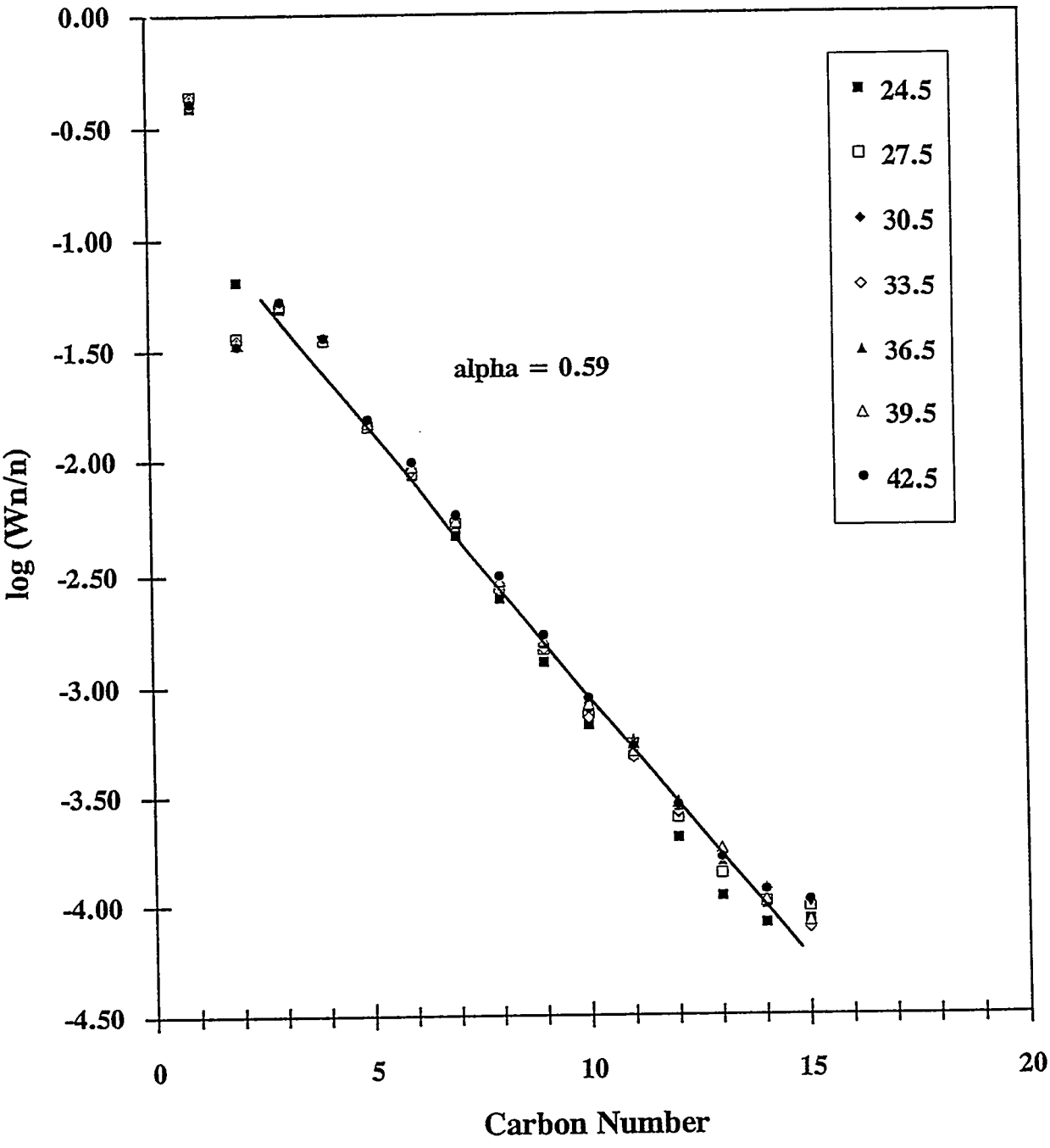
time on stream, hr	39.5	42.5
reaction temperature, °C	240	240
pressure, atm	1.0	1.0
flow, cc/min	90.0	90.0
C1 - C15 product distribution, weight %		
C1	44.12	43.22
C2	6.53	6.42
C3	13.84	13.98
C4	11.41	11.54
C5	8.73	8.93
C6	5.46	5.52
C7	3.86	4.05
C8	2.37	2.50
C9	1.43	1.52
C10	0.83	0.88
C11	0.55	0.58
C12	0.35	0.34
C13	0.24	0.22
C14	0.15	0.16
C15	0.13	0.16
alpha chain growth probability	0.58	0.59
C1 - C50 estimated total product distribution, weight %		
C1	43.8	42.7
C2 - C4	31.5	31.6
C5 - C12	23.8	24.7
C13 - C50	0.8	1.0
CO conversion, %	11.9	11.9
rate, g CH2/g cat/hr	0.65	0.65
CO2 formation, %	0.3	0.2

Time-on-Stream Plot for Co.053 - Run #10a



Schulz-Flory Plot for Co.053 - Run #10a

Time on Stream (hrs)



Co.053 - Run #10b

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 260 °C
H2/CO = 2
weight of catalyst = 0.206 g
WHSV = 12.48 1/hr
time on stream = 66.5 hrs

CO2 (g/g cat/hr) = 0.070
CO2 (% of CO) = 0.4
O/P = 3.65

CO conversion (%)	7.5
rate (g CH2/g cat/hr)	0.41
alpha	0.62
C1 (wt%)	46.9
C2 - C4 (wt%)	30.7
C5 - C12 (wt%)	20.8
C13 + (wt%)	1.6

Performance of Co.053

Dates: 03/15/95 - 03/16/95 Run #10b

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 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	260	260	260	260	260	260
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	49.93	49.85	48.31	48.69	48.52	48.51
C2	7.23	7.24	6.96	7.06	7.14	7.22
C3	14.61	14.77	14.50	14.54	14.45	14.34
C4	10.28	10.00	9.75	9.71	9.70	9.58
C5	6.87	6.79	6.89	7.08	7.10	7.06
C6	3.91	3.88	4.18	4.26	4.34	4.32
C7	2.69	2.72	3.32	3.05	3.03	3.11
C8	1.67	1.70	2.11	1.90	1.89	1.96
C9	1.03	1.07	1.32	1.21	1.25	1.29
C10	0.63	0.67	0.81	0.83	0.85	0.83
C11	0.43	0.46	0.55	0.59	0.59	0.59
C12	0.28	0.29	0.45	0.44	0.43	0.45
C13	0.18	0.20	0.27	0.28	0.29	0.30
C14	0.13	0.16	0.24	0.21	0.23	0.23
C15	0.14	0.19	0.34	0.17	0.19	0.21
alpha chain growth probability	0.59	0.61	0.64	0.60	0.61	0.61
C1 - C50 estimated total product distribution, weight %						
C1	49.3	49.0	46.9	48.2	48.0	47.8
C2 - C4	31.7	31.5	30.3	31.0	30.9	30.7
C5 - C12	18.0	18.2	20.5	19.7	19.9	20.1
C13 - C50	0.9	1.3	2.2	1.1	1.2	1.4
CO conversion, %	14.1	12.5	11.5	9.6	8.9	8.5
rate, g CH2/g cat/hr	0.77	0.68	0.63	0.52	0.49	0.46
CO2 formation, %	0.8	0.6	0.6	0.5	0.5	0.5

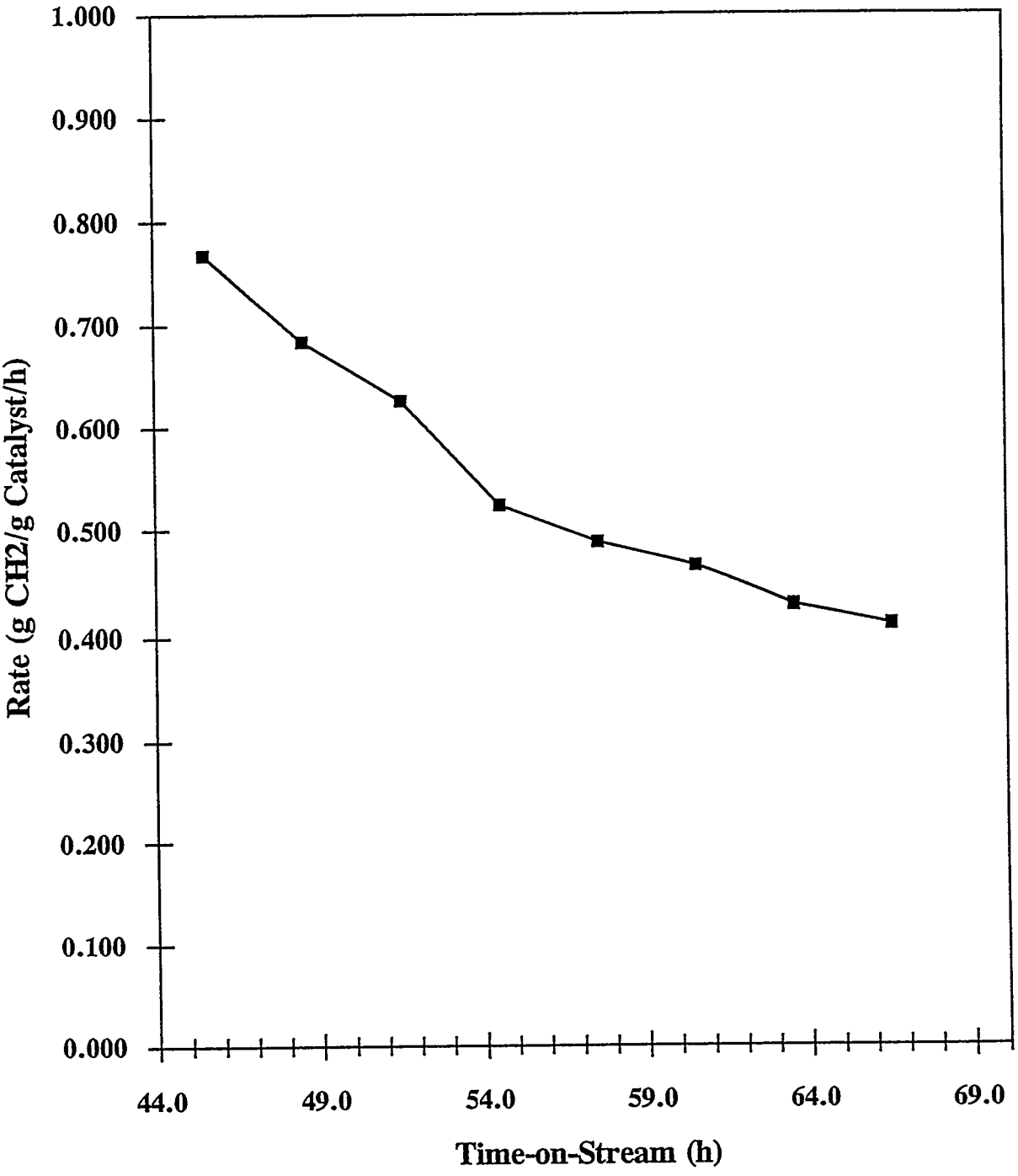
Performance of Co.053

Dates: 03/15/95 - 03/16/95 Run #10b

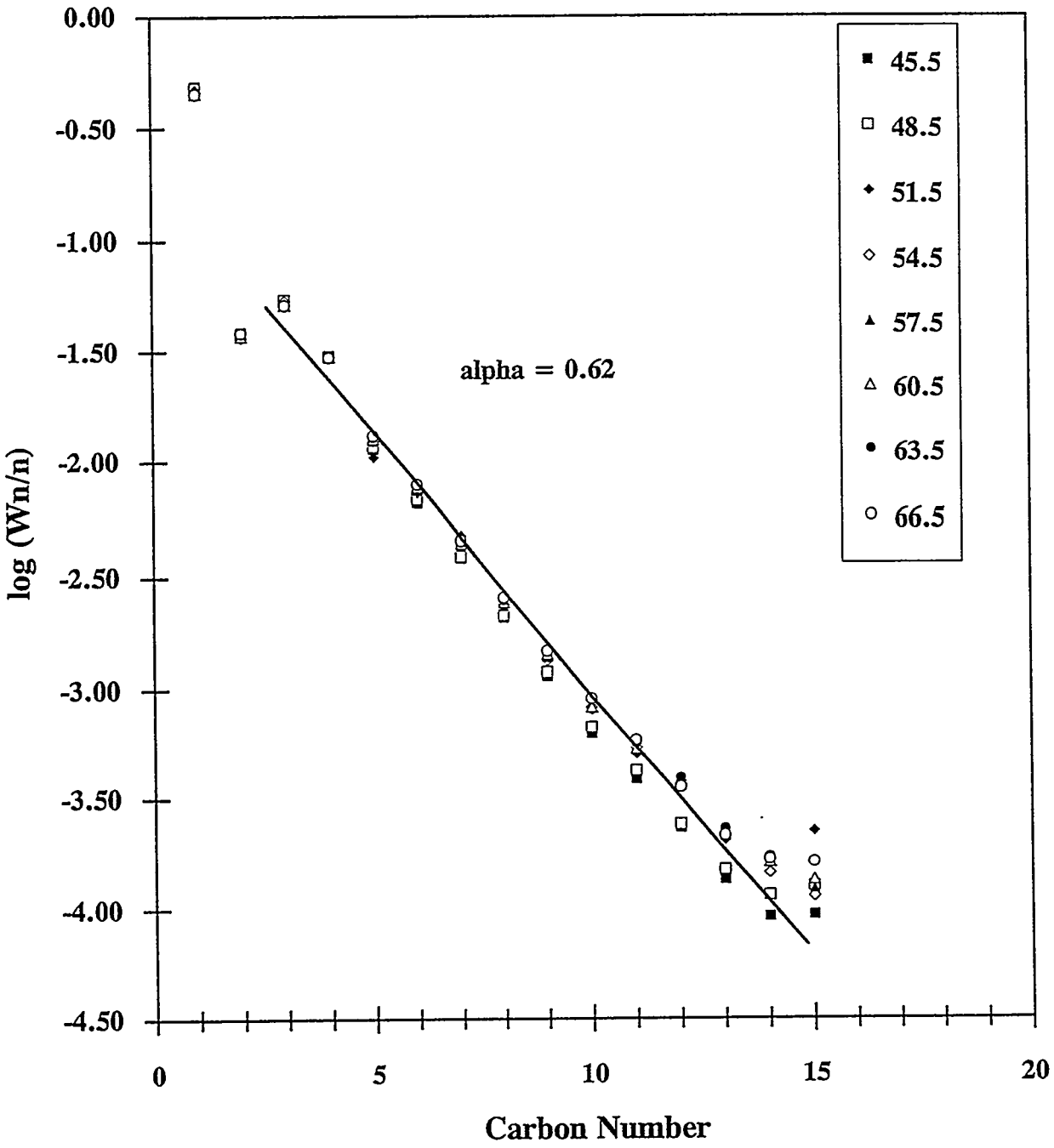
flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 1/hr, H2/CO ratio in feed = 2

time on stream, hr	63.5	66.5
reaction temperature, °C	260	260
pressure, atm	1.0	1.0
flow, cc/min	90.0	90.0
C1 - C15 product distribution, weight %		
C1	48.65	47.77
C2	7.41	7.42
C3	14.50	14.23
C4	9.79	9.62
C5	7.24	7.23
C6	3.17	4.45
C7	3.13	3.16
C8	2.00	2.05
C9	1.33	1.32
C10	0.90	0.91
C11	0.62	0.65
C12	0.47	0.43
C13	0.30	0.28
C14	0.24	0.24
C15	0.25	0.25
alpha chain growth probability	0.62	0.62
C1 - C50 estimated total product distribution, weight %		
C1	47.8	46.9
C2 - C4	31.2	30.7
C5 - C12	19.4	20.8
C13 - C50	1.6	1.6
CO conversion, %	7.8	7.5
rate, g CH2/g cat/hr	0.43	0.41
CO2 formation, %	0.5	0.4

Time-on-Stream Plot for Co.053 - Run #10b



Schulz-Flory Plot for Co.053 - Run #10b
Time on Stream (hrs)



Co.053 - Run #10c

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 280 °C
H2/CO = 2
weight of catalyst = 0.206 g
WHSV = 12.48 1/hr
time on stream = 93.5 hrs

CO2 (g/g cat/hr) = 0.054
CO2 (% of CO) = 0.3
O/P = 10.05

CO conversion (%)	3.0
rate (g CH2/g cat/hr)	0.16
alpha	0.69
C1 (wt%)	38.8
C2 - C4 (wt%)	34.3
C5 - C12 (wt%)	22.6
C13 + (wt%)	4.3

Performance of Co.053

Dates: 03/16/95 - 03/17/95 Run #10c

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 1/hr, H2/CO ratio in feed = 2

time on stream, hr	69.5	72.5	75.5	78.5	81.5	90.5
reaction temperature, °C	280	280	280	280	280	280
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	54.52	48.59	46.06	44.18	43.09	40.72
C2	8.83	9.64	10.35	10.85	11.41	12.63
C3	15.50	14.86	14.38	14.04	13.98	13.86
C4	8.66	8.94	8.90	8.83	8.84	8.84
C5	5.43	6.25	6.54	6.62	6.66	6.79
C6	1.33	3.84	4.26	4.66	4.45	4.50
C7	1.93	2.57	2.91	3.15	3.28	3.50
C8	1.28	1.70	2.01	2.24	2.33	2.48
C9	0.81	1.18	1.34	1.50	1.61	1.76
C10	0.49	0.77	0.98	1.13	1.24	1.36
C11	0.35	0.56	0.72	0.83	0.92	1.02
C12	0.26	0.38	0.53	0.63	0.69	0.73
C13	0.20	0.23	0.39	0.49	0.56	0.59
C14	0.19	0.23	0.32	0.52	0.46	0.61
C15	0.23	0.24	0.32	0.33	0.48	0.61
alpha chain growth probability	0.63	0.63	0.64	0.65	0.67	0.68
C1 - C50 estimated total product distribution, weight %						
C1	53.4	47.7	45.1	43.4	41.8	39.1
C2 - C4	32.3	32.8	32.9	33.1	33.2	33.9
C5 - C12	12.8	17.9	19.9	21.3	21.9	23.0
C13 - C50	1.5	1.6	2.1	2.2	3.1	4.0
CO conversion, %	13.0	8.5	6.5	5.4	4.7	3.3
rate, g CH2/g cat/hr	0.71	0.46	0.36	0.30	0.26	0.18
CO2 formation, %	1.5	0.7	0.8	0.5	0.4	0.3

Performance of Co.053

Dates: 03/16/95 - 03/17/95 Run #10c

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.5 1/hr, H2/CO ratio in feed = 2

time on stream, hr	93.5
reaction temperature, °C	280
pressure, atm	1.0
flow, cc/min	90.0

C1 - C15 product distribution, weight %

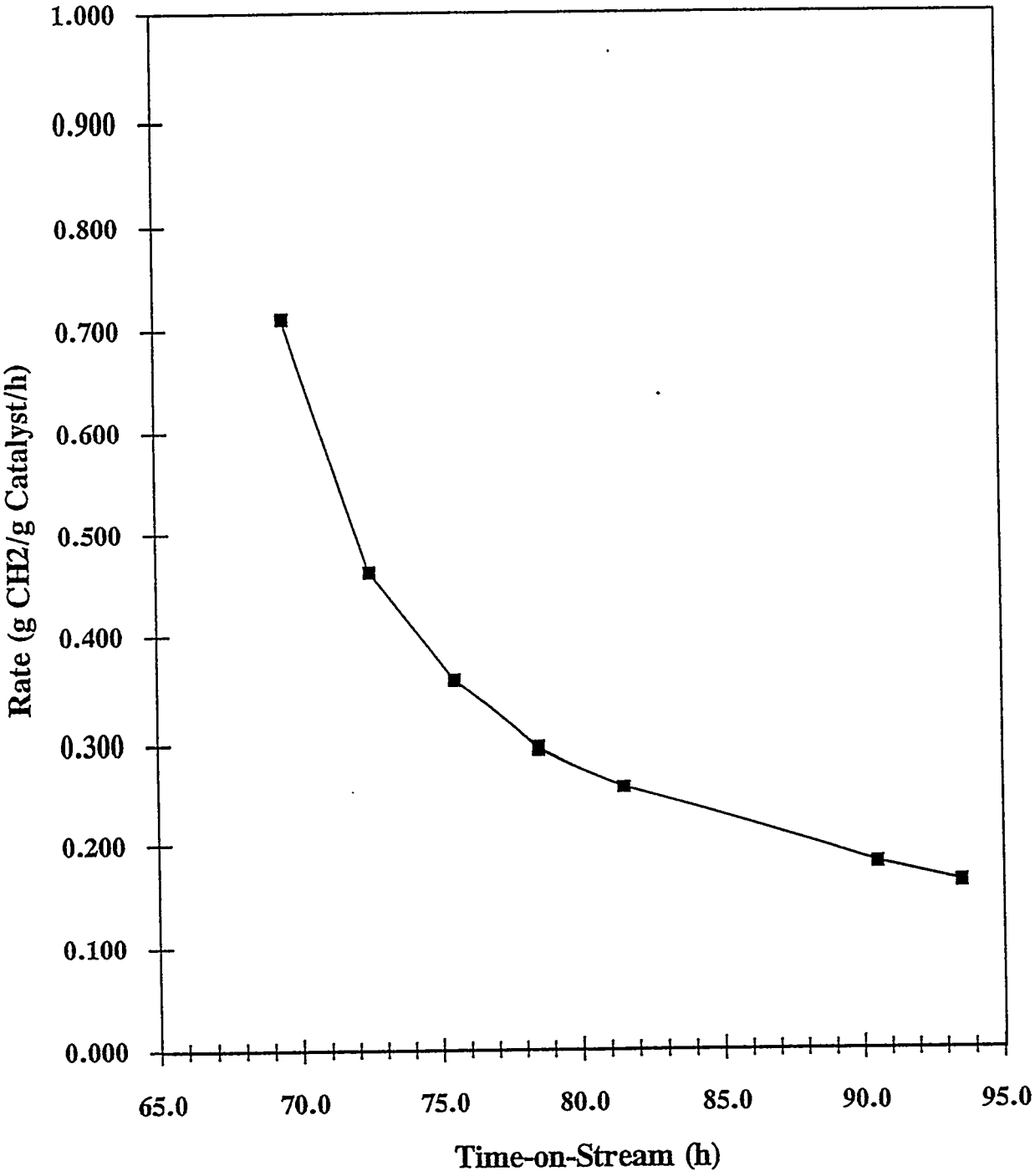
C1	40.51
C2	13.00
C3	13.96
C4	8.84
C5	6.75
C6	4.14
C7	3.40
C8	2.48
C9	1.81
C10	1.32
C11	1.03
C12	0.80
C13	0.61
C14	0.70
C15	0.66
alpha chain growth probability	0.69

C1 - C50 estimated total product distribution, weight %

C1	38.8
C2 - C4	34.3
C5 - C12	22.6
C13 - C50	4.3

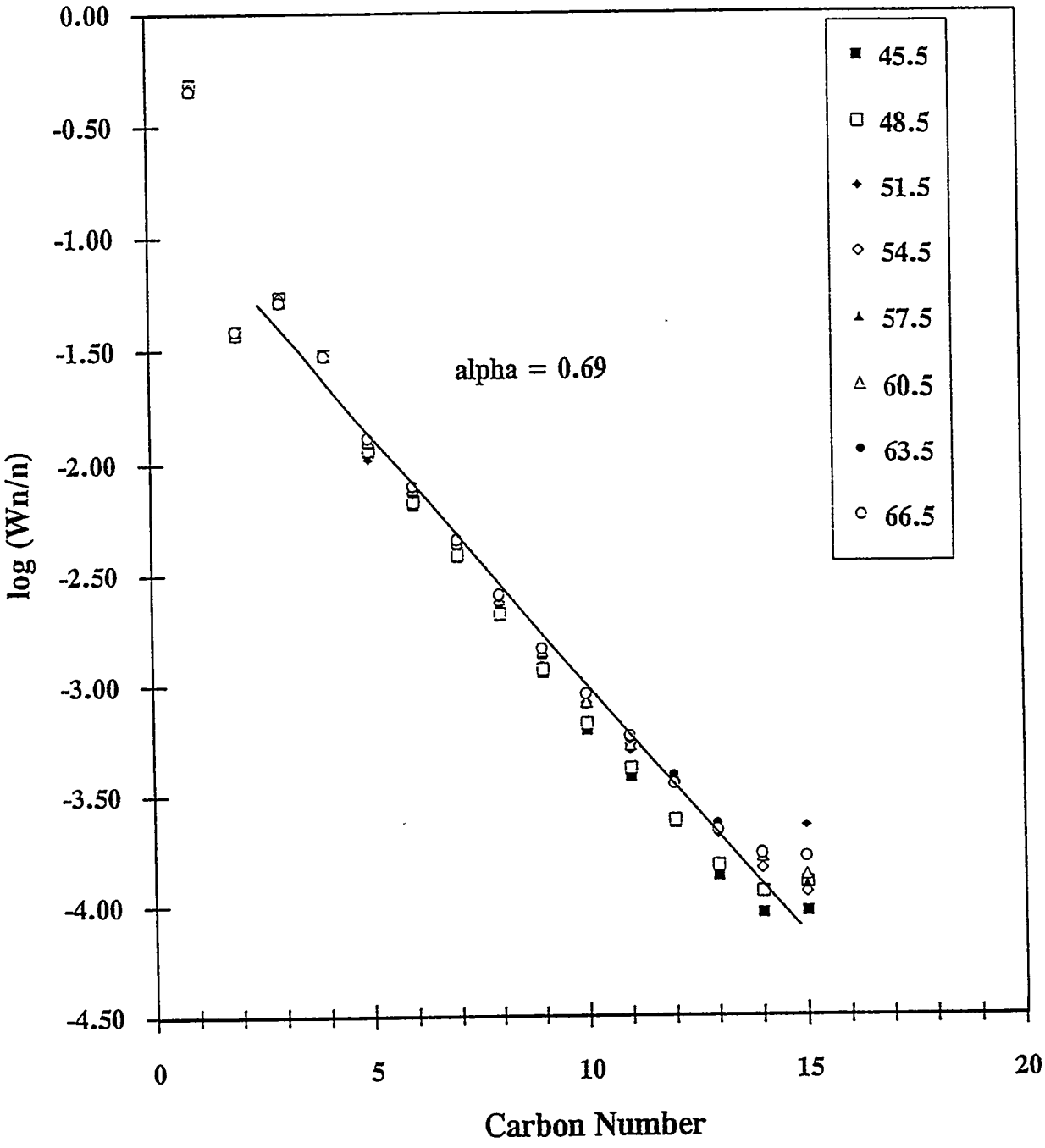
CO conversion, %	3.0
rate, g CH2/g cat/hr	0.16
CO2 formation, %	0.3

Time-on-Stream Plot for Co.053 - Run #10c



Schulz-Flory Plot for Co.053 - Run #10c

Time on Stream (hrs)



Co.053 - Run #11

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.211 g
WHSV = 12.21 1/hr
time on stream = 21.5 hrs

CO2 (g/g cat/hr) = 0.022
CO2 (% of CO) = 0.1
O/P = 1.55

CO conversion (%)	5.4
rate (g CH2/g cat/hr)	0.29
alpha	0.64
C1 (wt%)	26.9
C2 - C4 (wt%)	28.0
C5 - C12 (wt%)	42.3
C13 + (wt%)	2.8

Performance of Co.053

Dates: 03/20/95 - 03/21/95 Run #11

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 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	23.59	25.70	26.80	24.33	27.21	26.25
C2	4.12	4.56	4.64	4.22	5.07	4.52
C3	10.57	11.08	11.40	10.20	11.43	10.88
C4	10.99	11.45	10.79	10.29	11.57	11.12
C5	10.88	11.17	11.49	10.35	11.16	10.82
C6	10.04	8.79	9.00	8.21	8.82	8.44
C7	7.01	7.74	7.33	6.74	7.20	7.34
C8	5.18	5.65	5.35	4.94	5.31	5.80
C9	3.84	4.08	3.87	3.52	3.87	4.83
C10	3.19	2.84	2.78	2.55	2.73	3.53
C11	4.61	2.23	2.29	2.09	2.24	2.64
C12	3.99	1.61	1.58	1.46	1.41	1.58
C13	1.39	1.20	1.17	2.28	0.98	1.07
C14	0.43	1.26	1.07	6.46	0.62	0.88
C15	0.19	0.64	0.43	2.35	0.39	0.30
alpha chain growth probability	0.60	0.67	0.64	0.76	0.64	0.63
C1 - C50 estimated total product distribution, weight %						
C1	25.5	25.3	26.9	21.5	27.2	26.8
C2 - C4	27.8	26.7	27.0	21.9	28.1	27.1
C5 - C12	45.3	43.7	43.2	40.6	42.1	44.1
C13 - C50	1.4	4.3	2.9	16.0	2.6	2.0
CO conversion, %	6.6	6.5	6.1	7.2	5.7	5.6
rate, g CH2/g cat/hr	0.35	0.35	0.32	0.39	0.30	0.30
CO2 formation, %	0.2	0.1	0.2	0.1	0.1	0.1

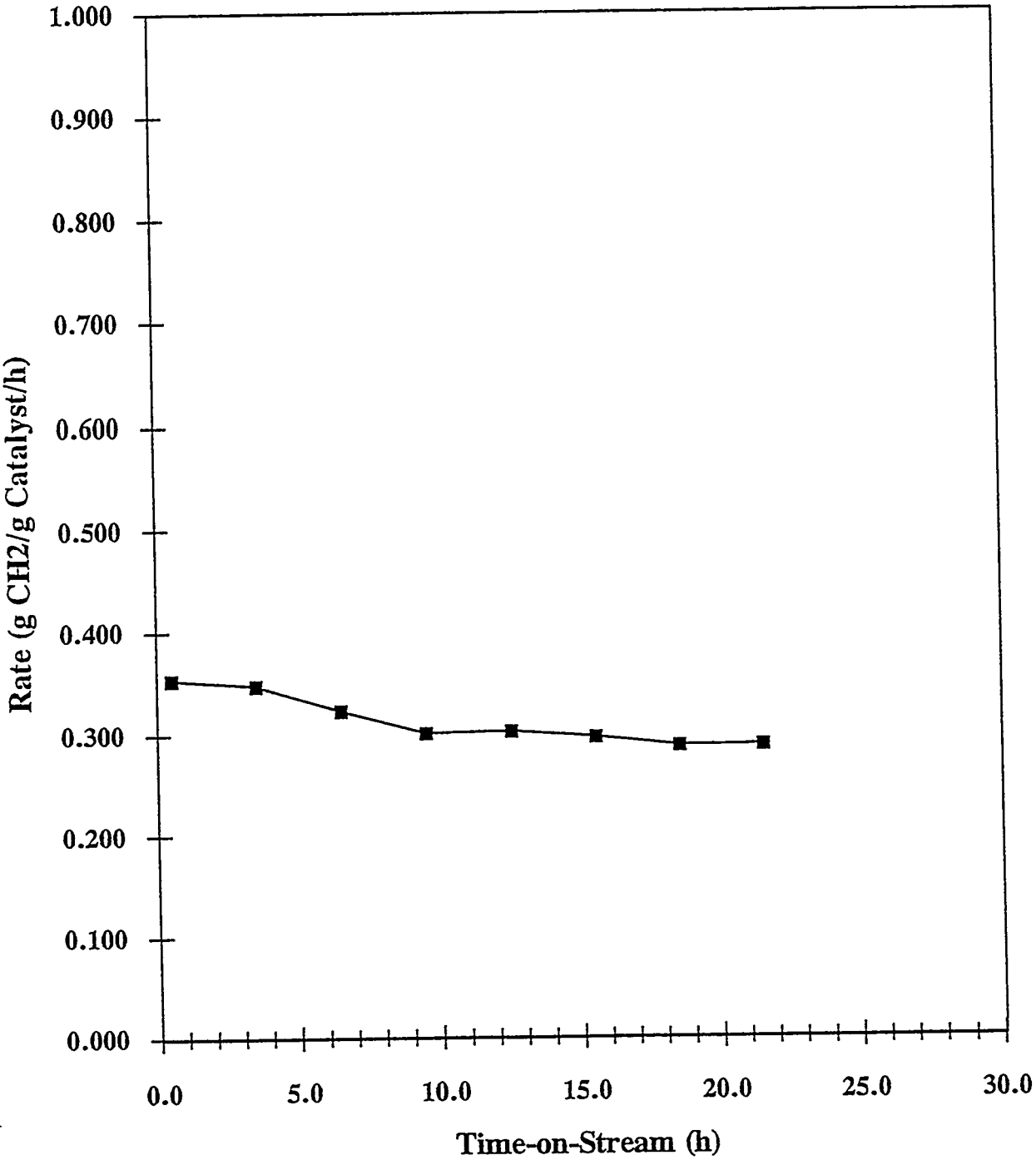
Performance of Co.053

Dates: 03/20/95 - 03/21/95 Run #11

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

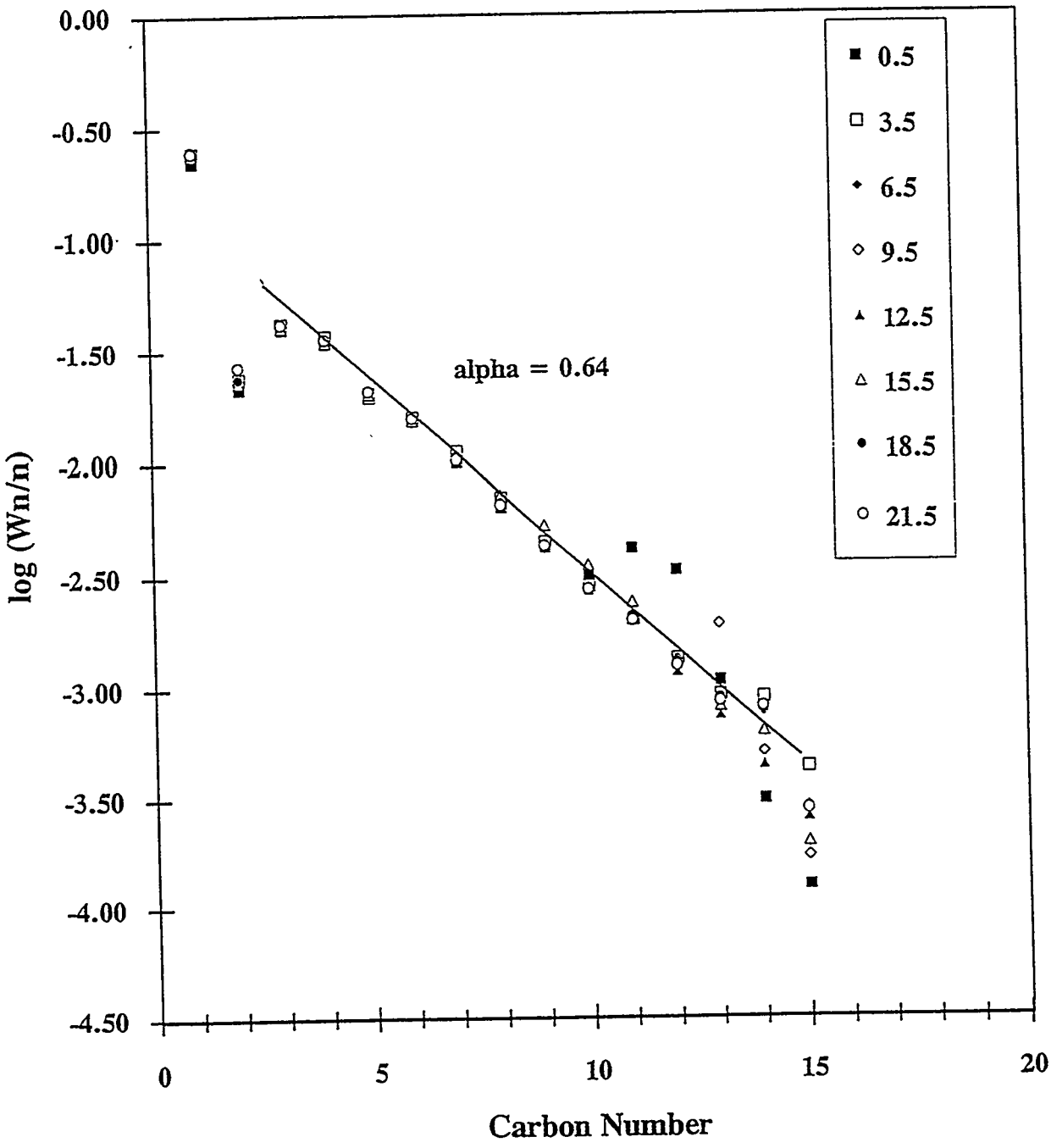
time on stream, hr	18.5	21.5
reaction temperature, °C	220	220
pressure, atm	1.0	1.0
flow, cc/min	90.0	90.0
C1 - C15 product distribution, weight %		
C1	27.36	26.75
C2	4.70	5.35
C3	11.31	11.12
C4	11.30	11.40
C5	11.21	11.08
C6	8.31	8.88
C7	7.30	7.15
C8	5.35	5.27
C9	3.88	3.90
C10	2.76	2.75
C11	2.28	2.19
C12	1.55	1.49
C13	1.16	1.12
C14	1.11	1.14
C15	0.42	0.42
alpha chain growth probability	0.64	0.64
C1 - C50 estimated total product distribution, weight %		
C1	27.5	26.9
C2 - C4	27.5	28.0
C5 - C12	42.1	42.3
C13 - C50	2.8	2.8
CO conversion, %	5.4	5.4
rate, g CH2/g cat/hr	0.29	0.29
CO2 formation, %	0.1	0.1

Time-on-Stream Plot for C0.053 - Run #11



Schulz-Flory Plot for Co.053 - Run #11

Time on Stream (hrs)



Co.053 - Run #11a

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 280 °C
H2/CO = 2
weight of catalyst = 0.211 g
WHSV = 12.21 1/hr
time on stream = 48.5 hrs

CO2 (g/g cat/hr) = 0.060
CO2 (% of CO) = 0.3
O/P = 9.14

CO conversion (%)	3.8
rate (g CH2/g cat/hr)	0.20
alpha	0.69
C1 (wt%)	38.7
C2 - C4 (wt%)	32.8
C5 - C12 (wt%)	23.8
C13 + (wt%)	4.6

Performance of Co.053

Dates: 03/21/95 - 03/22/95 Run #11a

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

time on stream, hr	27.5	30.5	33.5	36.5	39.5	42.5
reaction temperature, °C	280	280	280	280	280	280
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	55.79	50.17	45.26	43.76	42.75	42.10
C2	8.24	9.19	9.60	10.24	10.73	11.16
C3	14.60	15.42	14.40	14.20	14.08	14.02
C4	8.46	9.36	9.03	9.04	9.06	9.07
C5	5.06	6.47	6.61	6.83	6.95	6.98
C6	2.75	3.93	4.11	4.47	4.65	4.54
C7	1.77	2.66	2.96	3.24	3.34	3.39
C8	1.17	0.68	2.05	2.23	2.36	2.43
C9	0.73	1.08	1.47	2.63	1.61	1.65
C10	0.43	0.24	1.05	0.81	1.24	1.23
C11	0.34	0.24	1.04	0.57	0.89	0.88
C12	0.23	0.46	0.60	0.48	0.64	0.67
C13	0.17	0.07	0.86	0.58	0.53	0.57
C14	0.16	0.02	0.77	0.42	0.70	0.74
C15	0.12	0.01	0.19	0.50	0.48	0.57
alpha chain growth probability	0.60	0.48	0.61	0.67	0.67	0.68
C1 - C50 estimated total product distribution, weight %						
C1	55.2	50.4	45.5	42.1	41.5	40.5
C2 - C4	31.0	34.1	33.2	32.2	32.9	33.0
C5 - C12	13.0	15.4	20.0	22.5	22.5	22.8
C13 - C50	0.8	0.1	1.3	3.2	3.1	3.7
CO conversion, %	16.1	9.1	7.3	6.2	5.3	4.6
rate, g CH2/g cat/hr	0.86	0.49	0.39	0.33	0.28	0.25
CO2 formation, %	2.3	1.5	0.7	0.5	0.5	0.4

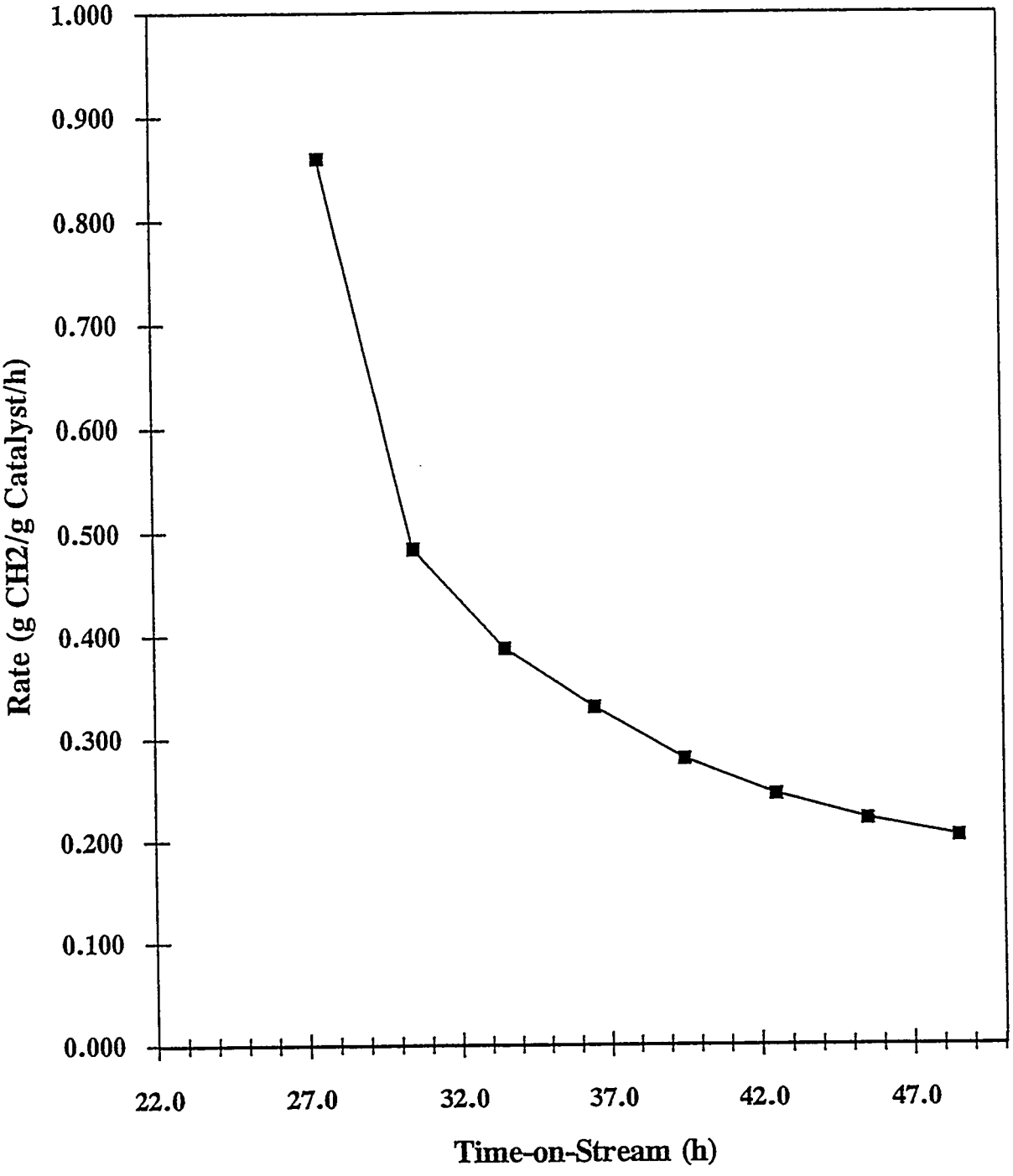
Performance of Co.053

Dates: 03/21/95 - 03/22/95 Run #11a

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

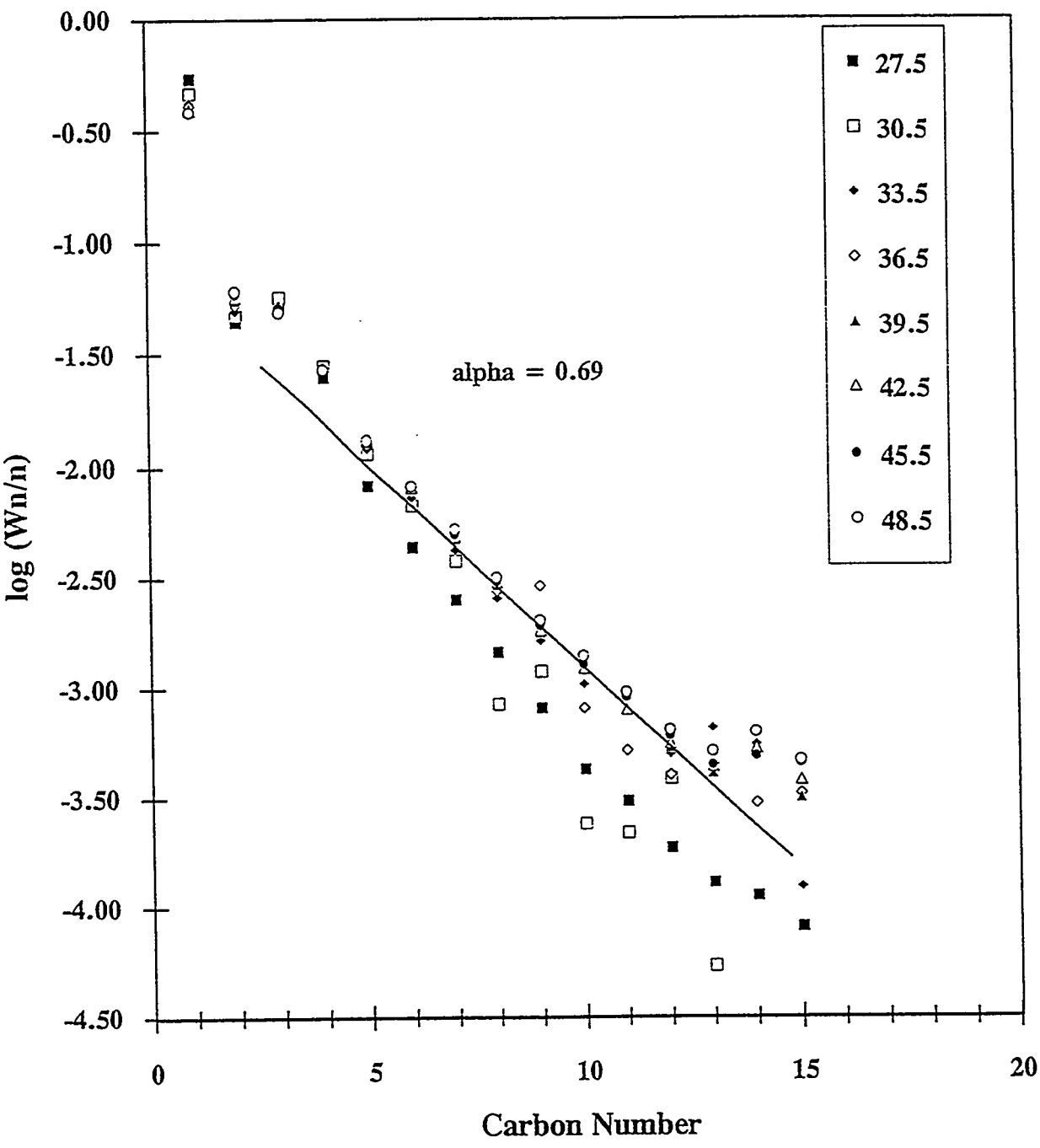
time on stream, hr	45.5	48.5
reaction temperature, °C	280	280
pressure, atm	1.0	1.0
flow, cc/min	90.0	90.0
C1 - C15 product distribution, weight %		
C1	41.35	40.56
C2	11.45	11.66
C3	13.93	13.79
C4	9.06	8.94
C5	7.03	7.01
C6	4.62	4.56
C7	3.46	3.64
C8	2.42	2.55
C9	1.73	1.83
C10	1.28	1.39
C11	1.00	1.05
C12	0.72	0.77
C13	0.58	0.67
C14	0.68	0.88
C15	0.68	0.70
alpha chain growth probability	0.69	0.69
C1 - C50 estimated total product distribution, weight %		
C1	39.4	38.7
C2 - C4	32.8	32.8
C5 - C12	23.3	23.8
C13 - C50	4.5	4.6
CO conversion, %	4.2	3.8
rate, g CH2/g cat/hr	0.22	0.20
CO2 formation, %	0.4	0.3

Time-on-Stream Plot for C0.053 - Run #11a



Schulz-Flory Plot for Co.053 - Run #11a

Time on Stream (hrs)



Co.053 - Run #12

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.210 g
WHSV = 12.24 1/hr
time on stream = 3.5 hrs

CO2 (g/g cat/hr) = 0.029
CO2 (% of CO) = 0.2
O/P = 0.98

CO conversion (%)	8.1
rate (g CH2/g cat/hr)	0.43
alpha	0.60
C1 (wt%)	26.6
C2 - C4 (wt%)	29.2
C5 - C12 (wt%)	42.9
C13 + (wt%)	1.3

Performance of Co.053

Dates: 03/23/95 - 03/24/95 Run #12

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

time on stream, hr	0.5	3.5	18.5	21.5	24.5	30.5
reaction temperature, °C	220	220	220	220	220	280
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	26.33	26.22	25.93	27.04	26.95	61.30
C2	5.02	4.51	4.32	4.48	4.74	8.61
C3	12.10	11.86	10.84	11.41	11.33	12.82
C4	12.27	12.38	11.02	11.59	11.62	7.57
C5	11.46	11.86	10.49	11.27	11.10	4.11
C6	8.89	9.29	8.80	8.85	8.83	1.90
C7	7.23	7.50	6.70	7.18	7.08	1.23
C8	5.08	5.34	4.85	5.15	5.13	0.83
C9	3.65	3.83	3.60	3.75	3.74	0.57
C10	2.60	2.59	2.63	2.64	2.68	0.32
C11	2.05	2.01	2.10	2.00	2.00	0.25
C12	1.36	1.22	1.53	1.38	1.43	0.16
C13	0.93	0.79	2.75	1.09	1.12	0.11
C14	0.70	0.42	3.73	1.43	1.21	0.10
C15	0.33	0.19	0.71	0.73	1.03	0.11
alpha chain growth probability	0.63	0.60	0.68	0.68	0.70	0.55
C1 - C50 estimated total product distribution, weight %						
C1	26.5	26.6	26.4	26.3	25.4	60.4
C2 - C4	29.5	29.2	26.6	26.7	26.1	28.6
C5 - C12	41.8	42.9	42.1	42.1	41.7	10.2
C13 - C50	2.2	1.3	4.9	4.8	6.8	0.7
CO conversion, %	8.5	8.1	7.5	7.2	7.5	25.0
rate, g CH2/g cat/hr	0.45	0.43	0.40	0.38	0.40	1.34
CO2 formation, %	0.2	0.2	0.1	0.1	0.2	4.7

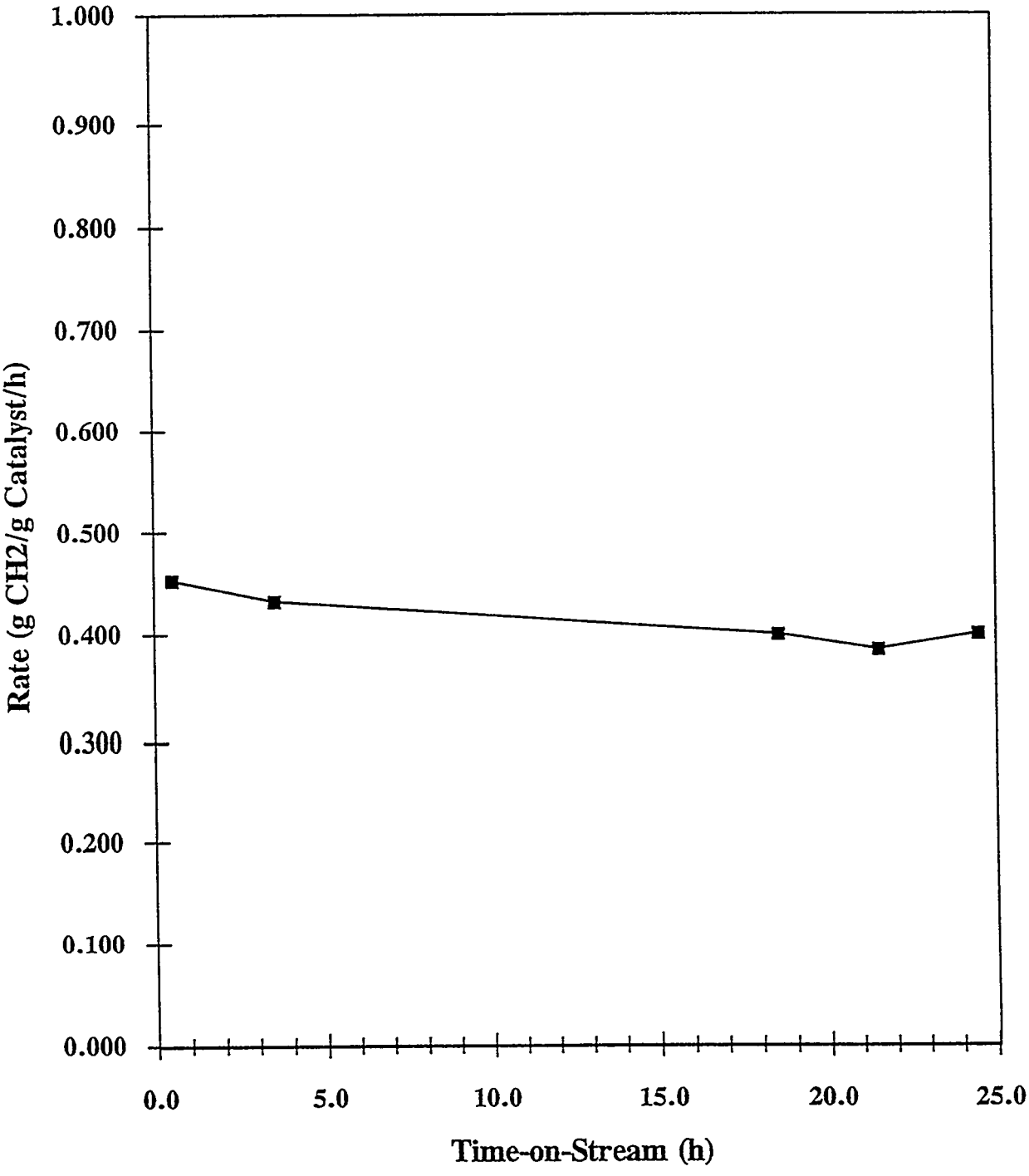
Performance of Co.053

Dates: 03/23/95 - 03/24/95 Run #12

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

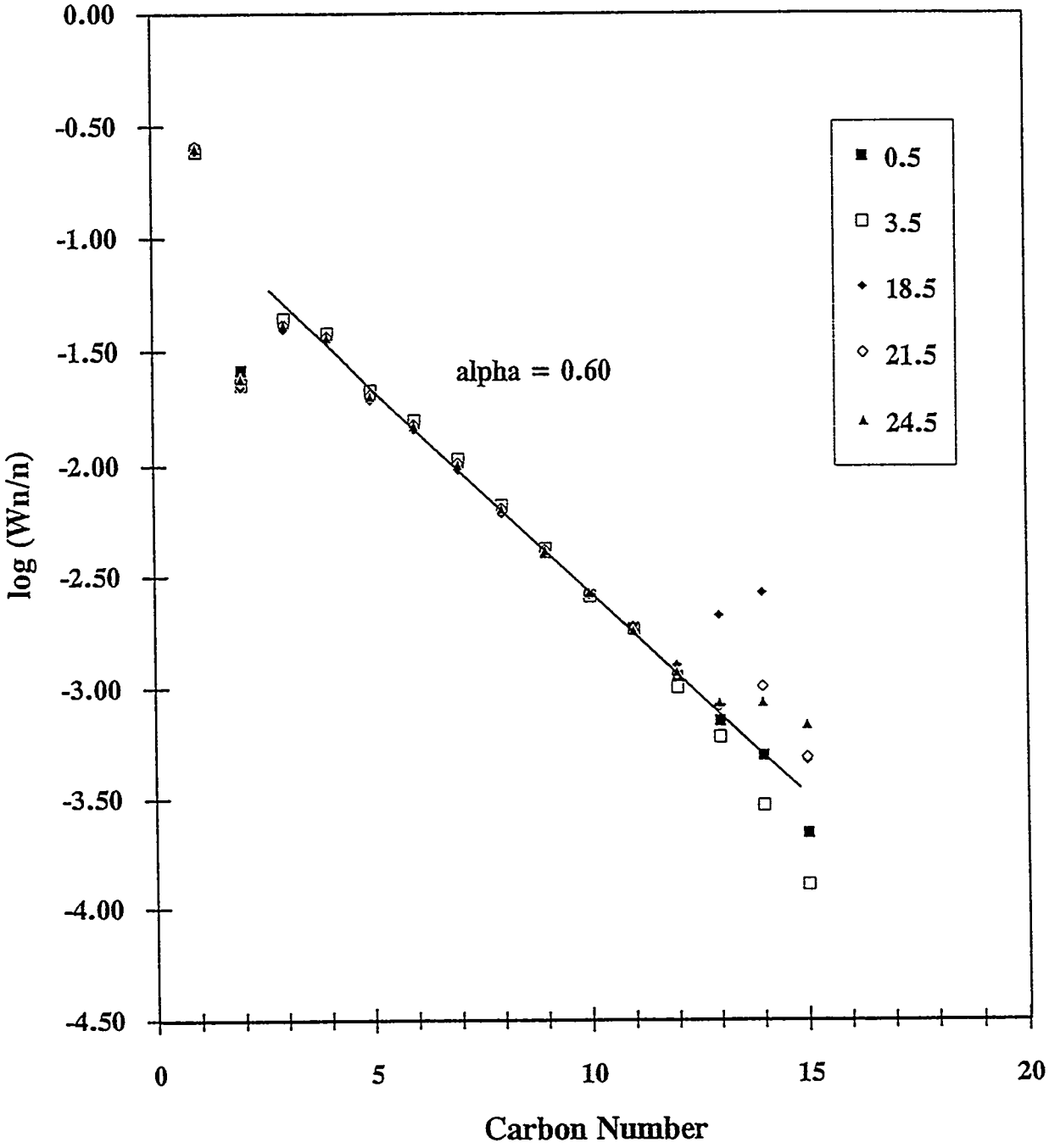
time on stream, hr	33.5	36.5	39.5	42.5	45.5
reaction temperature, °C	280	280	280	280	280
pressure, atm	1.0	1.0	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0	90.0	90.0
C1 - C15 product distribution, weight %					
C1	49.90	46.39	44.25	42.94	41.67
C2	9.11	10.00	10.75	11.46	11.89
C3	15.30	14.80	14.53	14.45	14.25
C4	9.01	9.02	9.05	9.07	8.95
C5	6.13	6.49	6.75	6.84	6.83
C6	2.93	3.94	4.30	4.52	4.66
C7	2.47	2.84	3.14	3.22	3.33
C8	1.67	1.89	2.09	2.33	2.30
C9	1.08	1.30	1.43	1.49	1.58
C10	0.72	0.90	1.03	1.06	1.19
C11	0.50	0.68	0.80	0.76	0.84
C12	0.37	0.44	0.49	0.54	0.61
C13	0.30	0.34	0.41	0.43	0.52
C14	0.25	0.40	0.47	0.48	0.65
C15	0.26	0.58	0.50	0.42	0.74
alpha chain growth probability	0.63	0.68	0.67	0.66	0.69
C1 - C50 estimated total product distribution, weight %					
C1	48.9	44.2	42.6	41.7	39.4
C2 - C4	32.7	32.2	33.0	33.9	33.1
C5 - C12	16.7	19.8	21.1	21.6	22.7
C13 - C50	1.7	3.8	3.3	2.7	4.8
CO conversion, %	11.8	8.9	7.0	5.9	5.3
rate, g CH2/g cat/hr	0.63	0.48	0.38	0.32	0.28
CO2 formation, %	1.2	0.9	0.6	0.5	0.4

Time-on-Stream Plot for C0.053 - Run #12



Schulz-Flory Plot for Co.053 - Run #12
Time on Stream (hrs)

hrs.



Co.053 - Run #12a

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

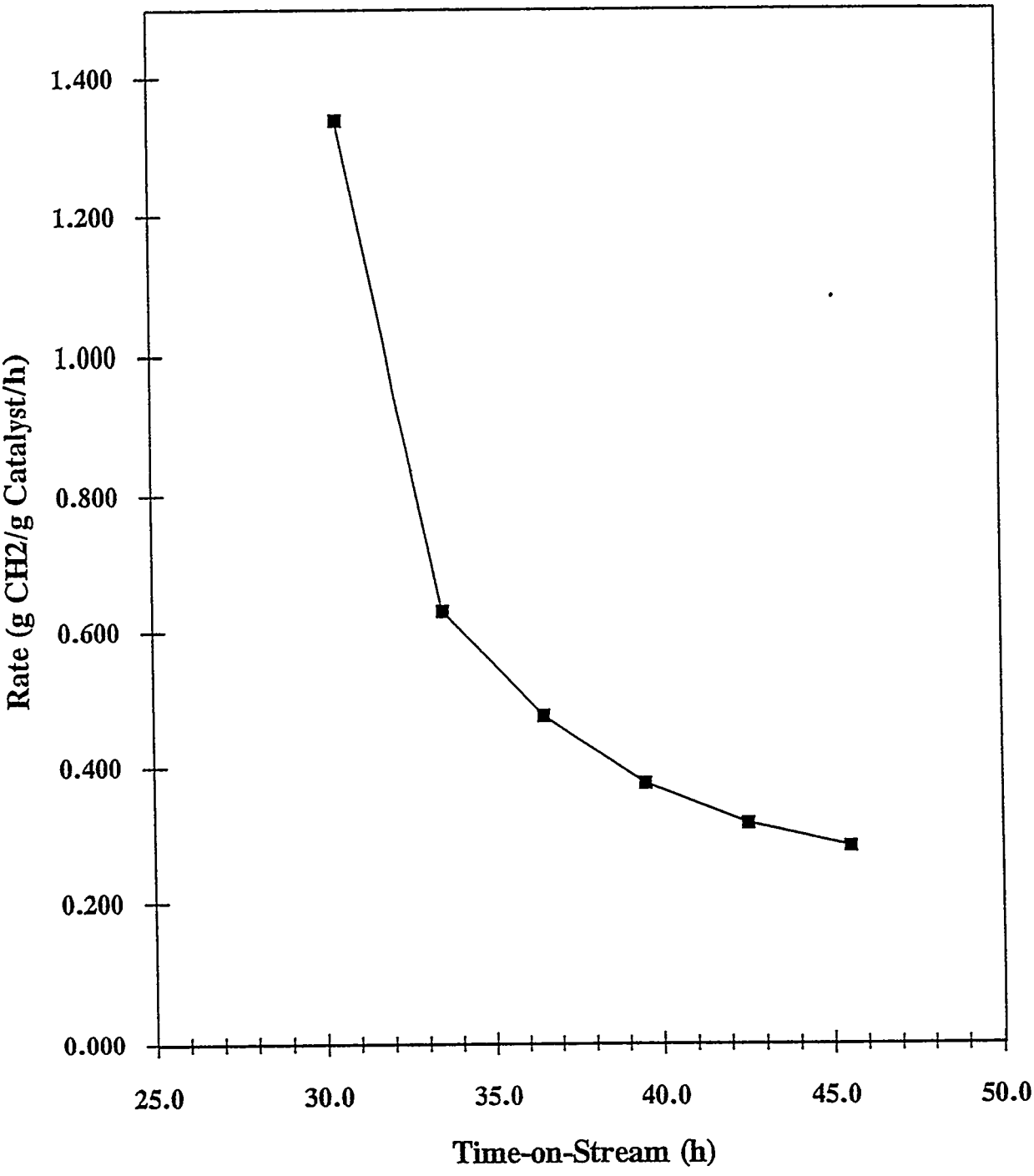
Reaction Conditions:

P = 1.0 atm
T = 280 °C
H2/CO = 2
weight of catalyst = 0.210 g
WHSV = 12.24 1/hr
time on stream = 45.5 hrs

CO2 (g/g cat/hr) = 0.083
CO2 (% of CO) = 0.4
O/P = 9.41

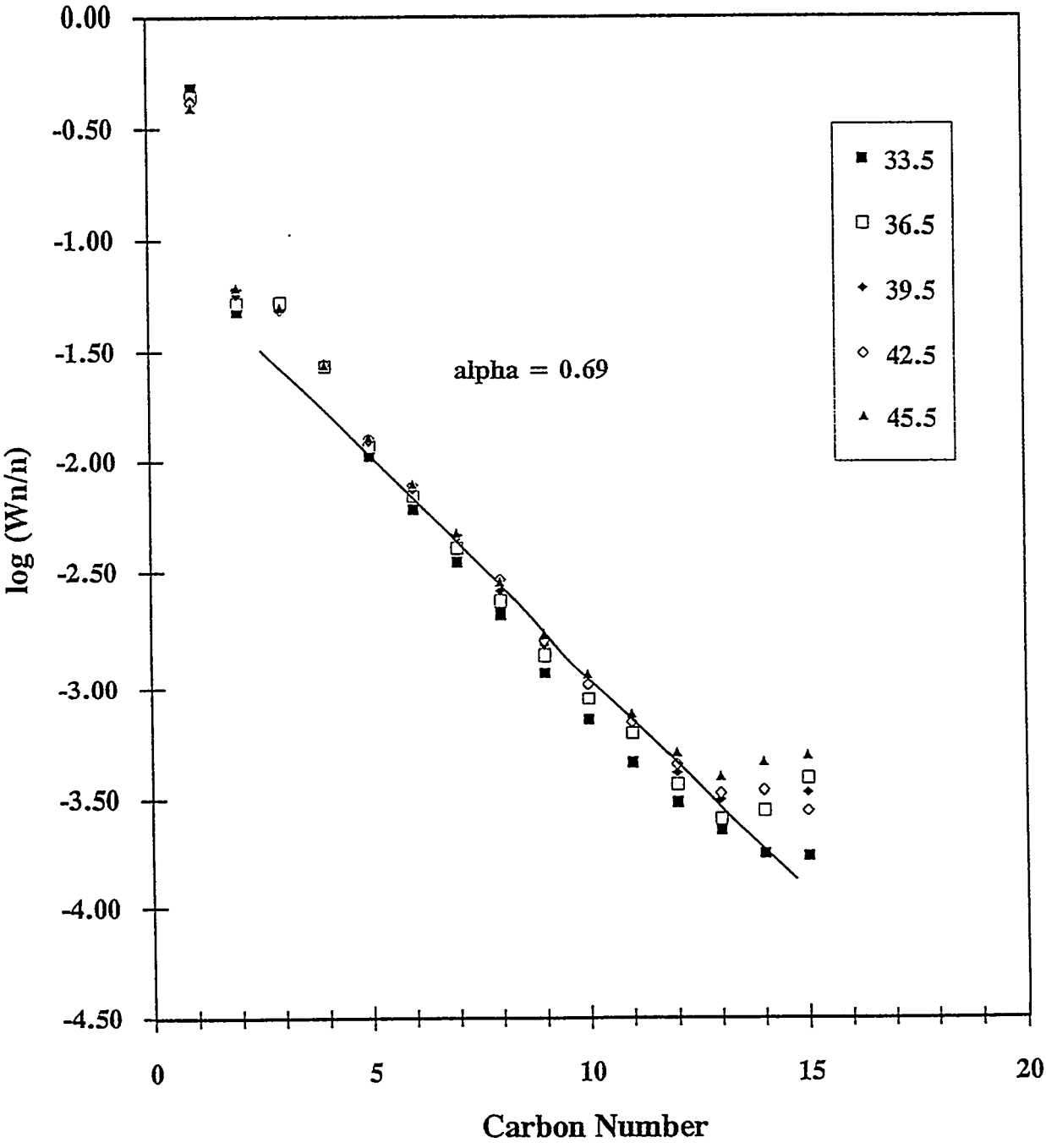
CO conversion (%)	5.3
rate (g CH2/g cat/hr)	0.28
alpha	0.69
C1 (wt%)	39.4
C2 - C4 (wt%)	33.1
C5 - C12 (wt%)	22.7
C13 + (wt%)	4.8

Time-on-Stream Plot for C0.053 - Run #12a



Schulz-Flory Plot for Co.053 - Run #12a
Time on Stream (hrs)

hrs.



Co.053 - Run #12b

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.210 g
WHSV = 12.24 1/hr
time on stream = 3.5 hrs

CO2 (g/g cat/hr) = 0.021
CO2 (% of CO) = 0.1
O/P = 5.07

CO conversion (%)	1.4
rate (g CH2/g cat/hr)	0.08
alpha	0.78
C1 (wt%)	20.0
C2 - C4 (wt%)	21.8
C5 - C12 (wt%)	38.8
C13 + (wt%)	19.5

Performance of Co.053

Dates: 03/29/95 - 03/30/95 Run #12b

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

time on stream, hr	0.5	3.5	0.5	6.5	9.5	12.5
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	23.55	24.31	32.10	31.31	31.24	30.83
C2	6.72	6.77	5.47	5.26	5.24	5.17
C3	9.97	9.94	13.05	12.13	12.17	12.12
C4	9.69	9.74	13.48	12.14	12.15	12.09
C5	9.81	9.52	10.70	11.16	11.22	11.30
C6	7.26	7.91	7.82	8.12	8.23	8.47
C7	6.74	6.44	6.09	6.47	6.48	6.54
C8	5.34	5.16	4.09	4.37	4.33	4.38
C9	4.36	4.18	2.78	3.00	2.97	2.96
C10	3.55	3.43	1.83	1.89	1.88	1.95
C11	2.84	2.82	1.37	1.46	1.44	1.47
C12	2.54	2.28	0.72	0.95	0.91	0.93
C13	2.39	2.10	0.35	0.72	0.58	0.59
C14	2.72	2.52	0.12	0.72	0.55	0.56
C15	2.51	2.87	0.04	0.30	0.62	0.64
alpha chain growth probability	0.77	0.78	0.52	0.62	0.66	0.66
C1 - C50 estimated total product distribution, weight %						
C1	20.2	20.0	32.6	31.2	30.0	29.6
C2 - C4	22.6	21.8	32.5	29.4	28.4	28.2
C5 - C12	40.0	38.8	34.6	37.4	37.6	38.1
C13 - C50	17.3	19.5	0.3	2.0	4.0	4.1
CO conversion, %	1.4	1.4	9.0	8.8	8.8	8.5
rate, g CH2/g cat/hr	0.07	0.08	0.48	0.47	0.47	0.45
CO2 formation, %	0.1	0.1	0.2	0.2	0.2	0.2

Performance of Co.053

Dates: 03/29/95 - 03/30/95 Run #12b

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.2 1/hr, H2/CO ratio in feed = 2

time on stream, hr	15.5	18.5	21.5
reaction temperature, °C	220	220	220
pressure, atm	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0
C1 - C15 product distribution, weight %			
C1	30.84	30.69	30.26
C2	5.15	5.11	5.40
C3	12.12	12.13	12.19
C4	12.10	12.10	12.25
C5	11.23	11.30	11.23
C6	8.40	8.50	8.47
C7	6.52	6.57	6.49
C8	4.39	4.42	4.41
C9	3.02	3.02	3.05
C10	1.97	1.99	2.08
C11	1.48	1.52	1.55
C12	0.92	0.87	0.88
C13	0.68	0.63	0.60
C14	0.58	0.54	0.58
C15	0.62	0.60	0.55
alpha chain growth probability	0.66	0.66	0.65
C1 - C50 estimated total product distribution, weight %			
C1	29.7	29.6	29.3
C2 - C4	28.2	28.3	28.9
C5 - C12	38.1	38.3	38.2
C13 - C50	4.0	3.9	3.6
CO conversion, %	8.4	8.4	8.3
rate, g CH2/g cat/hr	0.45	0.45	0.44
CO2 formation, %	0.2	0.2	0.2

Co.053 - Run #13

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

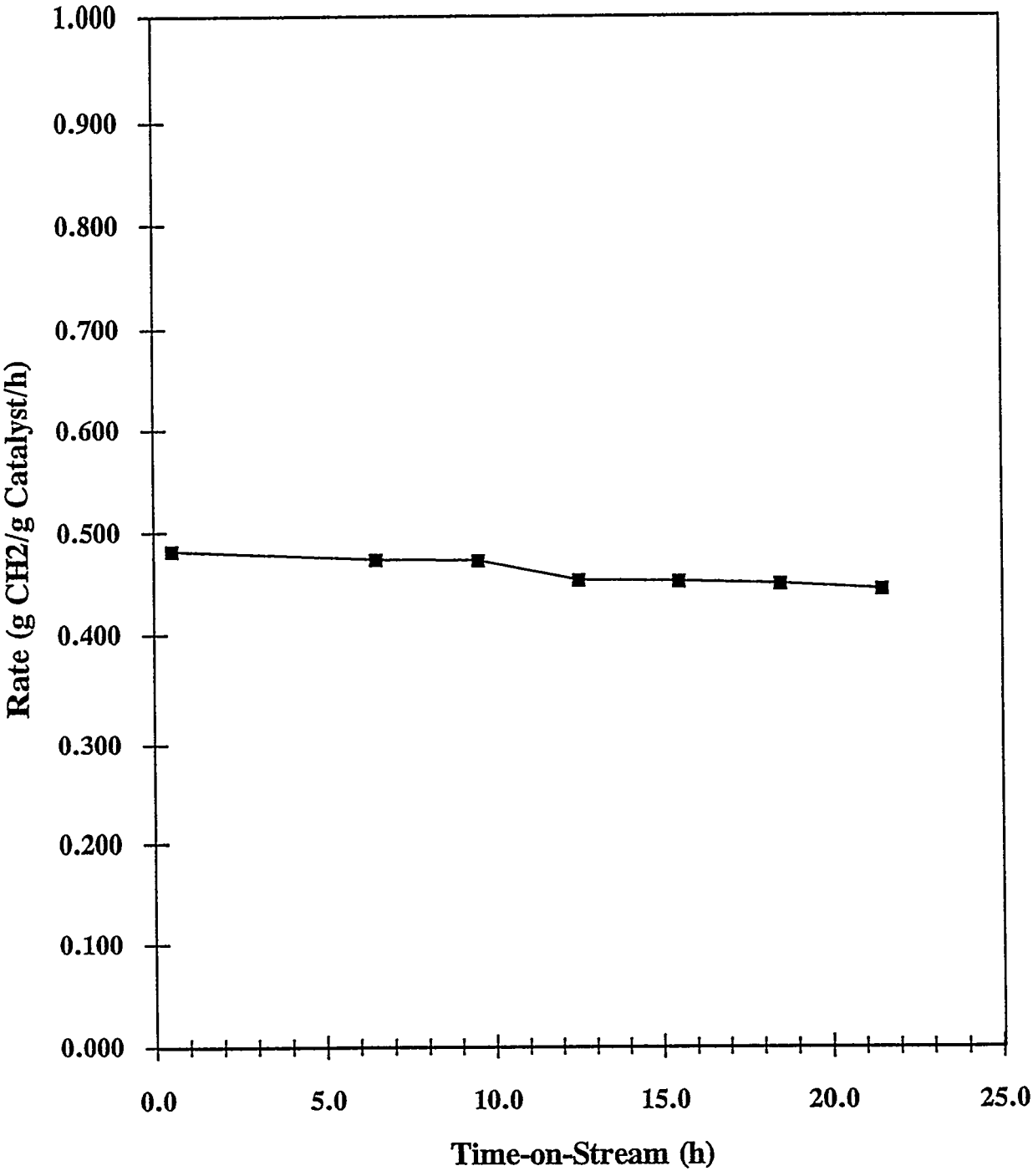
P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.210 g
WHSV = 12.24 1/hr
time on stream = 21.5 hrs

CO2 (g/g cat/hr) = 0.037
CO2 (% of CO) = 0.2
O/P = 0.88

CO conversion (%)	8.3
rate (g CH2/g cat/hr)	0.44
alpha	0.65
C1 (wt%)	29.3
C2 - C4 (wt%)	28.9
C5 - C12 (wt%)	38.2
C13 + (wt%)	3.6

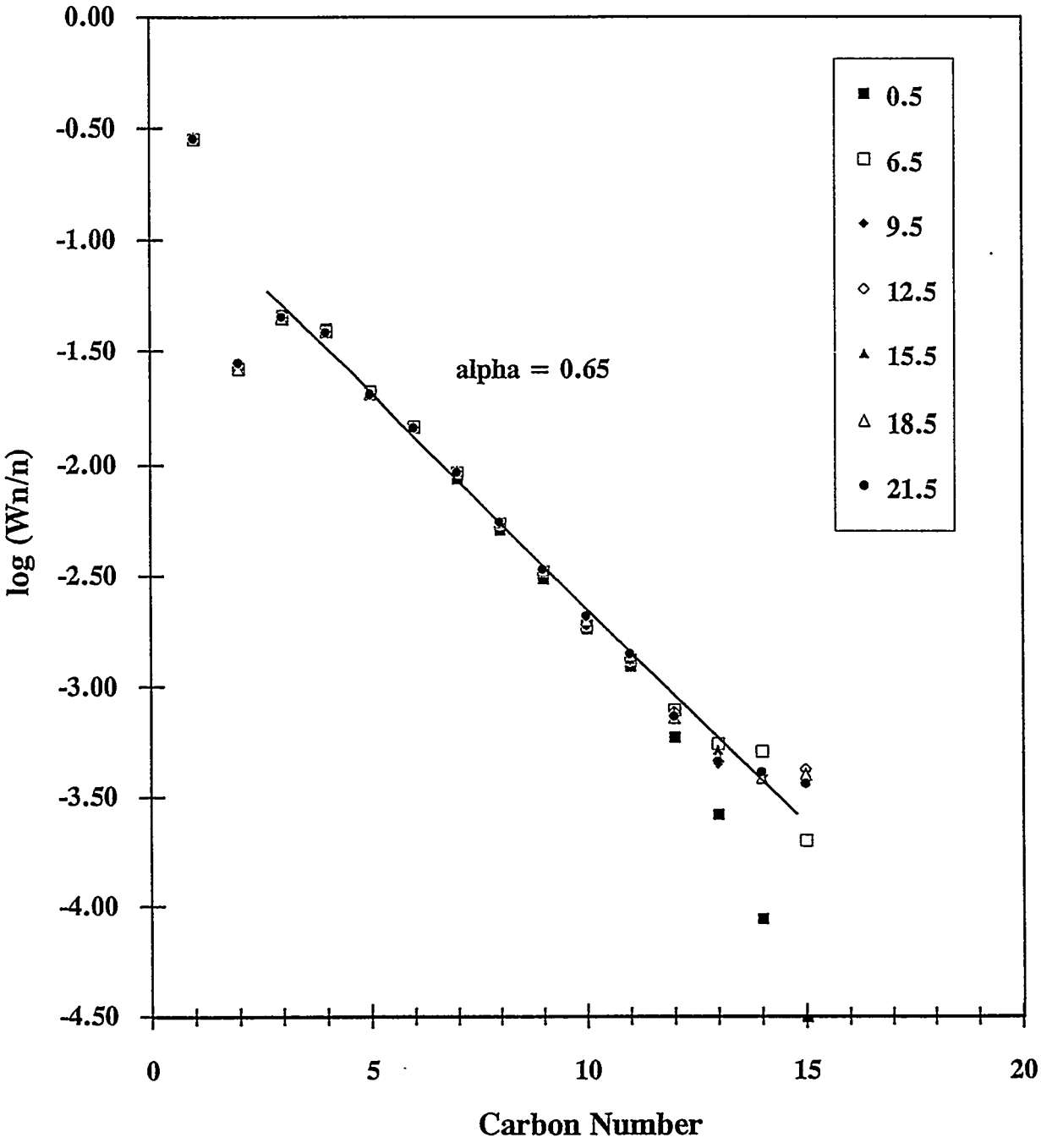
* calcined and reduced insitu after run 12

Time-on-Stream Plot for C0.053 - Run #13



Schulz-Flory Plot for Co.053 - Run #13
Time on Stream (hrs)

hrs.



Co.053 - Run #14

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.201 g
WHSV = 12.78 1/hr
time on stream = 19.5 hrs

CO2 (g/g cat/hr) = 0.025
CO2 (% of CO) = 0.1
O/P = 0.85

CO conversion (%)	6.7
rate (g CH2/g cat/hr)	0.37
alpha	0.74
C1 (wt%)	24.8
C2 - C4 (wt%)	24.4
C5 - C12 (wt%)	37.3
C13 + (wt%)	13.6

* Catalyst calcined (24 hr, 300 °C) and reduced (10 hr, 350 °C) after reaction at EI

Performance of Co.053

Dates: 04/17/95 - 04/18/95 Run #14

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.8 1/hr, H2/CO ratio in feed = 2

time on stream, hr	1.5	4.5	7.5	10.5	13.5	16.5
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	29.35	28.82	29.92	29.95	29.06	29.68
C2	4.95	5.17	5.29	5.11	4.88	4.96
C3	12.23	12.16	12.51	12.45	12.07	12.24
C4	12.13	12.12	12.53	12.29	11.90	12.01
C5	11.23	11.15	11.49	11.47	11.16	11.19
C6	8.04	8.15	8.52	8.30	8.10	8.01
C7	6.42	6.33	6.54	6.46	6.38	6.38
C8	4.26	4.23	4.38	4.34	4.26	4.25
C9	2.90	2.89	2.97	2.79	2.94	2.90
C10	1.85	1.88	2.09	2.30	2.10	1.89
C11	1.43	1.44	1.62	1.57	1.60	1.38
C12	1.10	1.19	0.87	0.90	1.05	0.98
C13	1.75	2.10	0.54	0.62	0.94	0.87
C14	1.26	1.24	0.39	0.60	2.42	2.21
C15	1.11	1.13	0.33	0.84	1.16	1.03
alpha chain growth probability	0.70	0.70	0.62	0.68	0.70	0.69
C1 - C50 estimated total product distribution, weight %						
C1	27.4	27.0	29.6	28.2	27.1	27.9
C2 - C4	27.4	27.5	30.0	28.1	26.9	27.5
C5 - C12	38.0	38.1	38.3	38.3	38.4	38.0
C13 - C50	7.2	7.3	2.2	5.4	7.5	6.7
CO conversion, %	6.8	6.4	5.7	5.9	6.1	6.0
rate, g CH2/g cat/hr	0.38	0.36	0.32	0.33	0.34	0.33
CO2 formation, %	0.1	0.1	0.1	0.1	0.2	0.1

Performance of Co.053

Dates: 04/17/95 - 04/18/95 Run #14

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.8 1/hr, H2/CO ratio in feed = 2

time on stream, hr	19.5
reaction temperature, °C	220
pressure, atm	1.0
flow, cc/min	90.0

C1 - C15 product distribution, weight %

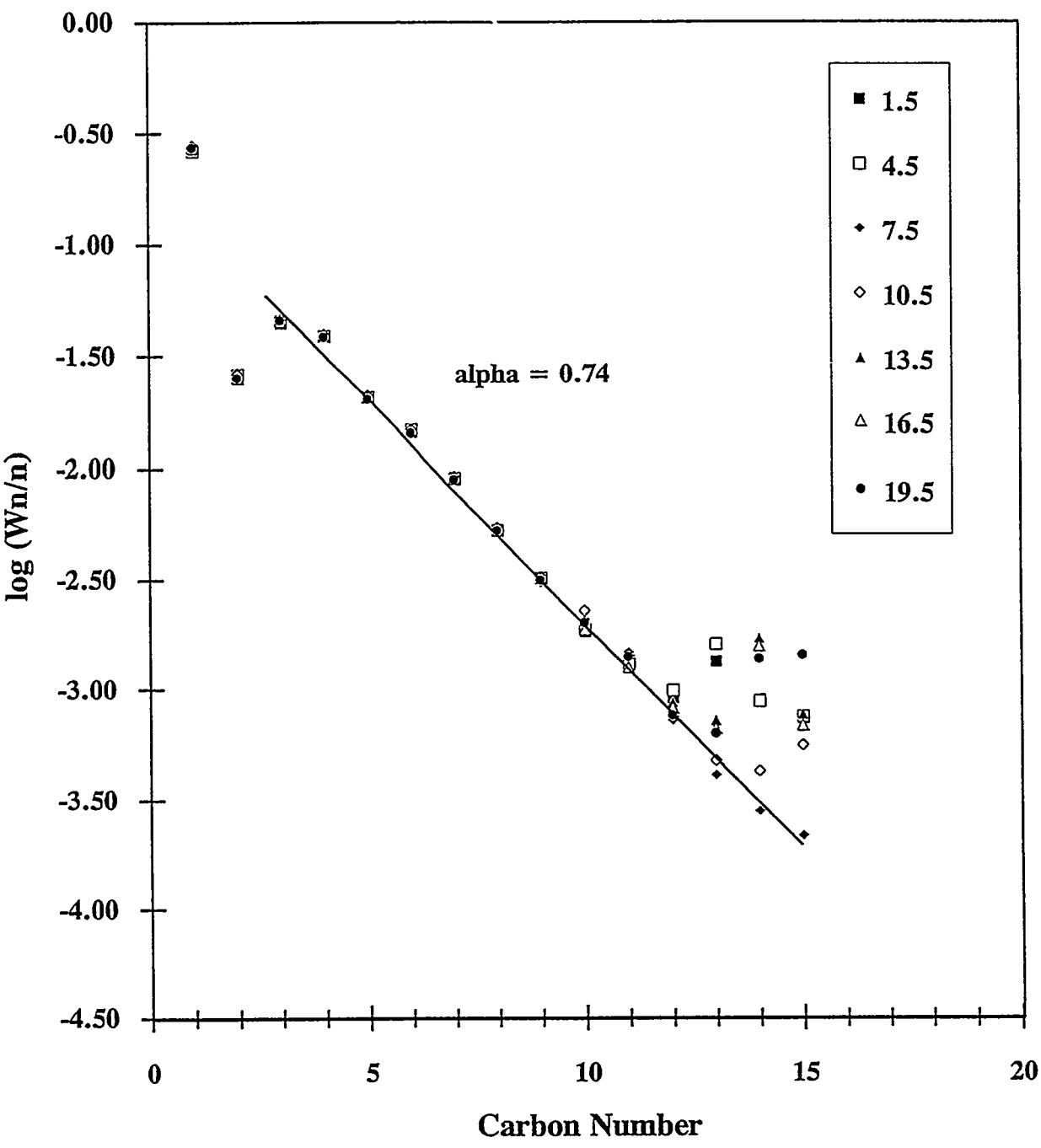
C1	29.27
C2	4.88
C3	12.06
C4	11.82
C5	11.09
C6	8.20
C7	6.26
C8	4.19
C9	2.84
C10	2.02
C11	1.55
C12	0.91
C13	0.82
C14	1.93
C15	2.15
alpha chain growth probability	0.74

C1 - C50 estimated total product distribution, weight %

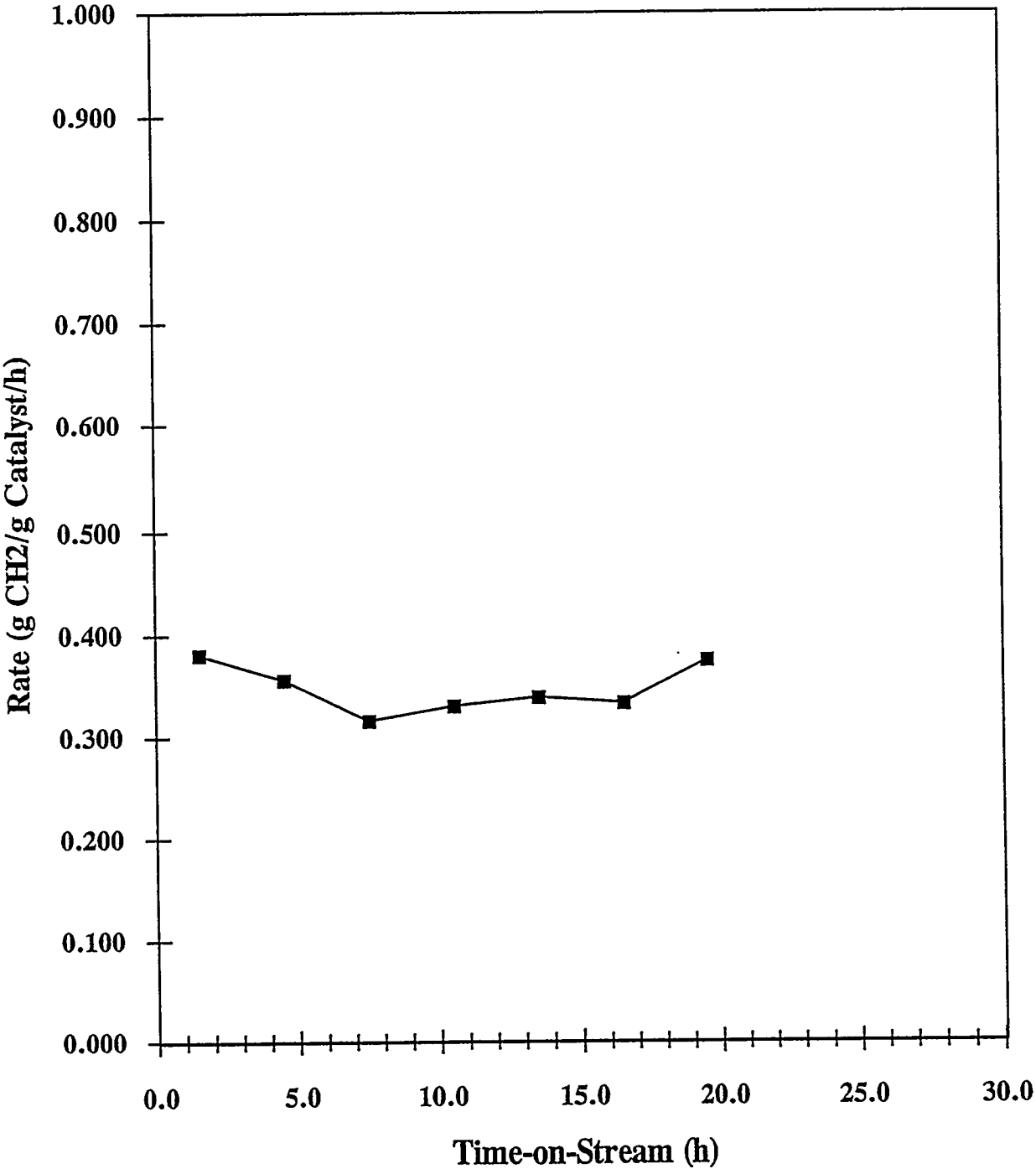
C1	24.8
C2 - C4	24.4
C5 - C12	37.3
C13 - C50	13.6

CO conversion, %	6.7
rate, g CH2/g cat/hr	0.37
CO2 formation, %	0.1

Schulz-Flory Plot for Co.053 - Run #14
Time on Stream (hrs)



Time-on-Stream Plot for Co.053 - Run #14



Co.061 - Run #1

Co wt%	NM wt %	Promotor wt%		Support
30	Ru 0.50			Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.190 g
WHSV = 13.51 1/hr
time on stream = 24.5 hrs

CO2 (g/g cat/hr) = 0.035
CO2 (% of CO) = 0.2
O/P = 1.42

CO conversion (%)	9.4
rate (g CH2/g cat/hr)	0.56
alpha	0.67
C1 (wt%)	29.2
C2 - C4 (wt%)	27.8
C5 - C12 (wt%)	38.9
C13 + (wt%)	4.1

Performance of Co.061

Dates: 02/23/95 - 02/24/95 Run #1

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.5 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	34.49	32.44	30.59	30.88	28.87	30.32
C2	5.63	5.42	5.21	4.99	4.85	4.82
C3	12.61	12.85	12.44	12.36	11.76	12.33
C4	12.06	12.22	12.15	11.90	11.42	11.96
C5	10.40	10.61	10.92	10.93	10.17	10.91
C6	4.56	7.70	8.04	8.06	7.52	8.27
C7	6.02	6.19	6.58	6.59	6.20	6.67
C8	4.08	4.18	4.51	4.55	4.31	4.64
C9	2.75	2.76	3.08	3.10	2.98	3.21
C10	1.74	1.75	2.04	2.18	2.18	2.14
C11	1.33	1.31	1.72	1.76	1.66	1.75
C12	0.92	0.91	1.01	1.06	6.39	1.14
C13	0.80	0.63	0.71	0.71	0.70	0.78
C14	1.03	0.53	0.50	0.51	0.50	0.56
C15	1.59	0.51	0.52	0.42	0.47	0.50
alpha chain growth probability	0.72	0.65	0.65	0.64	0.65	0.65
C1 - C50 estimated total product distribution, weight %						
C1	30.4	31.5	29.8	30.4	29.9	29.7
C2 - C4	26.7	29.6	29.0	28.8	29.0	28.5
C5 - C12	32.8	35.6	37.8	38.0	37.9	38.5
C13 - C50	10.1	3.3	3.4	2.8	3.2	3.3
CO conversion, %	15.9	12.1	10.3	9.7	9.8	9.3
rate, g CH2/g cat/hr	0.94	0.71	0.61	0.57	0.58	0.55
CO2 formation, %	0.3	0.3	0.2	0.3	0.2	0.2

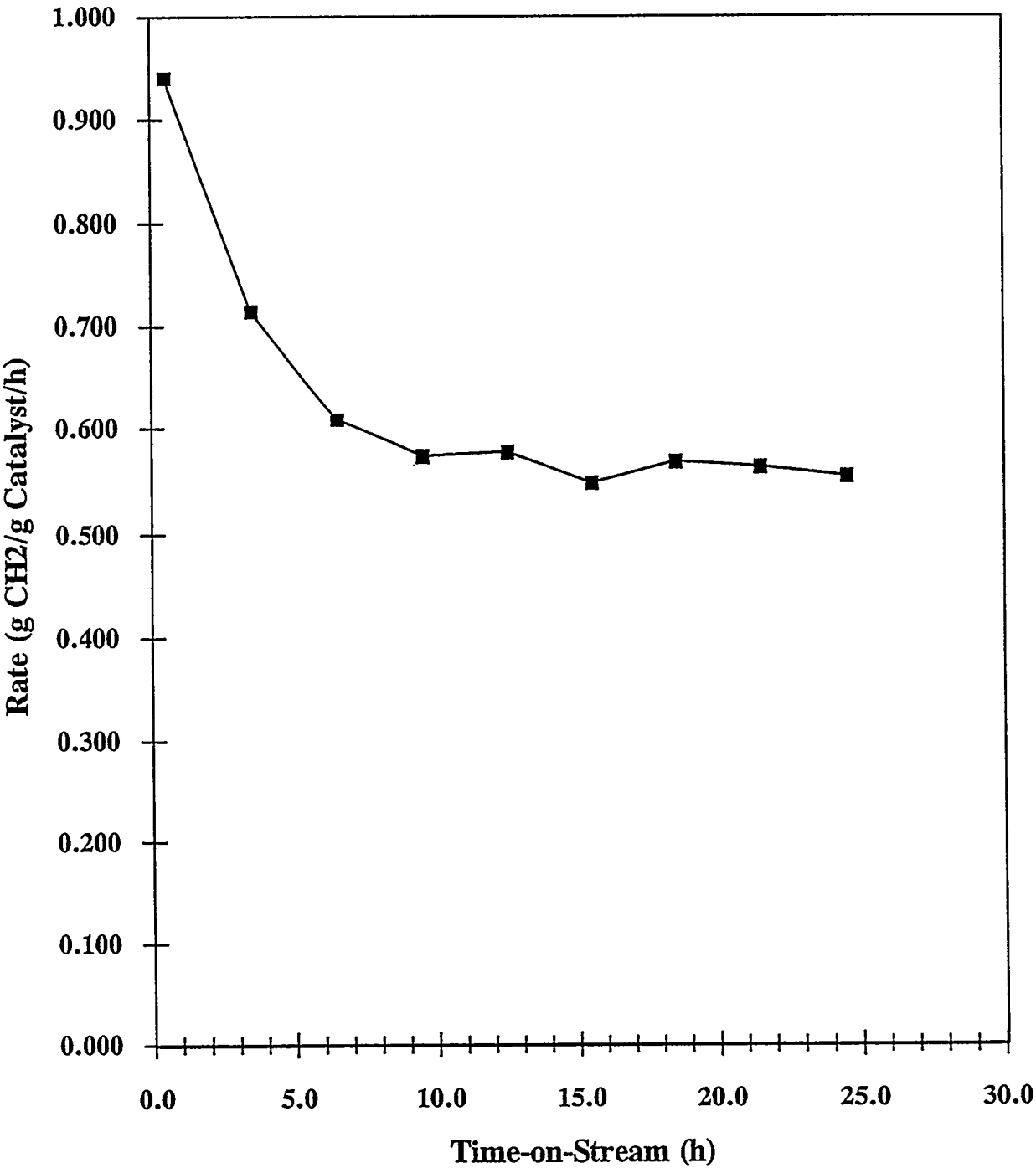
Performance of Co.061

Dates: 02/23/95 - 02/24/95 Run #1

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 13.5 1/hr, H2/CO ratio in feed = 2

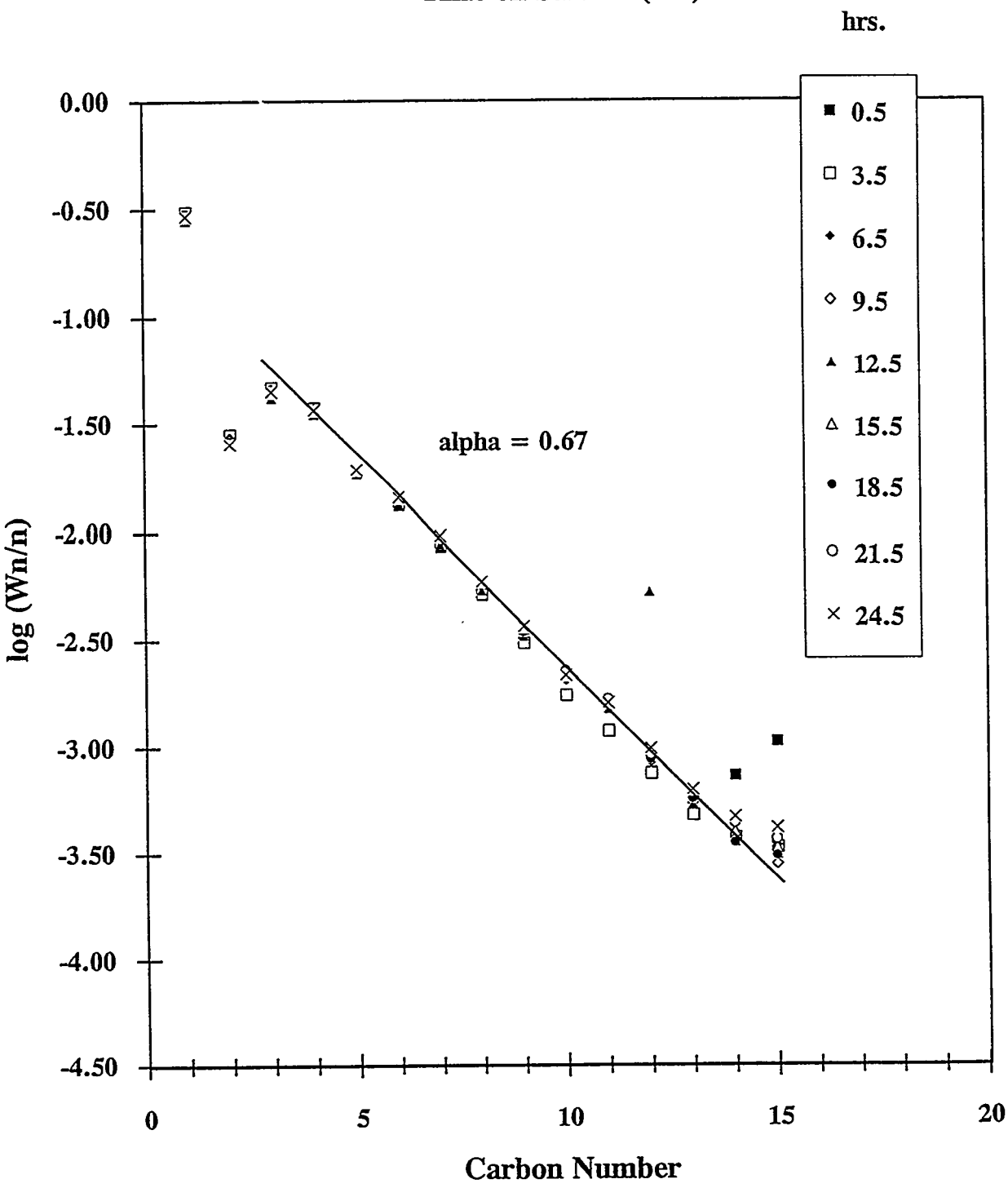
time on stream, hr	18.5	21.5	24.5
reaction temperature, °C	220	220	220
pressure, atm	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0
C1 - C15 product distribution, weight %			
C1	31.22	30.51	30.16
C2	4.92	4.83	4.78
C3	12.28	12.20	12.16
C4	11.74	11.59	11.71
C5	10.75	10.82	10.89
C6	8.12	8.31	8.32
C7	6.55	6.68	6.75
C8	4.54	4.67	4.73
C9	3.10	3.25	3.28
C10	2.28	2.22	2.16
C11	1.75	1.83	1.77
C12	1.05	1.11	1.18
C13	0.74	0.81	0.82
C14	0.50	0.62	0.66
C15	0.46	0.55	0.63
alpha chain growth probability	0.65	0.66	0.67
C1 - C50 estimated total product distribution, weight %			
C1	30.6	29.8	29.2
C2 - C4	28.4	27.9	27.8
C5 - C12	37.9	38.7	38.9
C13 - C50	3.0	3.6	4.1
CO conversion, %	9.6	9.5	9.4
rate, g CH2/g cat/hr	0.57	0.56	0.56
CO2 formation, %	0.2	0.2	0.2

Time-on-Stream Plot for Co.061 - Run #1



Schulz-Flory Plot for Co.061 - Run #1

Time on Stream (hrs)



Co.064 - Run #1

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50		Zr 8.50	Al2O3

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 = 24.5 hrs

CO2 (g/g cat/hr) = 0.028
CO2 (% of CO) = 0.2
O/P = 1.58

CO conversion (%)	7.1
rate (g CH2/g cat/hr)	0.38
alpha	0.64
C1 (wt%)	27.5
C2 - C4 (wt%)	28.4
C5 - C12 (wt%)	41.5
C13 + (wt%)	2.7

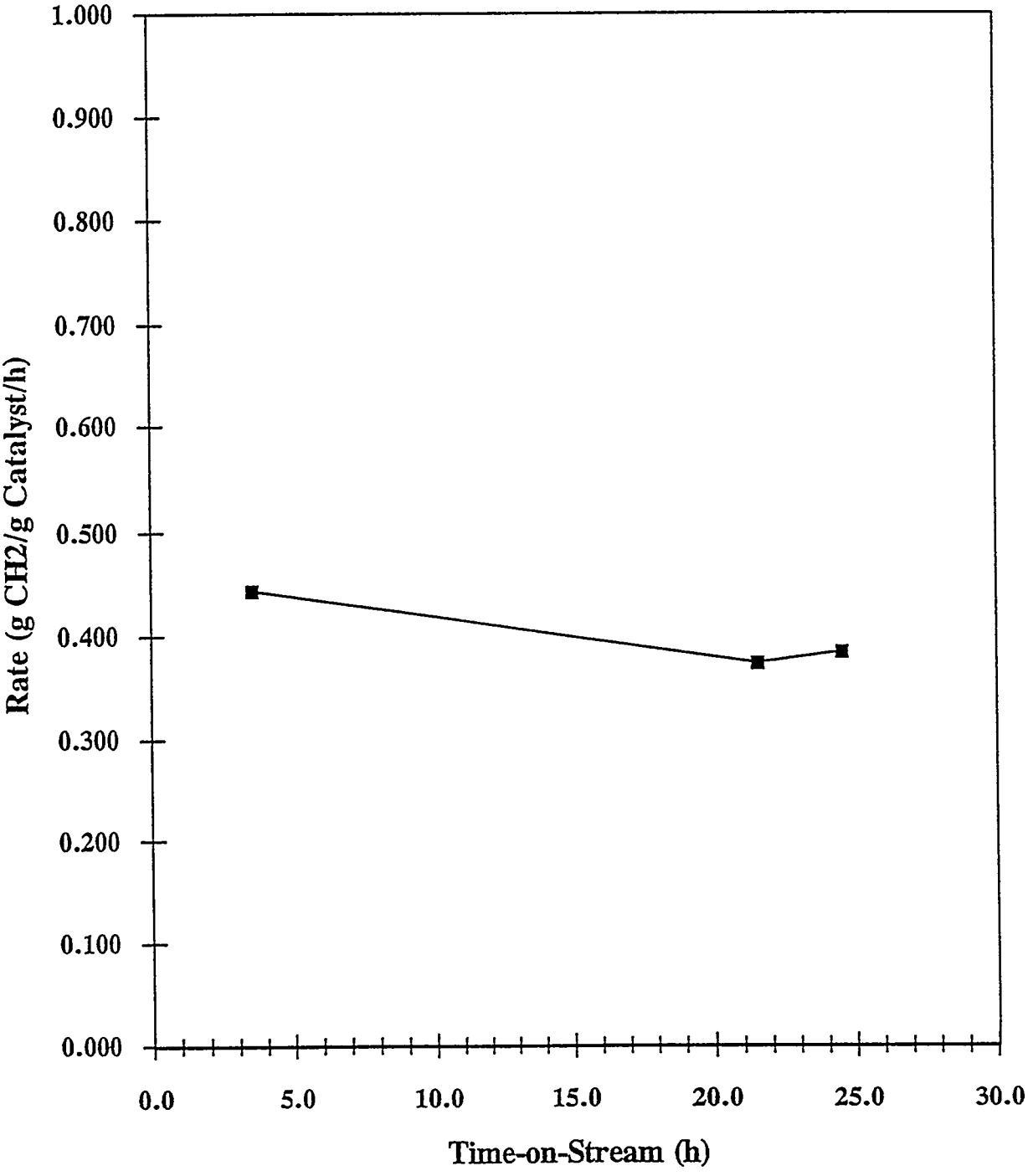
Performance of Co.064

Dates: 04/11/95 - 04/12/95 Run #1

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

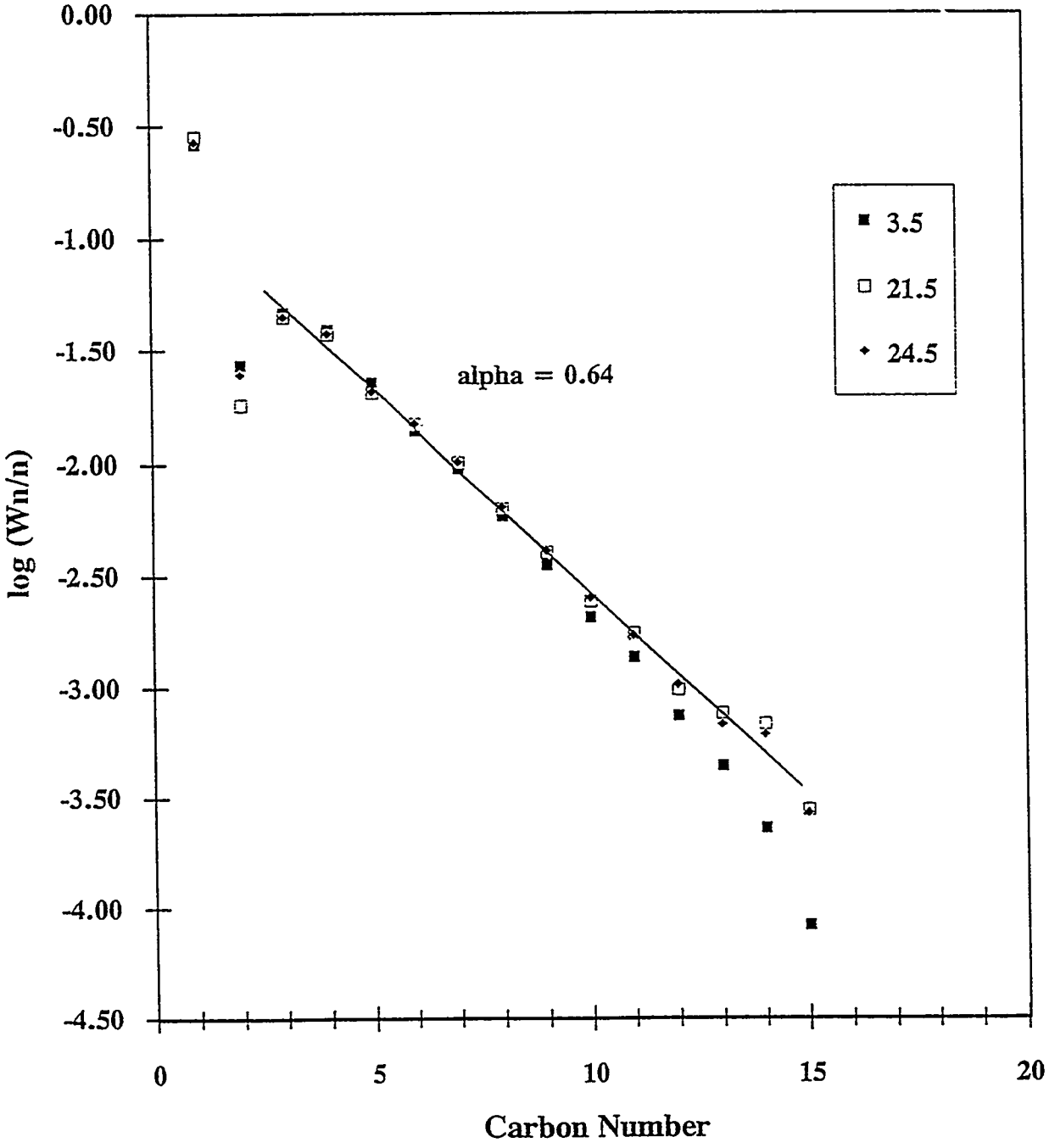
time on stream, hr	3.5	21.5	24.5
reaction temperature, °C	220	220	220
pressure, atm	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0
C1 - C15 product distribution, weight %			
C1	28.79	28.40	27.58
C2	5.44	3.25	4.61
C3	13.05	12.20	11.78
C4	11.30	11.80	12.14
C5	12.01	11.57	11.67
C6	9.28	9.08	8.43
C7	6.71	7.11	7.15
C8	4.67	5.03	5.13
C9	3.22	3.63	3.70
C10	2.08	2.44	2.53
C11	1.52	1.93	1.90
C12	0.90	1.19	1.25
C13	0.58	1.00	0.89
C14	0.32	0.96	0.86
C15	0.13	0.42	0.40
alpha chain growth probability	0.57	0.64	0.64
C1 - C50 estimated total product distribution, weight %			
C1	29.1	28.3	27.5
C2 - C4	30.1	27.1	28.4
C5 - C12	39.8	41.8	41.5
C13 - C50	0.9	2.8	2.7
CO conversion, %	8.2	6.9	7.1
rate, g CH2/g cat/hr	0.44	0.37	0.38
CO2 formation, %	0.2	0.2	0.2

Time-on-Stream Plot for Co.064 - Run #1



Schulz-Flory Plot for Co.064 - Run #1
Time on Stream (hrs)

hrs.



Cal.11 - Run #1

Co wt%	NM wt %	Promotor wt%		Support
20	Ru 0.50	K 0.30		Al2O3

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.208 g
WHSV = 12.39 1/hr
time on stream = 21.5 hrs

CO2 (g/g cat/hr) = 0.029
CO2 (% of CO) = 0.2
O/P = 4.71

CO conversion (%)	5.2
rate (g CH2/g cat/hr)	0.28
alpha	0.75
C1 (wt%)	20.0
C2 - C4 (wt%)	19.6
C5 - C12 (wt%)	48.1
C13 + (wt%)	12.2

Performance of Cal.11

Dates: 02/13/95 - 02/14/95 Run #1

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	21.42	22.60	20.99	20.99	21.03	21.11
C2	4.00	4.74	4.30	3.92	3.95	3.95
C3	9.74	9.74	8.60	8.30	8.23	8.17
C4	10.89	10.55	9.52	8.96	8.84	8.77
C5	12.00	9.57	10.28	10.33	10.20	10.11
C6	10.48	10.27	9.13	8.85	9.36	9.13
C7	8.89	7.54	8.32	8.47	8.40	8.37
C8	6.91	6.08	6.73	6.91	6.85	6.83
C9	5.38	4.85	5.48	5.64	5.66	5.67
C10	4.35	3.88	4.44	4.65	4.74	4.73
C11	3.10	3.17	3.65	3.73	4.01	3.94
C12	1.87	2.45	2.90	3.23	3.01	3.35
C13	0.72	1.79	2.26	2.38	2.39	2.53
C14	0.23	1.47	1.85	2.03	1.80	1.90
C15	0.03	1.29	1.57	1.61	1.54	1.44
alpha chain growth probability	0.51	0.73	0.74	0.75	0.74	0.74
C1 - C50 estimated total product distribution, weight %						
C1	22.6	21.5	19.7	19.8	19.9	20.3
C2 - C4	26.0	23.8	21.1	20.0	19.9	20.1
C5 - C12	51.2	45.9	48.2	48.8	49.2	49.3
C13 - C50	0.2	8.8	11.0	11.4	10.9	10.3
CO conversion, %	6.0	5.9	6.0	5.6	5.3	5.2
rate, g CH2/g cat/hr	0.33	0.32	0.33	0.30	0.29	0.28
CO2 formation, %	0.2	0.1	0.2	0.2	0.2	0.1

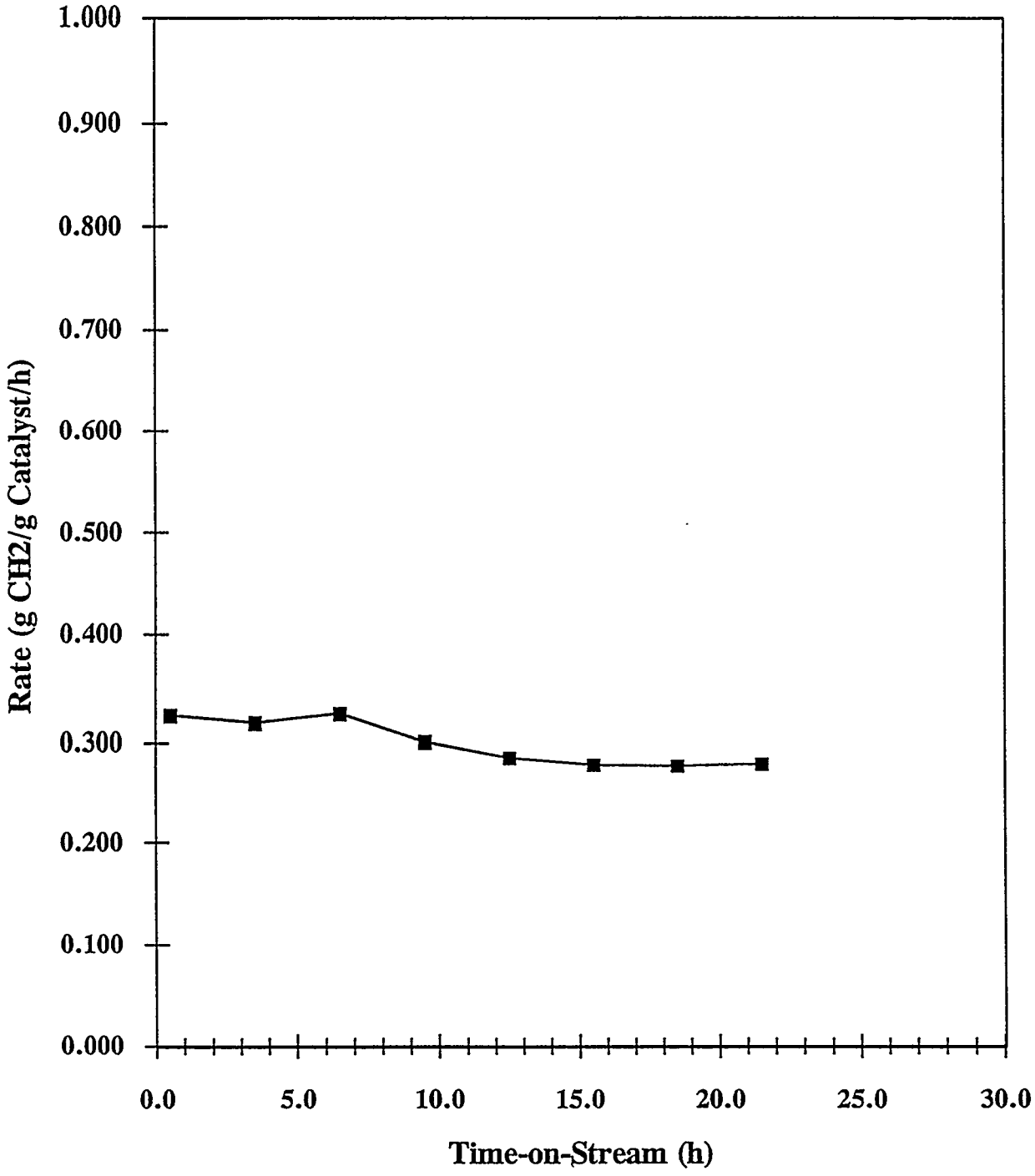
Performance of Cal.11

Dates: 02/13/95 - 02/14/95 Run #1

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

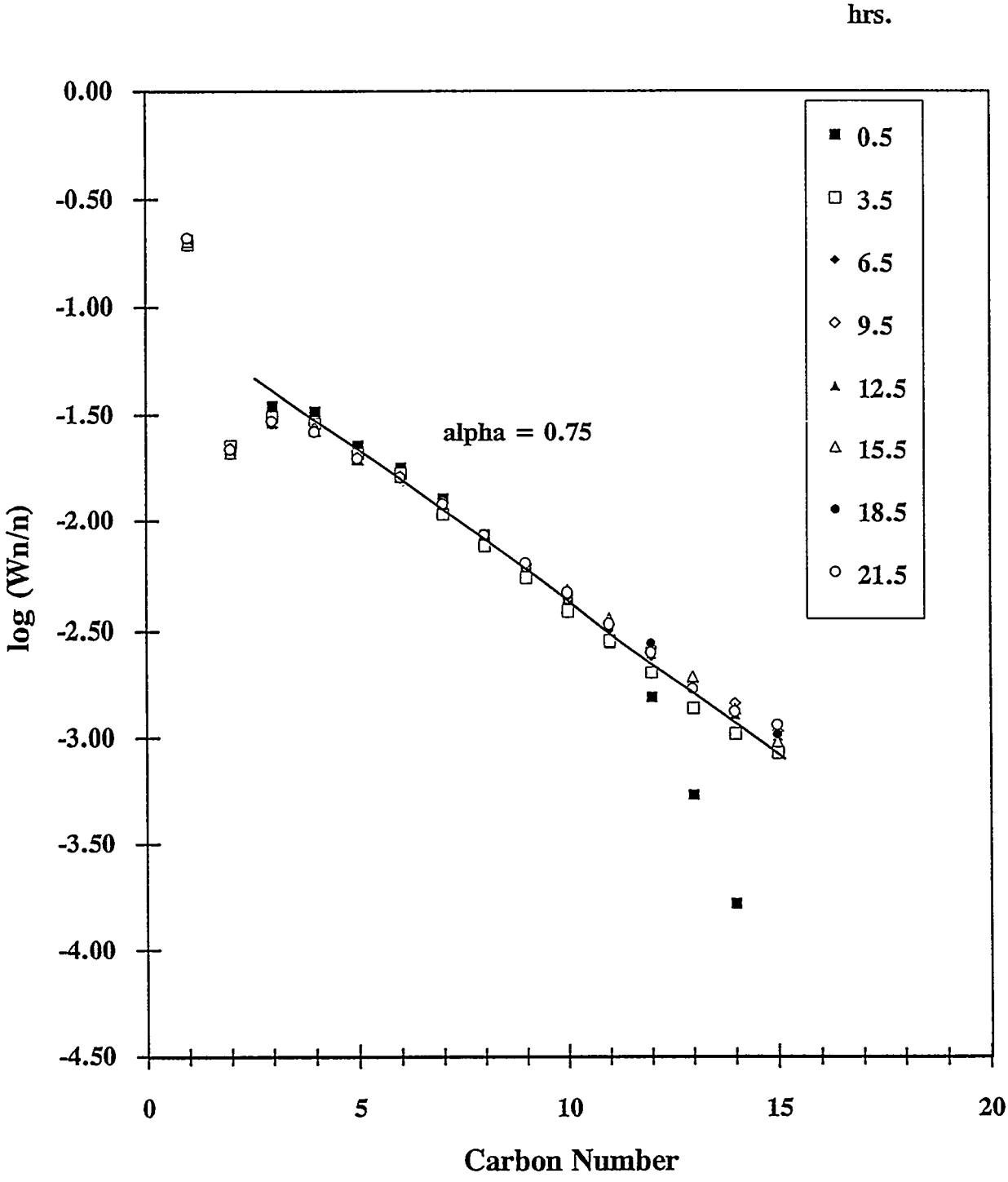
time on stream, hr	18.5	21.5	27.5
reaction temperature, °C	220	220	220
pressure, atm	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0
C1 - C15 product distribution, weight %			
C1	21.33	21.58	2.74
C2	4.01	4.05	5.19
C3	8.20	8.27	10.43
C4	8.79	8.83	11.16
C5	10.12	10.15	12.83
C6	9.30	9.09	9.14
C7	8.41	8.34	10.29
C8	6.92	6.82	8.55
C9	5.67	5.67	7.14
C10	4.67	4.63	5.91
C11	3.57	3.75	4.88
C12	3.36	3.04	4.14
C13	2.23	2.20	3.05
C14	1.88	1.86	2.46
C15	1.56	1.72	2.09
alpha chain growth probability	0.74	0.75	0.77
C1 - C50 estimated total product distribution, weight %			
C1	20.2	20.0	2.5
C2 - C4	19.8	19.6	24.8
C5 - C12	49.0	48.1	57.3
C13 - C50	11.0	12.2	15.4
CO conversion, %	5.1	5.2	4.0
rate, g CH2/g cat/hr	0.28	0.28	0.22
CO2 formation, %	0.1	0.2	0.2

Time-on-Stream Plot for CAL.11 - Run #1



Schulz-Flory Plot for Cal.11 - Run #1

Time on Stream (hrs)



Cal.12 - Run #1

Co wt%	NM wt %	Promotor wt%		Support
20	0.50	0.30		

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.203 g
WHSV = 12.64 1/hr
time on stream = 24.5 hrs

CO2 (g/g cat/hr) = 0.035
CO2 (% of CO) = 0.2
O/P = 3.89

CO conversion (%)	5.2
rate (g CH2/g cat/hr)	0.29
alpha	0.73
C1 (wt%)	21.6
C2 - C4 (wt%)	20.6
C5 - C12 (wt%)	48.2
C13 + (wt%)	9.6

Performance of Cal.12

Dates: 02/16/95 - 02/17/95 Run #1

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.6 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	22.52	21.69	22.06	22.26	22.81	22.48
C2	4.17	4.28	4.06	4.09	4.18	4.13
C3	10.18	9.57	8.74	8.66	8.74	8.53
C4	11.14	10.43	9.45	9.27	9.34	9.11
C5	11.95	10.80	10.57	10.43	10.04	10.38
C6	10.41	9.27	9.12	9.30	9.57	8.47
C7	8.49	8.17	8.26	8.27	8.01	8.36
C8	6.55	6.43	6.61	6.56	6.43	6.77
C9	4.95	5.03	5.31	5.24	5.20	5.52
C10	3.80	4.07	4.25	4.24	4.24	4.45
C11	2.86	3.22	3.47	3.51	3.44	3.59
C12	1.74	2.44	2.80	2.77	2.65	3.01
C13	0.76	1.93	2.25	2.18	2.15	2.04
C14	0.32	1.52	1.79	1.76	1.74	1.71
C15	0.16	1.16	1.26	1.45	1.45	1.45
alpha chain growth probability	0.60	0.72	0.73	0.74	0.74	0.74
C1 - C50 estimated total product distribution, weight %						
C1	23.3	20.9	21.3	21.1	21.6	21.3
C2 - C4	26.3	23.4	21.5	20.9	21.0	20.7
C5 - C12	49.3	47.7	48.4	47.9	47.3	47.9
C13 - C50	1.1	8.0	8.8	10.1	10.1	10.2
CO conversion, %	6.4	6.3	5.9	5.7	5.5	5.4
rate, g CH2/g cat/hr	0.35	0.35	0.33	0.32	0.30	0.30
CO2 formation, %	0.2	0.2	0.2	0.2	0.2	0.2

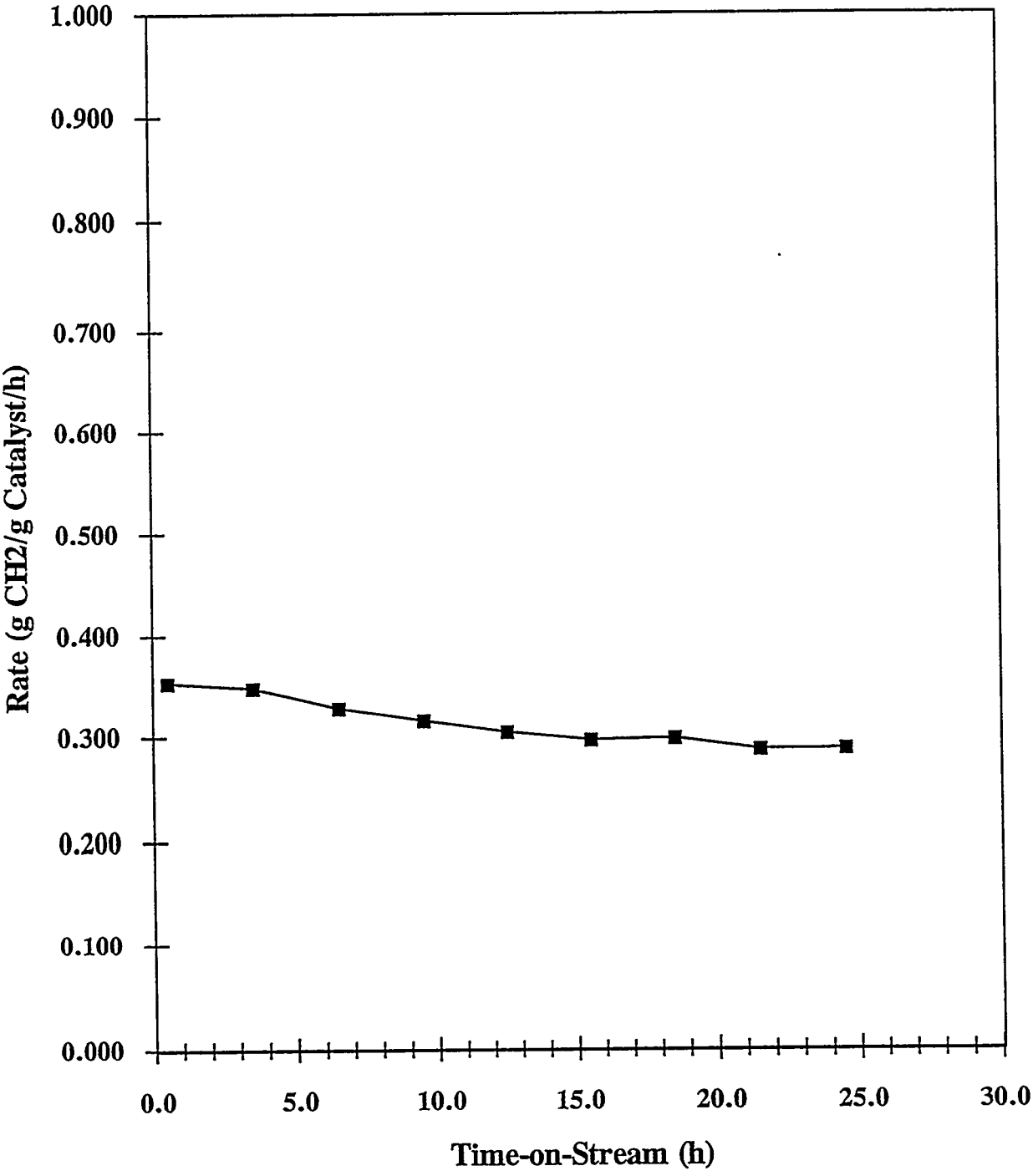
Performance of Cal.12

Dates: 02/16/95 - 02/17/95 Run #1

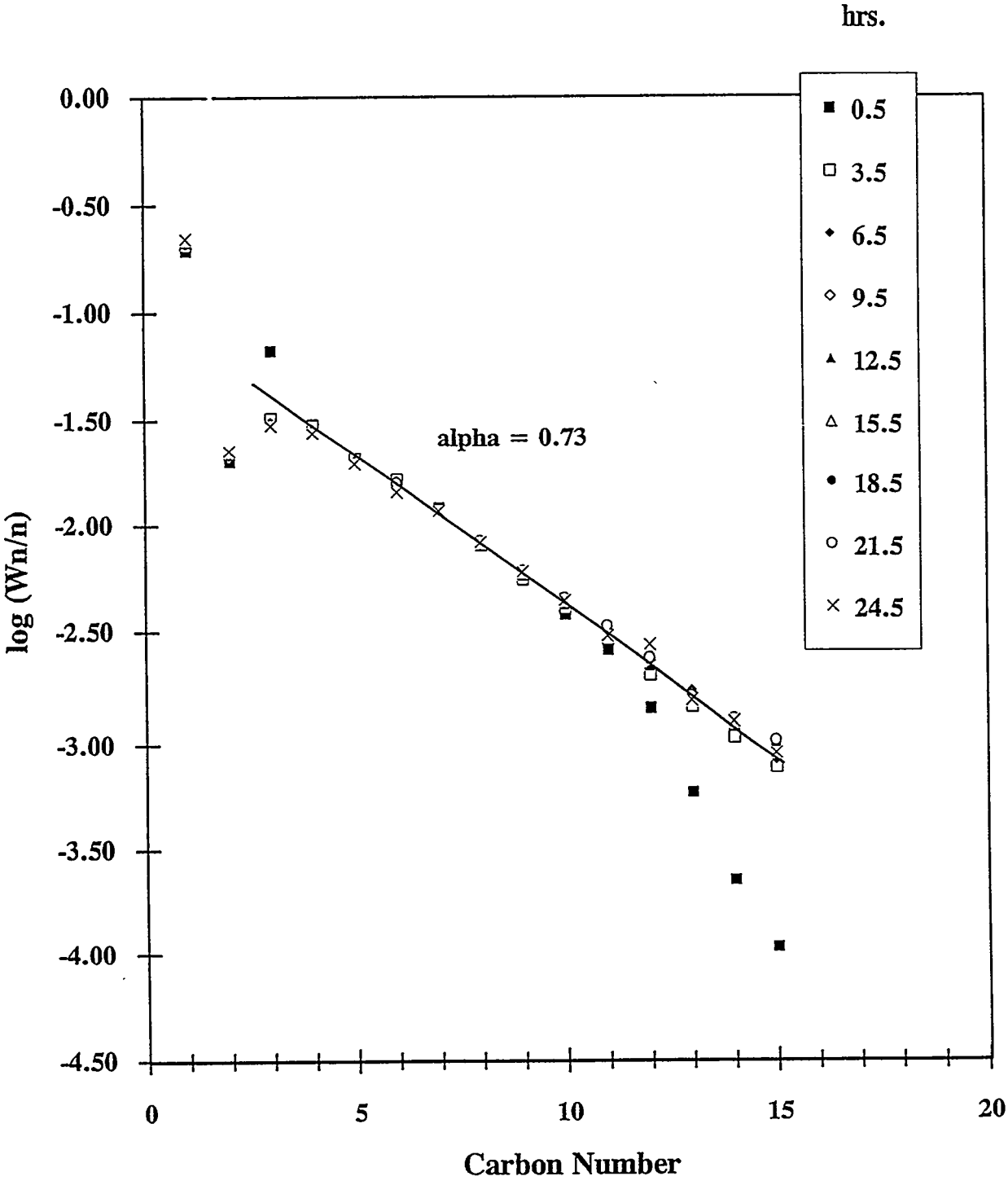
flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.6 1/hr, H2/CO ratio in feed = 2

time on stream, hr	18.5	21.5	24.5
reaction temperature, °C	220	220	220
pressure, atm	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0
C1 - C15 product distribution, weight %			
C1	22.34	22.38	22.56
C2	4.11	4.11	4.16
C3	8.44	8.43	8.39
C4	8.94	9.27	8.99
C5	10.17	10.20	10.07
C6	9.44	8.54	9.49
C7	8.28	8.28	8.15
C8	6.67	6.73	6.61
C9	5.43	5.48	5.40
C10	4.45	4.53	4.40
C11	3.62	3.69	3.31
C12	2.79	2.87	3.30
C13	2.08	2.11	2.04
C14	1.74	1.81	1.77
C15	1.49	1.57	1.37
alpha chain growth probability	0.74	0.74	0.73
C1 - C50 estimated total product distribution, weight %			
C1	21.1	21.0	21.6
C2 - C4	20.3	20.5	20.6
C5 - C12	48.2	47.5	48.2
C13 - C50	10.4	11.0	9.6
CO conversion, %	5.4	5.2	5.2
rate, g CH2/g cat/hr	0.30	0.29	0.29
CO2 formation, %	0.2	0.2	0.2

Time-on-Stream Plot for CAL.12 - Run #1



Schulz-Flory Plot for Cal.12 - Run #1
Time on Stream (hrs)



Cal.13 - Run #1

Co wt%	NM wt %	Promotor wt%		Support
20	0.50	0.30		

SUMMARY REACTION DATA

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.202 g
WHSV = 12.75 1/hr
time on stream = 24.5 hrs

CO2 (g/g cat/hr) = 0.024
CO2 (% of CO) = 0.1
O/P = 3.38

CO conversion (%)	4.6
rate (g CH2/g cat/hr)	0.26
alpha	0.77
C1 (wt%)	18.0
C2 - C4 (wt%)	20.1
C5 - C12 (wt%)	46.3
C13 + (wt%)	15.6

Performance of Cal.13

Dates: 02/20/95 - 02/21/95 Run #1

flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.7 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	17.08	19.53	20.72	20.28	20.31	20.46
C2	3.22	3.90	2.31	3.87	3.87	3.93
C3	7.40	7.79	7.98	7.77	7.67	7.66
C4	8.40	8.63	8.62	8.40	8.28	8.28
C5	9.49	9.97	10.01	9.75	9.60	9.60
C6	8.59	8.17	8.25	8.88	8.85	8.91
C7	7.51	8.30	8.44	8.23	8.25	8.22
C8	6.11	6.88	7.05	6.93	6.97	6.94
C9	4.96	7.09	5.87	5.79	5.82	5.80
C10	4.07	4.73	4.91	4.93	4.91	4.95
C11	3.37	3.91	4.04	4.15	4.17	4.16
C12	3.98	3.41	3.39	3.36	3.58	3.52
C13	7.31	2.86	2.80	2.80	2.80	2.80
C14	6.02	2.54	2.76	2.64	2.65	2.62
C15	2.49	2.31	2.85	2.22	2.26	2.15
alpha chain growth probability	0.78	0.77	0.79	0.77	0.77	0.77
C1 - C50 estimated total product distribution, weight %						
C1	16.0	17.4	17.5	18.3	18.2	18.6
C2 - C4	17.9	18.1	16.0	18.0	17.8	18.0
C5 - C12	46.9	48.0	46.1	47.7	47.6	47.8
C13 - C50	19.2	16.6	20.4	16.0	16.4	15.6
CO conversion, %	7.0	5.7	5.5	4.9	4.8	4.6
rate, g CH2/g cat/hr	0.39	0.32	0.31	0.28	0.27	0.26
CO2 formation, %	0.1	0.1	0.2	0.2	0.2	0.1

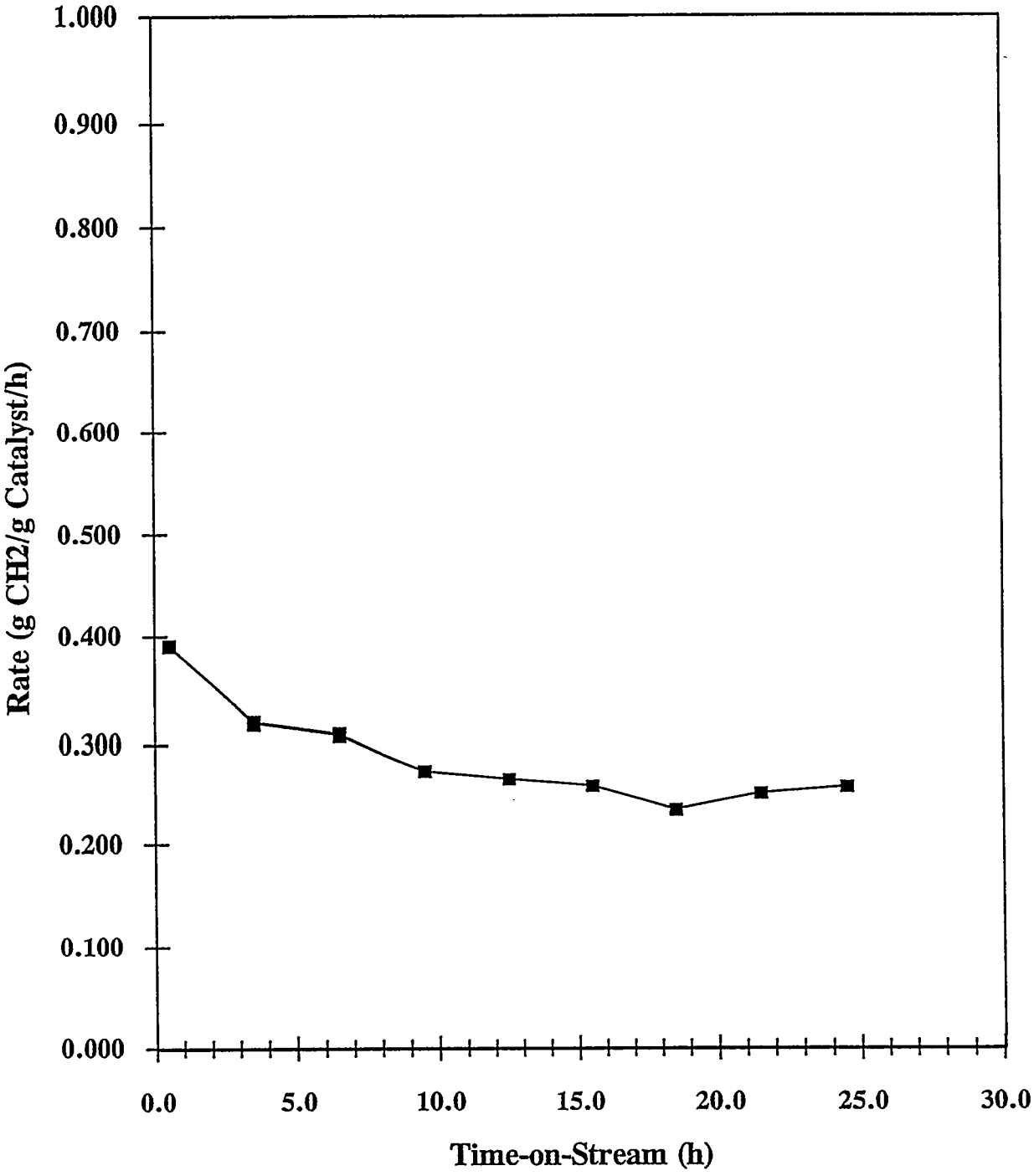
Performance of Cal.13

Dates: 02/20/95 - 02/21/95 Run #1

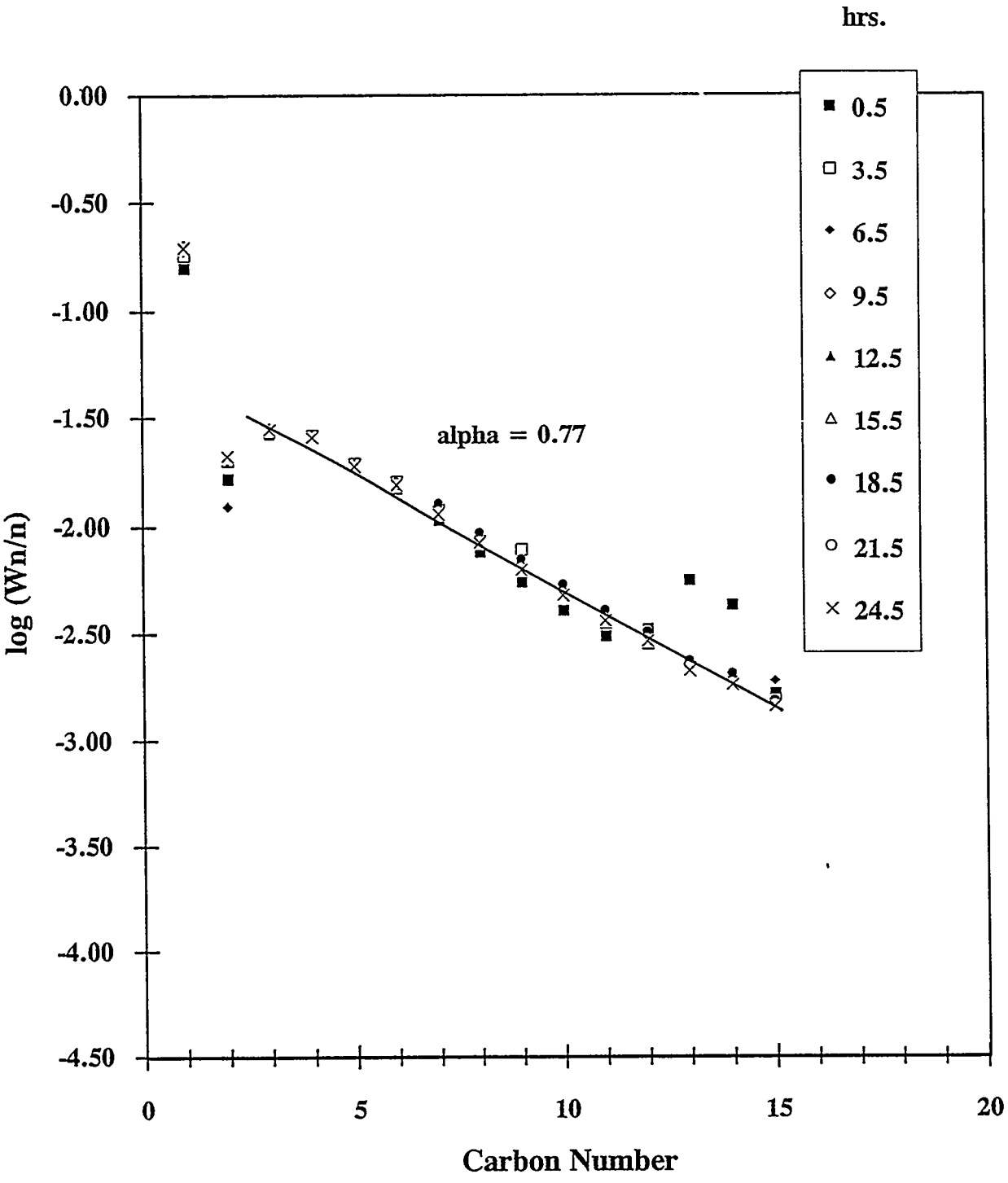
flow rate = 90.0 cc/min, loading= 0.2 g, WHSV = 12.7 1/hr, H2/CO ratio in feed = 2

time on stream, hr	18.5	21.5	24.5
reaction temperature, °C	220	220	220
pressure, atm	1.0	1.0	1.0
flow, cc/min	90.0	90.0	90.0
C1 - C15 product distribution, weight %			
C1	21.93	20.45	19.93
C2	4.23	3.95	3.84
C3	0.83	7.68	7.47
C4	8.85	8.25	10.94
C5	10.27	9.58	9.31
C6	9.27	8.88	8.55
C7	8.84	8.19	7.95
C8	7.51	6.91	6.72
C9	6.34	5.79	5.62
C10	5.35	4.91	4.76
C11	4.46	4.11	3.98
C12	3.89	3.59	3.48
C13	3.05	2.89	2.74
C14	2.88	2.61	2.54
C15	2.30	2.22	2.16
alpha chain growth probability	0.78	0.77	0.77
C1 - C50 estimated total product distribution, weight %			
C1	19.8	18.4	18.0
C2 - C4	12.6	17.9	20.1
C5 - C12	50.8	47.5	46.3
C13 - C50	16.9	16.1	15.6
CO conversion, %	4.2	4.5	4.6
rate, g CH2/g cat/hr	0.23	0.25	0.26
CO2 formation, %	0.2	0.1	0.1

Time-on-Stream Plot for CAL.13 - Run #1



Schulz-Flory Plot for Cal.13 - Run #1
Time on Stream (hrs)



Cal.13 - Run #2

Co wt%	NM wt%	Promotor wt%		Support
20	0.50	K 0.3		Al2O3

SUMMARY REACTION DATA*

Reaction Conditions:

P = 1.0 atm
T = 220 °C
H2/CO = 2
weight of catalyst = 0.209 g
WHSV = 12.32 1/hr
time on stream = 23.0 hrs

CO2 (g/g cat/hr) = 0.085
CO2 (% of CO) = 0.5
O/P = 2.58

CO conversion (%)	3.7
rate (g CH2/g cat/hr)	0.20
alpha	0.83
C1 (wt%)	14.0
C2 - C4 (wt%)	13.8
C5 - C12 (wt%)	39.5
C13 + (wt%)	32.7

* Reaction carried out in second reaction system

Performance of Cal.13

Dates: 02/20/95 - 02/21/95 Run #2

flow rate = 90.0 cc/min, loading= 0.21 g, WHSV = 12.3 1/hr, H2/CO ratio in feed = 2

time on stream, hr	3.0	5.5	21.0	23.0		
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	17.87	18.93	20.05	19.22		
C2	3.82	4.06	4.34	4.11		
C3	7.26	7.85	7.94	7.63		
C4	8.20	8.92	8.62	7.22		
C5	9.30	10.14	9.25	9.06		
C6	8.37	9.51	10.12	9.29		
C7	7.25	7.35	6.55	6.91		
C8	7.46	5.58	5.53	6.15		
C9	6.23	5.18	4.91	4.95		
C10	5.48	4.16	4.23	4.68		
C11	4.83	3.42	4.19	4.26		
C12	3.90	2.92	4.19	3.79		
C13	4.31	5.61	3.17	3.40		
C14	2.96	2.75	4.18	4.89		
C15	2.76	3.62	2.75	4.44		
alpha chain growth probability	0.80	0.81	0.79	0.83	1.00	1.00
C1 - C50 estimated total product distribution, weight %						
C1	15.6	14.9	17.5	14.0		
C2 - C4	16.8	16.4	18.2	13.8		
C5 - C12	46.5	42.3	43.8	39.5		
C13 - C50	21.1	26.4	20.5	32.7		
CO conversion, %	3.8	3.9	3.0	3.7		
rate, g CH2/g cat/hr	0.21	0.21	0.16	0.20		
CO2 formation, %	1.5	0.9	0.7	0.5		

APPENDIX C

CHRONOLGY OF RUNS IN SLURRY BUBBLE COLUMN REACTORS

APPENDIX C

CHRONOLOGY OF RUNS MADE IN THE SLURRY BUBBLE COLUMN REACTORS DURING THE FIRST QUARTER OF 1995

Task 2.0 -- Catalyst Testing

Subtask 2.2 - Slurry Bubble Column Testing

Run No. 35 in the M3-SBCR was started on January 3rd with a charge of 26.0 gm of Catalyst No. Co.041 to attempt another high CO conversion test. This catalyst contained 20% Co plus 8.5% Zr and 0.5% Ru on silica support. The CO conversion was 35.7% at startup conditions which is about 10% higher than obtained with a 15 gm charge (Run 20 in M3-SBCR). The conversion increased to 42.1% at 250°C and 45.1% at 260°C reaction temperature. Lowering the total gas feed rate from 905 SLH to 544 SLH resulted in a slight increase in CO conversion to 46.7%. Lowering the feed gas rate to 403 SLH increased conversion to 49.6%. Reducing the N_2 feed rate to 40% of total with a corresponding increase in H_2 and CO rates reduced the conversion to 47.9%. Reducing the N_2 feed rate to 25% increased the conversion back up to 49.7%. The reactor was returned to startup conditions for a catalyst activity check. The CO conversion was only 19.6%, about one half of the initial activity. The activity loss probably occurred at the higher temperatures. A run will be made with a larger charge of catalyst with a higher loading of cobalt.

Run No. 28 in the M4-SBCR was started on Jaunary 6th with a charge of 15.8 gm of Catalyst No. Co.057. This catalyst contained 20% Co plus 1.0% Re metal, and 1.0% La promoter on silica support. The CO conversion at startup conditions was 18.7%, which is similar to that obtained with an unpromoted silica supported catalyst, Co.011. The CO conversion increased to 25.3% at 250°C, and 29.7% at 260°C. The conversion dropped to 13.8% at the final rate check conditions, about a 25% loss over the entire run.

Run No. 36 in M3-SBCR was started on January 16th with a charge of 15.9 gm of Catalyst No. Co.032. This catalyst contained 20% Co and 8.5% Zr on alumina support with aqueous IW co-impregnation. The CO conversion at startup conditions was 24.0%. This was about 3.5% lower than obtained with Catalyst No. Co.034 which was prepared in multiple steps, aqueous IW, with Zr pre-impregnation. The latter catalyst preparation method appears to increase the final catalyst activity.

Run No. 29 in M4-SBCR was started on January 23rd with a charge of 45.4 gm of Catalyst No. Co.061 to attempt another high CO conversion test. This catalyst contained 30% Co with 0.5% Ru on alumina catalyst support. The initial CO conversion started at 42% and slowly diminished to 29% over a 24-hour period. Catalyst was found in the overhead product for the next three days. Synfluid was stopped after the first day, but this did not stop the catalyst carryover. It appears that the reactor slowly filled up with slurry as indicated by the slow decrease in CO conversion until it began to overflow. The run was shut down after three days and the reactor was drained without flushing. The reactor walls and internal filter were clean on the surfaces. The internal filter pores

were filled with wax and catalyst which was easily removed by steaming. It appears that the internal filter could not function properly with the 45 gm catalyst charge. Additional experiments will be made to determine the optimum catalyst loading that can be used in the existing SBCR's without catalyst carryover.

Run No. 37 in the M3-SBCR was started on January 30th with a charge of 15.9 gm of Catalyst No. Co.045. This catalyst contained 20% Co and 4% Zr on silica support (similar to Co.025 which had 8.5% Zr added). Conversion was only 14.77% at startup conditions, which was considerably lower than obtained with similar catalysts containing 0.0, 0.7, 8.5, and 15% Zr. The CO conversion reached a maximum of 27.4% at 260°C and dropped to 13.7% at startup conditions after 207 hours of operation. The catalyst activity was fairly stable and appeared to be unaffected at the higher temperatures.

Run No. 30 in the M4-SBCR was started on February 6th with a charge of 15.9 gm of Catalyst No. Co.011, an unpromoted 20% Co on silica support catalyst. The CO conversion was only 8% at startup conditions compared to 18.5% in Run 9 in M3 with the same catalyst. The reaction temperature was increased to 280°C where the CO conversion reached 28.5%. Lowering the total gas feed rate from 900 to 540 SLH increased conversion to 36.0%. Lowering the gas rate to 400 SLH increased conversion to 38.5%. Lowering the N_2 concentration from 60% to 25% resulted in a lower CO conversion at 36.0%. After returning to startup conditions, the CO conversion leveled out at 4.4%, a 45% drop from the initial startup conversion. This run will be repeated at a higher catalyst charge level, probably 30 gm (approximately 15 wt% of slurry).

A special test run was made in the M3-SBCR to determine whether slugging or plugging occurred in the reactor system at higher solids loading. A charge of 50 wt% inactive catalyst in synfluid was charged to the M3 reactor. The reactor was brought up to 240°C, 450 psi, and 900 SLH nitrogen gas feed rate. No catalyst carryover was observed. The gas rate was increased to 1300 SLH with still no solids carryover. Finally, synfluid was fed at 30 ml/hr and no overhead slugging and no plugging occurred in the internal heavy product filter. The reactor system can handle high solids loading. However, the reactor cannot handle high heat generation because there is no capability for removing the heat of reaction except by lowering the inlet gas temperature and by adding more nitrogen in the feed gas.

Run No. 38 in the M3-SBCR was started on March 15th with a charge of 15.9 gm of Catalyst No. Co.058. This catalyst contained 20% Co plus 1% La_2O_3 on alumina support. The CO conversion at startup conditions was 28.0%, the total hydrocarbon production rate was 1.28 g/g/hr, and the CH_4 selectivity was 11.9%. A similar catalyst, Co.005, which consisted of 20% Co and no additives on alumina support produced similar results; 27.1% CO conversion production rate of 1.34 g/g/hr, and 7.9% CH_4 selectivity. The addition of La_2O_3 had no effect on catalyst activity.

Run No. 39 in the M3-SBCR was started on March 22nd with a charge of 15.9 gm of Catalyst No. Co.064. This catalyst contained 20% Co with 0.5% Ru and 8.5% Zr on alumina support. This catalyst is similar to Catalyst No. Co.034, but has 0.5% Ru added. The CO conversion was considerably higher with the added Ru, 34.2% vs. 27.5%, but the CH_4 selectivity was also much higher, 13.6% vs. 10.4%. Similar CO conversion and CH_4 selectivity was obtained with Catalyst No.

Co.053 which contained 0.5% Ru and no Zr. The addition of Zr to promoted or unpromoted alumina supported catalysts has little or no effect on catalyst activity.

Subtask 3.1 - Reproducibility of Catalyst with Low Methane Selectivity

Three 1 Kg samples were obtained from Calsicat for reproducibility and aging tests. Each catalyst contained 20% Co, 0.5% ruthenium, and 0.3% potassium on Vista Catapal B alumina.

Run No. 31 in the M4-SBCR was started on February 20th with a charge of 15.9 gm of Catalyst No. CAL.12. The initial CO conversion at startup conditions was 27.6%. The total hydrocarbon production rate was 1.26 g/g/hr and the CH_4 selectivity was 7.9%. These values are very similar to those obtained with two previously formulated Calsicat catalysts, CAL.04 and CAL.05. They are also similar to the reference catalyst prepared by Pitt, Catalyst No. Co.047.

Run No. 32 in the M4-SBCR was started on February 27th with a charge of 15.9 gm of the second batch of catalyst from Calsicat, No. CAL.11. The initial CO conversion was slightly higher at startup conditions, 30.6%. The THC was slightly higher, 1.40 g/g/hr, but the CH_4 selectivity was the same, 7.8%. This catalyst contained a little more ruthenium than CAL.12.

Run No. 33 in M4-SBCR was started on March 6th with a charge of 15.9 gm of the third batch of catalyst from Calsicat, No. CAL.13. The initial CO conversion at startup conditions was 28.1%, very similar to the first batch of catalyst, CAL.12. The total hydrocarbon production rate was similar, 1.28 g/g/hr vs. 1.26 g/g/hr, but the CH_4 selectivity was a little lower, 6.4% vs. 7.9%. This run will be extended up to 1000 hours at the same run conditions as the catalyst aging test of the low methane selectivity catalyst prepared by Calsicat. At 111 hours into the run, the CO conversion had dropped to 25.12% and the THC to 1.145 g/g cat/hr. For the next 300 hours, the CO conversion slowly dropped at 0.58%/day and the THC production rate dropped at 1.1 g/g cat/hr. This run will be continued to 1000 hours on stream or terminated earlier if deemed necessary.

APPENDIX D

SLURRY BUBBLE COLUMN REACTOR DATA

Table I

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefins C6-18,%	Comments
2	CO.001	16.5	1	162	177	225	450	2.0	20	15.9	0.70	2.3	0.8	96.4	0.53	0.98	0.88	5.00	2.27	25.2	
2	CO.001	16.5	2	202	228	200	450	2.0	20	3.9	0.17	0.0	0.0	99.9	0.00	0.81	0.91	0.00	0.00	21.7	
2	CO.001	16.5	3	254	280	240	450	2.0	20	30.9	1.36	11.7	1.8	85.5	1.04	0.87	0.77	2.63	1.64	22.4	
2	CO.001	16.5	4	302	323	225	450	1.2	20	9.9	0.59	0.7	0.3	98.4	0.67	0.76	0.90	0.00	7.14	29.4	
2	CO.001	16.5	5	350	372	225	450	2.0	20	15.3	0.68	6.0	1.0	92.5	0.49	0.84	0.88	4.00	2.70	23.1	
2	CO.001	16.5	6	398	420	225	300	2.0	20	12.5	0.55	6.1	1.1	92.2	0.63	0.79	0.86	4.35	2.86	21.7	
2	CO.001	16.5	7	446	468	240	300	2.0	20	22.9	1.02	16.5	0.8	81.5	1.16	0.71	0.79	3.03	1.79	22.4	
2	CO.001	16.5	8	494	516	240	600	2.0	20	29.9	1.33	12.6	1.6	85.0	0.84	0.76	0.82	2.63	1.69	22.4	
2	CO.001	16.5	9	517	540	240	600	2.0	0	29.5	1.31	12.0	1.7	85.3	0.96	0.76	--	2.50	1.56	22.4	
2	CO.001	16.5	9	541	564	240	600	2.0	0	28.4	1.26	10.4	1.7	87.1	0.89	0.77	--	3.03	1.72	--	
2	CO.001	16.5	9	565	588	240	600	2.0	0	27.9	1.27	11.1	1.7	86.2	0.93	0.76	--	3.03	1.72	--	
2	CO.001	16.5	9	589	612	240	600	2.0	0	27.0	1.20	10.7	1.7	86.7	0.89	0.76	0.82	2.78	2.00	--	
2	CO.001	16.5	10	637	660	240	600	2.0	20	26.4	1.17	11.0	1.7	86.4	0.85	0.77	0.83	2.86	1.96	22.4	G.C.Calib
2	CO.001	16.5	11	684	706	225	450	2.0	20	11.6	0.51	5.4	1.0	93.0	0.61	0.81	0.87	5.26	3.45	23.8	
3	CO.005	19.5	1	12	36	240	450	2.0	20	33.2	1.23	5.6	1.6	91.8	1.06	0.80	0.81	2.04	1.27	23.1	G.C.Calib
3	CO.005	19.5	2	60	84	220	450	2.0	20	15.0	0.56	2.9	0.6	96.2	0.24	0.86	0.87	4.55	3.23	21.7	
3	CO.005	19.5	3	108	132	240	450	1.2	20	18.5	0.94	6.9	1.0	91.3	0.85	0.81	--	5.88	3.85	26.6	
3	CO.005	19.5	4	156	179	240	450	2.0	20	29.6	1.11	11.5	1.8	85.8	0.91	0.76	0.78	2.22	1.39	21.7	
4	CO.002	20.1	1	37	59	240	450	2.0	20	36.1	1.32	22.9	3.2	72.4	1.51	0.66	0.77	0.65	0.31	16.8	
4	CO.002	20.1	2	85	106	220	450	2.0	20	16.6	0.60	3.8	1.1	94.7	0.35	0.84	0.88	2.44	0.89	--	
4	CO.002	20.1	3	133	149	210	600	1.0	20	5.2	0.28	0.0	0.0	99.1	0.87	0.89	0.94	0.00	0.00	--	Power Fail
5	CO.003	15.1	1	15	35	240	450	2.0	20	31.7	1.53	16.7	2.4	79.8	1.16	0.71	--	1.30	0.60	18.2	G.C.Calib
5	CO.003	15.1	2	61	83	220	450	2.0	20	13.2	0.63	5.1	1.0	93.4	0.51	0.82	0.90	4.55	1.89	--	
5	CO.003	15.1	3	88	107	240	450	2.0	20	28.4	1.37	15.1	2.4	81.4	1.11	0.75	--	1.45	0.97	--	
5	CO.003	15.1	4	133	155	240	450	1.0	20	13.1	0.95	4.2	1.2	93.3	1.24	0.83	0.88	6.67	3.70	--	
5	CO.003	15.1	5	181	203	240	600	1.0	20	13.4	0.97	3.9	1.1	93.7	1.30	0.81	--	5.26	3.45	30.1	
5	CO.003	15.1	6	217	227	240	450	2.0	20	25.4	1.23	14.9	2.4	81.7	1.03	0.73	--	1.89	1.19	--	
6	CO.011	15.3	1	13	35	240	450	2.0	20	14.3	0.67	7.6	1.6	89.4	1.42	0.78	0.83	4.17	2.57	21.7	
6	CO.011	15.3	2	61	83	220	450	2.0	20	5.1	0.23	0.0	0.0	97.2	2.78	0.87	0.82	--	--	--	
6	CO.011	15.3	3	88	107	240	450	2.0	20	13.5	0.63	5.4	1.7	91.1	1.86	0.79	--	4.00	2.83	--	
6	CO.011	15.3	4	133	155	240	450	1.0	20	6.3	0.44	0.4	1.0	95.5	3.05	0.82	0.88	--	--	--	
6	CO.011	15.3	5	181	203	240	600	1.0	20	6.7	0.46	0.2	0.9	96.0	2.91	0.84	0.89	12.00	3.67	27.3	G.C.Calib
6	CO.011	15.3	6	217	226	240	450	2.0	20	12.0	0.57	5.9	1.8	90.4	1.91	0.78	--	4.40	2.43	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
7	CO.012	15.8	1	14	36	240	450	2.0	20	13.9	0.63	6.1	1.5	90.6	1.74	0.80	0.89	4.00	2.57	17.5	
7	CO.012	15.8	2	62	84	220	450	2.0	20	5.1	0.23	0.0	0.2	97.8	2.02	0.89	0.90	--	2.50	--	
7	CO.012	15.8	3	88	92	240	450	2.0	20	13.1	0.59	6.1	1.7	90.4	1.75	0.80	--	5.00	2.25	--	Power Fail
7	CO.012	15.8	4	134	156	240	450	1.0	20	3.9	0.26	4.8	2.3	86.3	6.64	0.70	0.85	16.00	3.50	--	
7	CO.012	15.8	5	182	204	240	600	1.0	20	4.3	0.28	0.1	2.1	91.6	9.29	0.75	0.82	8.50	3.50	30.8	
7	CO.012	15.8	6	218	227	240	450	2.0	20	7.2	0.32	7.3	3.2	85.1	4.45	0.70	--	5.00	3.17	--	
8	CO.015	15.0	1	14	35	240	450	2.0	20	28.3	1.37	12.7	2.0	84.1	1.24	0.76	0.80	1.61	1.07	19.6	G.C.Calib
8	CO.015	15.0	2	61	83	220	450	2.0	20	11.5	0.56	4.4	1.0	93.9	0.80	0.81	0.89	3.60	2.14	--	
8	CO.015	15.0	3	97	106	240	450	2.0	20	26.4	1.28	13.2	2.1	83.5	1.12	0.75	--	1.69	1.20	--	
8	CO.015	15.0	4	133	155	240	450	1.0	20	11.5	0.83	4.8	1.2	92.5	1.53	0.80	0.85	5.60	3.29	--	
8	CO.015	15.0	5	181	191	240	600	1.0	20	12.4	0.90	4.9	0.8	93.6	0.73	0.84	0.85	5.20	3.14	30.8	Power Fail
9	CO.011	15.0	1	13	35	240	450	2.0	20	18.5	0.89	8.8	1.7	88.8	0.77	0.78	0.83	3.18	1.85	20.3	G.C.Calib
9	CO.011	15.0	2	61	82	220	450	2.0	20	6.3	0.31	0.0	1.0	98.6	0.41	0.88	0.93	12.00	1.80	--	
9	CO.011	15.0	3	97	107	240	450	2.0	20	16.6	0.80	8.4	2.1	88.7	0.81	0.77	--	3.30	2.00	--	
9	CO.011	15.0	4	133	155	240	450	1.0	20	8.0	0.58	1.3	1.3	96.3	1.16	0.82	0.87	7.00	2.83	--	
9	CO.011	15.0	5	181	203	240	600	1.0	20	8.7	0.63	1.4	1.1	96.4	1.05	0.83	0.87	5.00	2.67	30.5	
9	CO.011	15.0	6	228	229	240	450	2.0	20	14.7	0.71	7.9	2.2	89.1	0.85	0.78	--	3.78	1.67	--	Power Fail
11	CO.017	15.0	1	9	31	240	450	2.0	20	27.2	1.32	11.2	1.8	85.9	1.14	0.77	0.80	2.09	1.20	30.8	
11	CO.017	15.0	2	55	79	220	450	2.0	20	11.4	0.55	5.0	0.0	94.8	0.22	0.88	0.90	5.00	3.20	--	
11	CO.017	15.0	3	81	103	240	450	2.0	20	25.9	1.26	11.7	1.6	85.6	1.14	0.77	--	1.95	1.26	--	
11	CO.017	15.0	4	129	151	240	450	1.0	20	11.6	0.84	5.0	0.0	93.9	1.19	0.82	0.86	25.0	2.88	--	
11	CO.017	15.0	5	177	199	240	600	1.0	20	11.6	0.84	4.2	0.0	94.7	1.17	0.86	0.86	24.0	1.63	21.0	G.C.Calib
11	CO.017	15.0	6	213	221	240	450	2.0	20	24.3	1.20	12.1	1.4	86.4	0.08	0.78	--	2.47	1.64	--	
12	CO.018	15.6	1	13	35	240	450	2.0	20	33.8	1.56	9.7	2.0	86.6	1.68	0.75	0.85	1.81	1.13	21.0	G.C.Calib
12	CO.018	15.6	2	61	80	220	450	2.0	20	12.6	0.59	2.8	0.0	97.1	0.08	0.90	0.88	--	--	--	
12	CO.018	15.6	3	97	107	240	450	2.0	20	27.9	1.30	9.4	1.9	87.7	1.03	0.75	--	2.65	2.17	--	
12	CO.018	15.6	4	133	155	240	450	1.0	20	12.4	0.86	3.3	0.0	95.0	1.67	0.80	0.86	--	--	--	
12	CO.018	15.6	5	181	203	240	600	1.0	20	13.0	0.90	3.2	0.0	94.9	1.86	0.80	0.85	--	--	38.5	
12	CO.018	15.6	6	217	226	240	450	2.0	20	26.4	1.22	10.1	1.4	86.8	1.74	0.73	--	2.89	2.05	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
13	CO.016	14.7	1	16	35	240	450	2.0	20	26.4	1.31	8.3	1.7	89.3	0.68	0.78	0.81	2.00	1.41	21.7	G.C.Calib
13	CO.016	14.7	2	65	83	220	450	2.0	20	9.7	0.48	0.0		0.99.9	0.00	0.91	0.88	--	--	--	TCD weak.
13	CO.016	14.7	3	89	105	240	450	2.0	20	25.2	1.25	9.2	1.7	88.6	0.51	0.78	--	2.10	1.41	--	CH4 peaks
13	CO.016	14.7	4	134	155	240	450	1.0	20	10.9	0.81	1.2	0.7	97.7	0.32	0.84	0.86	--	--	--	are lower
13	CO.016	14.7	5	181	203	240	600	1.0	20	11.4	0.85	0.0	0.4	99.3	0.25	0.92	0.86	--	--	32.2	than
13	CO.016	14.7	6	210	226	240	450	2.0	20	22.7	1.12	3.8	1.9	93.7	0.46	0.79	--	2.37	1.41	--	expected.
14	CO.019	15.2	1	14	35	240	450	2.0	20	13.9	0.66	0.4	1.7	97.2	0.70	0.80	0.86	5.33	2.67	26.6	G.C.Calib
14	CO.019	15.2	2	66	83	220	450	2.0	20	3.8	0.18	0.0	1.7	96.7	1.56	0.88	--	--	--	--	New TCD
14	CO.019	15.2	3	88	105	240	450	2.0	20	12.2	0.57	0.0	2.0	96.3	1.67	0.80	--	5.60	3.80	--	
14	CO.019	15.2	4	133	155	240	450	1.0	20	--	--	--	--	--	0.85	--	--	--	--	--	Repair G.C
14	CO.019	15.2	5	169	178	240	600	1.0	20	5.9	0.41	0.0	1.5	96.1	2.42	0.80	--	8.50	13.00	--	Valve Leak
14	CO.019	15.2	6	193	203	240	450	2.0	20	10.2	0.48	0.8	2.2	95.0	1.96	0.79	--	4.80	3.40	--	CH4 peaks
14	CO.019	15.2	7	217	226	240	450	1.0	20	5.1	0.36	0.0	1.6	95.4	3.09	0.80	--	--	--	--	undetected
15	CO.005	14.7	1	25	35	240	450	2.0	20	27.1	1.34	7.9	1.6	89.7	0.82	0.79	0.82	2.30	1.38	23.1	G.C.Calib
15	CO.005	14.7	2	62	83	220	450	2.0	20	10.7	0.53	0.0	0.9	98.4	0.70	0.83	0.88	4.25	3.25	--	
15	CO.005	14.7	3	86	105	240	450	2.0	20	25.3	1.25	7.6	1.8	89.6	1.01	0.78	--	2.42	1.50	--	
15	CO.005	14.7	4	134	155	240	450	1.0	20	11.6	0.85	0.0	1.1	97.5	1.37	0.82	0.85	7.00	4.60	--	
15	CO.005	14.7	5	182	203	240	600	1.0	20	12.3	0.90	0.0	1.0	97.7	1.33	0.83	0.85	7.00	4.40	--	
15	CO.005	14.7	6	210	226	240	450	2.0	20	23.0	1.13	5.9	1.8	91.4	0.99	0.78	--	3.20	2.00	--	
16	CO.002	15.4	1	14	35	240	450	2.0	20	30.1	1.42	12.5	2.5	83.9	1.09	0.75	0.80	1.00	0.66	17.5	
16	CO.002	15.4	2	67	83	220	450	2.0	20	12.8	0.60	4.2	1.3	93.9	0.65	0.80	0.86	2.57	1.63	--	G.C.Calib
16	CO.002	15.4	3	91	107	240	450	2.0	20	28.2	1.34	17.3	2.9	78.8	0.99	0.71	--	0.93	0.65	--	
16	CO.002	15.4	4	136	155	240	450	1.0	20	12.6	0.89	4.4	1.6	92.8	1.21	0.79	0.84	4.43	2.88	--	
16	CO.002	15.4	5	182	198	240	600	1.0	20	13.1	0.92	3.6	1.4	93.9	1.12	0.81	0.84	4.29	2.75	25.2	
16	CO.002	15.4	6	209	227	240	450	2.0	20	25.6	1.22	17.4	3.1	78.7	0.83	0.71	--	1.00	0.66	--	
17	CO.025	15.6	1	21	35	240	450	2.0	20	26.6	1.24	10.7	2.1	86.4	0.82	0.76	0.82	2.25	1.47	21.7	G.C.Calib
17	CO.025	15.6	2	62	83	220	450	2.0	20	8.4	0.39	0.0	1.1	96.9	1.94	0.82	0.92	6.50	3.00	--	
17	CO.025	15.6	3	90	107	240	450	2.0	20	21.5	1.00	9.0	2.0	88.0	1.03	0.77	--	2.64	1.64	--	
17	CO.025	15.6	4	134	155	240	450	1.0	20	10.3	0.71	0.8	1.2	96.7	1.30	0.82	0.93	7.67	4.25	--	
17	CO.025	15.6	5	181	203	240	600	1.0	20	11.7	0.81	1.3	1.1	96.5	1.12	0.83	0.88	8.00	4.25	32.9	
17	CO.025	15.6	6	217	226	240	450	2.0	20	19.9	0.93	9.3	2.2	87.7	0.91	0.76	--	2.92	1.85	--	
18	CO.004	15.0	1	20	39	240	450	2.0	20	33.9	1.64	15.3	2.4	80.9	1.37	0.74	0.79	1.17	0.78	20.3	Repair G.C
18	CO.004	15.0	2	66	87	220	450	2.0	20	15.1	0.73	4.1	1.6	94.0	0.29	0.81	0.85	3.83	2.25	--	
18	CO.004	15.0	3	92	111	240	450	2.0	20	32.7	1.59	15.7	2.6	80.2	1.49	0.73	--	1.20	0.80	--	
18	CO.004	15.0	4	138	159	240	450	1.0	20	14.7	1.06	4.1	1.2	93.2	1.44	0.80	0.83	6.17	3.75	--	
18	CO.004	15.0	5	186	207	240	600	1.0	20	15.0	1.09	3.6	1.1	94.1	1.18	0.82	0.83	5.67	4.00	33.6	
18	CO.004	15.0	6	214	230	240	450	2.0	20	28.4	1.38	14.9	2.5	86.5	1.13	0.73	--	1.58	1.03	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefins C6-18,%	Comments
19	CO.021	15.6	1	16	35	240	450	2.0	20	23.2	1.08	9.4	2.0	88.0	0.73	0.77	0.82	2.56	1.54	20.3	
19	CO.021	15.6	2	62	83	220	450	2.0	20	8.3	0.38	0.0	1.3	98.2	0.51	0.82	0.88	4.33	3.33	--	
19	CO.021	15.6	3	90	107	240	450	2.0	20	21.8	1.02	10.2	2.2	86.7	0.95	0.76	--	2.50	1.53	--	
19	CO.021	15.6	4	134	155	240	450	1.0	20	9.9	0.69	1.7	1.6	95.5	1.41	0.81	0.83	6.00	3.80	--	
19	CO.021	15.6	5	182	203	240	600	1.0	20	11.5	0.80	1.8	1.2	95.8	1.16	0.83	0.85	6.50	3.80	30.8	
19	CO.021	15.6	6	210	226	240	450	2.0	20	19.9	0.93	9.6	2.3	87.2	0.95	0.76	--	2.31	1.38	--	
20	CO.041	15.8	1	17	37	240	450	2.0	20	25.3	1.16	11.0	2.1	86.0	0.88	0.76	0.84	2.94	1.61	20.3	
20	CO.041	15.8	2	66	75	220	450	2.0	20	9.1	0.41	0.0	1.5	97.8	0.65	0.82	0.91	8.00	2.75	--	
20	CO.041	15.8	3	90	109	240	450	2.0	20	26.3	1.21	9.5	1.9	87.8	0.82	0.78	--	2.81	1.71	--	
20	CO.041	15.8	4	136	148	240	450	1.0	20	12.7	0.88	1.9	1.2	95.9	0.95	0.83	0.86	9.00	4.20	--	
20	CO.041	15.8	5	169	178	240	600	1.0	20	13.2	0.91	2.0	1.0	96.1	0.93	0.84	--	7.00	3.50	--	
20	CO.041	15.8	6	193	203	240	450	2.0	20	24.6	1.13	9.4	1.8	87.9	0.92	0.78	--	2.93	1.75	--	
21	CO.014	15.1	1	24	38	240	450	2.0	20	8.5	0.40	8.3	3.5	85.8	2.43	0.74	0.83	2.75	1.67	17.5	G.C.Calib
21	CO.014	15.1	2	68	86	220	450	2.0	20	3.2	0.15	0.0	2.3	93.4	4.31	0.76	0.86	3.50	3.00	--	
21	CO.014	15.1	3	93	110	240	450	2.0	20	7.1	0.34	8.7	3.0	85.9	2.46	0.71	--	3.00	2.00	--	
21	CO.014	15.1	4	138	157	240	450	1.0	20	2.2	0.15	0.0	2.8	89.3	7.92	0.67	0.84	9.00	4.00	--	
21	CO.014	15.1	5	186	206	240	600	1.0	20	2.1	0.15	0.0	2.6	94.8	2.68	0.71	0.81	4.50	3.50		
22	CO.040	14.5	1	19	32	240	450	2.0	20	1.8	0.09	0.0	4.0	94.1	1.89	0.71	0.82	2.50	2.00	--	G.C.Calib
22	CO.040	14.5	2	43	63	220	450	2.0	20	0.7	0.03	0.0	0.7	97.1	2.17	0.91	--	1.00	2.00	--	Shut down
23	CO.047	15.8	1	21	39	240	450	2.0	20	28.2	1.29	7.7	1.5	89.3	1.47	0.79	0.84	3.14	1.69	24.5	
23	CO.047	15.8	2			220	450	2.0	20	--	--	--	--	--	--	--	--	--	--	--	Repair G.C
23	CO.047	15.8	3	94	111	240	450	2.0	20	25.6	1.17	8.9	1.5	88.2	1.38	0.78	--	3.15	2.00	--	
23	CO.047	15.8	4	141	159	240	450	1.0	20	11.9	0.81	2.9	0.9	94.1	2.13	0.82	0.88	7.33	4.75	--	
23	CO.047	15.8	5	187	207	240	600	1.0	20	11.8	0.81	2.6	0.8	94.6	2.01	0.82	0.87	7.00	3.60		
23	CO.047	15.8	6	215	226	240	450	2.0	20	24.0	1.10	10.7	1.9	85.7	1.71	0.75	--	3.54	2.13	--	
24	CO.049	15.6	1	19	39	240	450	2.0	20	30.6	1.41	10.9	1.8	85.7	1.66	0.76	0.82	2.09	1.30	14.0	
24	CO.049	15.6	2	71	87	220	450	2.0	20	12.0	1.07	2.7	0.9	95.3	1.09	0.81	0.95	4.25	3.25	--	
24	CO.049	15.6	3	95	111	240	450	2.0	20	29.5	1.37	9.5	1.6	87.6	1.30	0.78	--	2.32	1.40	--	
24	CO.049	15.6	4	139	159	240	450	1.0	20	12.6	0.87	3.1	1.0	94.1	1.80	0.81	0.86	8.33	4.20	--	
24	CO.049	15.6	5	187	207	240	600	1.0	20	13.4	0.93	2.6	0.9	94.8	1.68	0.82	0.88	8.33	4.20	37.8	
24	CO.049	15.6	6	211	231	240	450	2.0	20	24.9	1.16	10.4	1.7	86.5	1.36	0.76	--	2.75	1.75	--	
25	CO.047	15.6	1	19	33	240	450	2.0	20	28.1	1.30	8.8	1.6	88.1	1.50	0.78	0.85	2.93	1.88	25.9	Repeat R23
25	CO.047	15.6	2	55	69	220	450	2.0	20	7.4	0.34	1.5	1.2	96.3	1.02	0.76	0.89	3.00	4.67	--	
25	CO.047	15.6	3	93	159	240	450	2.0	20	25.6	1.19	8.9	1.6	87.9	1.48	0.77	--	3.14	2.00	--	
25	CO.047	15.6	4	143	159	240	450	1.0	20	10.8	0.75	3.0	1.0	94.2	1.84	0.81	0.94	8.00	4.75	--	
25	CO.047	15.6	5	189	207	240	600	1.0	20	12.4	0.86	2.2	0.8	95.6	1.39	0.83	0.86	7.33	4.50	36.4	
25	CO.047	15.6	6	215	231	240	450	2.0	20	23.2	1.08	9.6	1.7	87.4	1.28	0.77	--	3.50	2.07	--	
26	CO.031	15.9	1	19	39	240	450	2.0	20	30.9	1.41	12.1	1.9	84.9	1.12	0.75	0.83	1.83	1.14	22.4	
26	CO.031	15.9	2	67	87	220	450	2.0	20	13.6	0.62	3.9	0.9	94.6	0.49	0.80	0.85	4.20	2.67	--	
26	CO.031	15.9	3	93	111	240	450	2.0	20	29.5	1.35	12.2	2.1	84.6	1.15	0.75	--	1.97	1.25	--	
26	CO.031	15.9	4	141	159	240	450	1.0	20	12.9	0.88	3.6	1.1	94.3	1.11	0.80	0.88	7.75	4.00	--	
26	CO.031	15.9	5	189	207	240	600	1.0	20	13.9	0.95	3.5	1.0	94.4	1.12	0.81	0.85	6.80	3.71	30.1	
26	CO.031	15.9	6	221	230	240	450	2.0	20	26.6	1.22	12.0	2.2	84.9	0.96	0.74	--	2.30	1.43	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using H2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
27	CO.029	15.9	1	23	39	240	450	2.0	20	28.3	1.27	8.3	1.6	87.9	2.21	0.77	0.84	3.40	2.20	27.3	
27	CO.029	15.9	2	71	87	220	450	2.0	20	9.5	0.43	1.7	1.1	96.0	1.23	0.80	0.89	5.67	3.00	--	
27	CO.029	15.9	3	99	111	240	450	2.0	20	25.7	1.16	7.7	1.6	88.8	1.86	0.78	--	4.00	2.36	--	
27	CO.029	15.9	4	150	159	240	450	1.0	20	12.0	0.82	1.9	0.9	95.4	1.88	0.83	0.90	8.33	4.75	--	
27	CO.029	15.9	5	191	207	240	600	1.0	20	12.1	0.82	1.7	0.9	95.6	1.75	0.83	0.89	7.67	4.75	39.9	
27	CO.029	15.9	6	222	230	240	450	2.0	20	23.7	1.08	8.2	1.7	88.5	1.60	0.78	--	3.92	2.67	--	
28	COW.01	15.0	1	19	36	240	450	2.0	20	1.1	0.05	0.0	12.	83.9	4.23	0.58	--	3.33	2.50	--	Shut down
29	CO.053	25.2	1	21	39	240	450	2.0	20	42.0	1.19	15.8	2.3	79.5	2.42	0.73	--	1.00	0.67	17.5	
29	CO.053	25.2	2	71	87	220	450	2.0	20	20.5	0.59	5.7	4.8	89.0	0.50	0.79	0.84	3.38	2.10	--	
29	CO.053	25.2	3	95	111	240	450	2.0	20	39.2	1.13	15.8	2.9	79.2	2.09	0.72	--	1.11	0.74	--	
29	CO.053	25.2	4	143	159	240	450	1.0	20	18.4	0.79	5.3	2.6	90.6	1.52	0.80	0.84	5.86	3.56	--	
29	CO.053	25.2	5	191	207	240	600	1.0	20	19.7	0.85	4.6	1.2	92.9	1.34	0.82	--	5.71	3.44	33.6	
29	CO.053	25.2	6	239	255	240	600	2.0	20	40.8	1.17	14.8	2.1	81.4	1.68	0.75	0.80	1.10	0.74	--	
29	CO.053	25.2	7	303	304	240	450	2.0	20	31.5	0.45	21.0	3.9	72.2	2.93	0.63	--	1.34	0.97	--	G.C.Repair
29	CO.053	25.2	8	332	351	260	450	2.0	20	31.0	0.44	36.4	5.3	52.6	5.74	0.52	--	2.60	1.75	--	
29	CO.053	25.2	9	375	376	240	450	2.0	20	18.0	0.55	23.0	3.5	72.1	1.46	0.66	--	3.21	2.05	--	
29	CO.053	25.2	10	415	423	240	450	2.0	20	21.6	0.98	14.4	2.5	82.4	0.82	0.72		2.87	1.79		G.C.Repair
30	CO.053	29.6	1	26	39	240	450	2.0	20	41.8	1.02	22.6	2.9	71.5	3.05	0.66		0.99	0.65	19.6	
30	CO.053	29.6	2	55	63	260	450	2.0	20	46.9	1.11	40.6	5.5	46.0	7.98	0.45		0.83	0.64		
30	CO.053	29.6	3	79	87	280	450	2.0	20	41.4	0.96	41.9	6.5	42.0	9.63	0.40		2.06	1.35		
30	CO.053	29.6	4	103	111	240	450	2.0	20	19.9	0.49	19.2	3.6	75.8	1.45	0.64	--	4.29	2.50	--	
30	CO.053	29.6	5	131	135	265	450	2.0	20	36.4	0.89	36.4	5.2	54.4	4.04	0.53	--	2.45	1.60	--	
30	CO.053	29.6	6	154	159	280	450	2.0	20	39.6	0.96	48.3	5.9	39.0	6.84	0.40	--	2.44	1.62	--	
30	CO.053	29.6	7	174	183	300	450	2.0	20	40.7	0.94	42.4	6.8	40.7	10.2	0.47	--	3.11	2.03	--	
30	CO.053	29.6	8	198	207	309	450	2.0	20	38.3	0.85	22.8	7.3	58.3	11.6	0.62	--	3.76	2.48	--	G.C.Calib
30	CO.053	29.6	9	220	231	310	450	2.0	20	37.5	0.87	55.5	7.2	25.5	11.8	0.13	--	3.93	2.67	--	
30	CO.053	29.6	10	242	254	320	450	2.0	20	40.8	0.90	61.7	7.4	14.5	16.4	0.00	--	3.62	2.63	--	
30	CO.053	29.6	11	270	279	320	450	1.0	20	30.8	0.92	42.9	6.0	26.9	24.2	0.30	--	5.68	4.28	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfld cc/hr	Conv. %	Prod. Rate	Selectivity %CH4	%C2H6	%C3+	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-C18,%	Comments
31	Co.055	15.0	1	23	39	240	450	2.0	20	30.0	1.46	23.7	3.73	70.2	0.61	0.81	0.90	0.60	20.3	
31	Co.055	15.0	2	71	87	220	450	2.0	20	9.1	0.44	10.6	2.53	85.7	0.61	0.85	2.89	1.80	--	
31	Co.055	15.0	3	98	110	240	450	2.0	20	25.8	1.26	23.9	3.94	70.1	0.58	--	1.06	0.70	--	
31	Co.055	15.0	4	143	159	240	450	1.0	20	14.7	1.06	5.5	1.44	91.7	0.78	0.83	5.71	3.22	--	
31	Co.055	15.0	5	196	207	240	600	1.0	20	16.1	1.16	4.7	1.21	92.8	0.80	0.83	6.17	3.11	33.6	
31	Co.055	15.0	6	222	234	240	450	2.0	20	29.1	1.42	18.0	2.84	77.8	0.69	--	1.40	0.91	--	
32	Co.044	16.4	1	23	39	240	450	2.0	20	20.9	0.93	6.7	1.91	90.8	0.77	0.83	3.42	2.17	23.1	
32	Co.044	16.4	2	71	87	220	450	2.0	20	10.3	0.46	0.0	0.92	98.8	0.85	--	4.33	4.50	--	
32	Co.044	16.4	3	102	110	240	450	2.0	20	21.8	0.97	6.4	1.72	91.3	0.79	--	3.00	1.77	--	
32	Co.044	16.4	4	143	159	240	450	1.0	20	9.87	0.25	2.1	3.19	92.5	0.61	0.87	7.33	4.00	--	
32	Co.044	16.4	5	174	182	240	450	2.0	20	20.2	0.89	6.8	1.85	90.8	0.79	--	2.92	1.75	--	
33	Co.053	31.4	1	24	39	240	450	2.0	20	41.4	0.94	23.2	3.14	69.6	0.65	0.76	0.82	0.58	21.7	G.C.Calib
33	Co.053	31.4	2	54	63	240	300	2.0	20	35.2	0.47	29.9	3.93	59.6	0.55	--	0.89	0.70	--	
33	Co.053	31.4	3	78	87	240	300	2.0	20	38.7	0.38	31.1	3.90	57.5	0.54	--	0.97	0.71	--	
33	Co.053	31.4	4	102	111	250	300	2.0	20	39.6	0.38	43.1	4.60	41.1	0.38	--	0.99	0.77	--	
33	Co.053	31.4	5	126	135	260	300	2.0	20	37.7	0.37	42.1	4.59	42.4	0.42	--	1.76	1.21	--	
33	Co.053	31.4	6	150	159	260	450	2.0	20	45.0	0.44	43.2	4.80	40.9	0.44	--	1.35	0.95	--	
33	Co.053	31.4	7	174	183	260	450	2.0	20	45.7	0.73	46.4	4.63	40.2	0.43	--	1.06	0.77	--	
33	Co.053	31.4	8	198	207	260	450	2.0	20	49.2	0.98	44.4	4.26	43.5	0.51	--	0.87	0.65	--	
33	Co.053	31.4	9	222	230	240	450	2.0	20	16.1	0.38	33.7	4.79	59.2	0.35	--	3.14	1.91	--	
34	Co.060	15.6	1	23	32	240	450	2.0	20	31.4	1.46	14.0	2.34	82.2	0.75	0.79	1.61	1.00	23.1	G.C.Calib
34	Co.060	15.6	2	71	87	220	450	2.0	20	13.0	0.60	0.1	1.77	97.8	0.81	0.88	4.00	2.83	--	G.C.Calib
34	Co.060	15.6	3	102	111	240	450	2.0	20	28.8	1.34	14.1	2.40	82.2	0.73	--	1.87	1.17	--	
34	Co.060	15.6	4	150	157	240	450	1.0	20	13.5	0.94	4.3	1.75	92.5	0.77	0.85	7.00	4.67	--	
34	Co.060	15.6	5	191	207	240	600	1.0	20	12.8	0.89	2.2	1.64	94.9	0.82	0.86	6.60	4.33	38.5	G.C.Calib
34	Co.060	15.6	6	222	230	240	450	2.0	20	24.9	1.16	13.8	2.78	82.2	0.74	--	2.73	1.73	--	
35	Co.041	26.0	1	23	39	240	450	2.0	20	35.7	1.00	13.6	2.13	82.9	0.79	0.82	1.09	0.74	18.2	
35	Co.041	26.0	2	54	63	250	450	2.0	20	42.1	1.17	27.3	4.61	64.4	0.65	--	0.49	0.41	--	G.C.Calib
35	Co.041	26.0	3	78	87	260	450	2.0	20	45.1	1.24	41.7	6.83	44.9	0.51	--	0.35	0.37	--	
35	Co.041	26.0	4	102	111	260	450	2.0	20	46.7	0.77	39.1	4.55	49.9	0.56	--	0.66	0.52	--	
35	Co.041	26.0	5	126	135	260	450	2.0	20	49.6	0.61	39.4	4.02	49.6	0.57	--	0.70	0.52	--	
35	Co.041	26.0	6	150	159	260	450	2.0	20	47.9	0.95	33.1	3.93	58.7	0.64	--	0.75	0.52	--	
35	Co.041	26.0	7	174	183	260	450	2.0	20	49.7	1.24	30.9	4.38	61.3	0.66	--	0.71	0.49	--	
35	Co.041	26.0	8	198	206	240	450	2.0	20	19.6	0.55	17.3	2.64	79.1	0.71	--	2.08	1.63	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
)Conversion is total CO conversion over the period (%).
)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
)Alpha: Based on GC analysis of offgas and liquid product.

un	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
36	Co.032	15.9	1	23	39	240	450	2.0	20	24.0	1.10	9.1	1.8	88.2	0.83	0.77	0.83	3.23	2.00	25.2	
36	Co.032	15.9	2	71	87	220	450	2.0	20	7.7	0.35	0.0	1.5	97.8	0.77	0.81	0.91	4.00	3.33	--	
36	Co.032	15.9	3	102	111	240	450	2.0	20	21.1	0.97	8.7	2.4	88.2	0.68	0.78	--	3.08	1.86	--	G.C.Calib
36	Co.032	15.9	4	126	135	240	450	1.0	20	9.5	0.65	1.4	1.2	96.5	0.87	0.83	--	7.67	4.50	--	
36	Co.032	15.9	5	150	159	240	450	2.0	20	18.2	0.83	8.9	1.6	88.9	0.64	0.78	--	3.36	2.36	--	
36	Co.032	15.9	6	174	183	250	450	2.0	20	23.3	1.07	14.5	3.0	81.6	1.01	0.73	--	2.29	1.48	--	
36	Co.032	15.9	7	199	207	260	450	2.0	20	25.3	1.17	23.5	3.8	71.2	1.51	0.61	--	1.76	1.15	--	G.C.Calib
36	Co.032	15.9	8	222	230	240	450	2.0	20	11.0	0.51	10.4	2.9	85.9	0.88	0.67	--	3.33	2.33	--	
37	Co.045	15.9	1	23	39	240	450	2.0	20	14.8	0.67	8.0	1.7	89.4	0.91	0.76	0.84	2.78	1.90	20.3	
37	Co.045	15.9	2	54	63	220	450	2.0	20	5.1	0.23	0.0	1.5	97.7	0.77	0.80	0.88	4.00	3.00	--	
37	Co.045	15.9	3	78	87	240	450	2.0	20	13.8	0.63	8.2	1.9	89.0	0.89	0.76	--	3.00	1.80	--	
37	Co.045	15.9	4	102	111	240	450	1.0	20	6.5	0.44	0.1	1.4	97.3	1.16	0.82	--	5.00	2.00	--	
37	Co.045	15.9	5	126	135	240	450	2.0	20	13.4	0.61	0.6	1.8	88.9	0.80	0.79	--	2.00	0.00	--	
37	Co.045	15.9	6	150	159	250	450	2.0	20	19.6	0.91	17.5	2.5	80.0	--	0.77	--	--	0.00	--	G.C.Calib
37	Co.045	15.9	7	174	183	260	450	2.0	20	27.4	1.26	30.1	5.2	62.2	2.49	0.61	--	0.83	0.60	--	
37	Co.045	15.9	8	198	207	240	450	2.0	20	13.7	0.63	9.3	1.7	87.4	0.78	0.75	--	2.67	1.67	--	
38	Co.058	15.9	1	23	39	240	450	2.0	20	28.0	1.28	11.9	2.1	85.1	0.91	0.75	0.85	1.88	1.17	22.4	
38	Co.058	15.9	2	47	63	220	450	2.0	20	11.7	0.54	1.4	1.4	96.9	0.38	0.81	--	4.00	3.00	--	
38	Co.058	15.9	3	74	88	240	450	2.0	20	12.7	0.87	3.2	1.3	94.5	1.01	0.81	--	7.25	4.40	--	
38	Co.058	15.9	4	96	111	240	450	2.0	20	26.4	1.21	11.9	2.2	85.0	0.87	0.74	--	2.09	1.26	--	
39	Co.064	15.9	1	23	39	240	450	2.0	20	34.2	1.56	13.6	2.3	82.6	1.55	0.73	0.85	1.40	0.92	21.0	G.C.CALIB
39	Co.064	15.9	2	47	62	220	450	2.0	20	15.0	0.68	4.6	1.2	93.8	0.44	0.78	--	4.17	2.38	--	
39	Co.064	15.9	3	71	87	240	450	2.0	20	15.9	1.09	4.7	1.2	92.9	1.28	0.80	--	7.86	3.88	--	
39	Co.064	15.9	4	95	111	240	450	2.0	20	33.1	1.52	15.7	2.6	80.3	1.52	0.72	--	1.37	0.90	--	

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-C18,%	Comments
29	Co.053	25.2	1	21	39	240	450	2.0	20	42.0	1.19	15.8	2.3	79.5	2.42	0.73	--	1.00	0.67	17.5	
29	Co.053	25.2	2	71	87	220	450	2.0	20	20.5	0.59	5.7	4.8	89.0	0.50	0.79	0.84	3.38	2.10	--	
29	Co.053	25.2	3	95	111	240	450	2.0	20	39.2	1.13	15.8	2.9	79.2	2.09	0.72	--	1.11	0.74	--	
29	Co.053	25.2	4	143	159	240	450	1.0	20	18.4	0.79	5.3	2.6	90.6	1.52	0.80	0.84	5.86	3.56	33.6	
29	Co.053	25.2	5	191	207	240	600	1.0	20	19.7	0.85	4.6	1.2	92.9	1.34	0.82	0.85	5.71	3.44	--	
29	Co.053	25.2	6	239	255	240	600	2.0	20	40.8	1.17	14.8	2.1	81.4	1.68	0.75	0.80	1.10	0.74	--	
29	Co.053	25.2	7	303	304	240	450	2.0	20	31.5	0.45	21.0	3.9	72.2	2.93	0.63	--	1.34	0.97	--	G.C.Repair
29	Co.053	25.2	8	332	351	260	450	2.0	20	31.0	0.44	36.4	5.3	52.6	5.74	0.52	--	2.60	1.75	--	
29	Co.053	25.2	9	375	376	240	450	2.0	20	18.0	0.55	23.0	3.5	72.1	1.46	0.66	--	3.21	2.05	--	
29	Co.053	25.2	10	415	423	240	450	2.0	20	21.6	0.98	14.4	2.5	82.4	0.82	0.72	0.79	2.87	1.79	25.9	G.C.Repair

Feed Gas Rates

Per No	N2 SLH	H2 SLH	CO SLH	Total SLH
1	565	225	112	902
2	565	225	112	902
3	565	225	112	902
4	565	169	169	903
5	565	169	169	903
6	565	225	112	902
7	733	112	56	901
8	733	112	56	901
9	551	234	117	912
10	367	348	175	890

Table I
(Continued)

SUMMARY OF M3 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-C18,%	Comments
33	Co.053	31.4	1	24	39	240	450	2.0	20	41.4	0.94	23.2	3.1	69.6	4.06	0.65	0.76	0.82	0.58	21.7	G.C.Calib
33	Co.053	31.4	2	54	63	240	300	2.0	20	35.2	0.47	29.9	3.9	59.6	6.57	0.55	--	0.89	0.70	--	
33	Co.053	31.4	3	78	87	240	300	2.0	20	38.7	0.38	31.1	3.9	57.5	7.48	0.54	--	0.97	0.71	--	
33	Co.053	31.4	4	102	111	250	300	2.0	20	39.6	0.38	43.1	4.6	41.1	11.3	0.38	--	0.99	0.77	--	
33	Co.053	31.4	5	126	135	260	300	2.0	20	37.7	0.37	42.1	4.6	42.4	10.9	0.42	--	1.76	1.21	--	
33	Co.053	31.4	6	150	159	260	450	2.0	20	45.0	0.44	43.2	4.8	40.9	11.1	0.44	--	1.35	0.95	--	
33	Co.053	31.4	7	174	183	260	450	2.0	20	45.7	0.73	46.4	4.6	40.2	8.77	0.43	--	1.06	0.77	--	
33	Co.053	31.4	8	198	207	260	450	2.0	20	49.2	0.98	44.4	4.3	43.5	7.84	0.51	--	0.87	0.65	--	
33	Co.053	31.4	9	222	230	240	450	2.0	20	16.1	0.38	33.7	4.8	59.2	2.24	0.35	--	3.14	1.91	--	

Feed Gas Rates

Per No	N2 SLH	H2 SLH	CO SLH	Total SLH
1	563	225	112	900
2	338	135	67	540
3	250	100	50	400
4	250	100	50	400
5	250	100	50	400
6	250	100	50	400
7	160	160	80	400
8	100	200	100	400
9	563	225	112	900

Table II

COMPARISON OF CONVERSION AND SELECTIVITY OF

METHANE REDUCTION CATALYSTS AT STARTUP CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

a) Total flow is ca. 15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-563 SLH, H2-225 SLH, CO-112.5 SLH.
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C+1 (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Catalyst Prom%	Composit. Metal%	Suppt
M-3	SBCR												
5	CO.003	15.1	31.7	1.53	16.7	2.4	79.8	1.16	0.71	--	1.0La	0.5Ru	Al
6	CO.011	15.3	14.3	0.67	7.6	1.6	89.4	1.42	0.78	0.83	0.0	0.0	Si
7	CO.012	15.8	13.9	0.63	6.1	1.5	90.6	1.74	0.80	0.89	0.0	0.0	Si
8	CO.015	15.0	28.3	1.37	12.7	2.0	84.1	1.24	0.76	0.80	1.0La	0.43Ru	Al
9	CO.011	15.0	18.5	0.89	8.8	1.7	88.8	0.77	0.78	0.83	0.0	0.0	Si
11	CO.017	15.0	27.2	1.32	11.2	1.8	85.9	1.14	0.77	0.80	1.0La	0.5Ru	Al
12	CO.018	15.6	33.8	1.56	9.7	2.0	86.6	1.68	0.75	0.85	0.0	0.5Ru	Al
13	CO.016	14.7	26.4	1.31	(1)	1.7	89.3	0.68	0.78	0.81	1.0La	0.43Ru	Al
14	CO.019	15.2	13.9	0.66	(2)	1.7	97.2	0.70	0.80	0.86	0.0	0.5Ru	Si
15	CO.005	14.7	27.1	1.34	7.9	1.6	89.7	0.82	0.79	0.82	0.0	0.0	Al
16	CO.002	15.4	30.1	1.42	12.5	2.5	83.9	1.09	0.75	0.80	1.0La	0.43Ru	Al
17	CO.025	15.6	26.6	1.24	10.7	2.1	86.4	0.82	0.76	0.82	8.5Zr	0.0	Si
18	CO.004	15.0	33.9	1.64	15.3	2.4	80.9	1.37	0.74	0.79	1.0La	0.43Ru	Al
19	CO.021	15.6	23.2	1.08	9.4	2.0	88.0	0.73	0.77	0.82	0.7Zr	0.0	Si
20	CO.041	15.8	25.3	1.16	11.0	2.1	86.0	0.88	0.76	0.84	8.5Zr	0.5Ru	Si
21	CO.014	15.1	8.5	0.40	8.3	3.5	85.8	2.43	0.74	0.83	0.0	0.5Ru	Ti
22	CO.040	14.5	1.8	0.09	0.0	4.0	94.1	1.89	0.71	0.82	0.0	0.0	Ti
23	CO.047	15.8	28.2	1.29	7.7	1.5	89.3	1.47	0.79	0.84	0.3K	0.5Ru	Al
24	CO.049	15.6	30.6	1.41	10.9	1.8	85.7	1.66	0.76	0.82	0.1K	0.5Ru	Al
25	CO.047	15.6	28.1	1.30	8.8	1.6	88.1	1.50	0.78	0.85	0.3K	0.5Ru	Al
26	CO.031	15.9	30.9	1.41	12.1	1.9	84.9	1.12	0.75	0.83	1.4Zr	0.0	Al
27	CO.029	15.9	28.3	1.27	8.3	1.6	87.9	2.21	0.77	0.84	0.5K	0.5Ru	Al
28	COW.01	15.0	1.1	0.05	0.0	12.	83.9	4.23	0.58	--	5.0Cu	10.0Zn	Al
29	CO.053	25.2	42.0	1.19	15.8	2.3	79.5	2.42	0.73	--	0.0	0.5Ru	Al
30	CO.053	29.6	41.8	1.02	22.6	2.9	71.5	3.05	0.66	0.77	0.0	0.5Ru	Al
31	CO.055	15.0	30.0	1.46	23.7	3.7	70.2	2.30	0.61	0.81	1.0La	1.0Re	Al
32	CO.044	16.4	20.9	0.93	6.7	1.9	90.8	0.56	0.77	0.83	15Zr	0.0	Si
33	CO.053	31.4	41.4	0.94	23.2	3.1	69.6	4.06	0.65	0.76	0.0	0.5Ru	Al
34	CO.060	15.6	31.4	1.46	14.0	2.3	82.2	1.48	0.75	0.79	0.0	0.0	Al

Note: Catalyst Run 9 screened thru 170 x 400 mesh.
Catalysts For Runs 11 through 28 (except Runs 21 and 22) screened thru 150x 400 mesh.
Catalysts for Runs 21 and 22 screened thru 100 x 400 mesh.
Catalysts Nos. Co.029 and Co.060 contained 30 wt% cobalt.

G.C. Problems
(1) Weak TCD filaments in G.C. CH4 peaks smaller than expected.
(2) Internal valve in G.C. leaked. CH4 peak undetected.

Table II
(Continued)

DATE: 03/31/95

M3 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-563 SLH, H2-225 SLH, CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons, C1+ (kg/kg cat.,hr)
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %C1	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%
35	Co.041	26.0	35.7	1.00	13.6	2.1	82.9	1.4	0.79	0.76	1.09	0.74	18.2
36	C0.032	15.9	24.0	1.10	9.1	1.8	88.2	0.8	0.77	0.83	3.23	2.00	25.2
37	Co.045	15.9	14.8	0.67	8.0	1.7	89.4	0.9	0.76	0.84	2.78	1.90	20.3
38	Co.058	15.9	28.0	1.28	11.9	2.1	85.1	0.9	0.75	0.85	1.88	1.17	22.4
39	Co.064	15.9	34.2	1.56	13.6	2.3	82.6	1.6	0.73	0.85	1.40	0.92	21.0

Note: All catalysts were screened thru 150 x 400 mesh.

Table III

M3 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
2	220 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-563 SLH, H2-225 SLH, CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons, C1+ (kg/kg cat.,hr)
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefin C6-18,
5	CO.003	15.1	13.2	0.63	5.1	1.0	93.4	0.5	0.82	0.90	4.55	1.89	--
6	CO.011	15.3	5.1	0.23	0.0	0.0	97.2	2.8	0.87	0.82	--	--	--
7	CO.012	15.8	5.1	0.23	0.0	0.2	97.8	2.0	0.89	0.90	--	2.50	--
8	CO.015	15.0	11.5	0.56	4.4	1.0	93.9	0.8	0.81	0.89	3.60	2.14	--
9	CO.011	15.0	6.3	0.31	0.0	1.0	98.6	0.4	0.88	0.93	12.00	1.80	--
11	CO.017	15.0	11.4	0.55	5.0	0.0	94.8	0.2	0.88	0.90	5.00	3.20	--
12	CO.018	15.6	12.6	0.59	2.8	0.0	97.1	0.1	0.90	0.88	--	--	--
13	CO.016	14.7	9.7	0.48	(1)	0.1	99.9	0.0	0.91	0.88	--	--	--
14	CO.019	15.2	3.8	0.18	(2)	1.7	96.7	1.6	0.88	--	--	--	--
15	CO.005	14.7	10.7	0.53	0.0	0.9	98.4	0.7	0.83	0.88	4.25	3.25	--
16	CO.002	15.4	12.8	0.60	4.2	1.3	93.9	0.7	0.80	0.86	2.57	1.63	--
17	CO.025	15.6	8.4	0.39	0.0	1.1	96.9	1.9	0.82	0.92	6.50	3.00	--
18	CO.004	15.0	15.1	0.73	4.1	1.6	94.0	0.3	0.81	0.85	3.83	2.25	--
19	CO.021	15.6	8.3	0.38	0.0	1.3	98.2	0.5	0.82	0.88	4.33	3.33	--
20	CO.041	15.8	9.1	0.41	0.0	1.5	97.8	0.7	0.82	0.91	8.00	2.75	--
21	CO.014	15.1	3.2	0.15	0.0	2.3	85.8	4.3	0.76	0.86	3.50	3.00	--
22	CO.040	14.5	0.7	0.35	0.0	0.7	97.1	2.2	0.91	--	1.00	2.00	--
23	CO.047	15.8	---	---	(3)	---	----	---	----	----	----	----	--
24	CO.049	15.6	12.0	1.07	2.7	0.9	95.3	1.1	0.81	0.95	4.25	3.25	--
25	CO.047	15.6	7.4	0.34	1.5	1.2	96.3	1.0	0.76	0.89	3.00	4.67	--
26	CO.031	15.9	13.6	0.62	3.9	0.9	94.6	0.5	0.80	0.85	4.20	2.67	--
27	CO.029	15.9	9.5	0.43	1.7	1.1	96.0	1.2	0.80	0.89	5.67	3.00	--
29	CO.053	25.2	20.5	0.59	5.7	4.8	89.0	0.5	0.79	0.84	3.38	2.10	--
31	CO.055	15.0	9.1	0.44	10.6	2.5	85.7	1.1	0.61	0.85	2.89	1.80	--
32	CO.044	16.4	10.3	0.46	0.0	0.9	98.8	0.3	0.85	--	4.33	4.50	--
34	CO.060	15.6	13.0	0.60	0.1	1.8	97.8	0.4	0.81	0.88	4.00	2.83	--

Note: Catalyst Run 9 screened thru 170 x 400 mesh.
Catalysts for Runs 11 thru 27 (except Runs 21 and 22) screened through 150 x 400 mesh.
Catalysts for Runs 21 and 22 screened thru 100 x 400.

(1) Weak TCD filaments in G.C. CH4 peaks smaller than expected.
(2) Internal valve in G.C. leaked. CH4 peak undetected.
(3) Replaced dual column restrictor valve.

Table III
(Continued)

DATE: 03/31/95

M3 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
2	220 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-563 SLH, H2-225 SLH, CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons, C1+ (kg/kg cat.,hr)
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefin C6-18,
36	Co.032	15.9	7.7	0.35	0.0	1.5	97.8	0.77	0.81	0.91	4.00	3.33	--
37	Co.045	15.9	5.1	0.23	0.0	1.5	97.7	0.77	0.80	0.88	4.00	3.00	--
38	Co.058	15.9	11.7	0.54	1.4	1.4	96.9	0.38	0.81	--	4.00	3.00	--
39	Co.064	15.9	15.0	0.68	4.6	1.2	93.8	0.44	0.78	--	4.17	2.38	--

Note: All catalysts were screened thru 150 x 400 mesh.

Table IV DATE: 12/30/94

M3 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
4	240 C	450psi	1.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-562 SLH, H2-119 SLH, CO-119 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons, C1+ (kg/kg cat.,hr)
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefin C6-18,
5	CO.003	15.1	13.1	0.95	4.2	1.2	93.3	1.2	0.83	0.88	6.67	3.70	--
6	CO.011	15.3	6.3	0.44	0.4	1.0	95.5	3.1	0.82	0.88	--	--	--
7	CO.012	15.8	3.9	0.26	4.8	2.3	86.3	6.6	0.70	0.85	16.00	3.50	--
8	CO.015	15.0	11.5	0.83	4.8	1.2	92.5	1.5	0.80	0.85	5.60	3.29	--
9	CO.011	15.0	8.0	0.58	1.3	1.3	96.3	1.2	0.82	0.87	7.00	2.83	--
11	CO.017	15.0	11.6	0.84	5.0	0.0	93.9	1.2	0.82	0.86	25.00	2.88	--
12	CO.018	15.6	12.4	0.86	3.3	0.0	95.0	1.7	0.80	0.86	--	--	--
13	CO.016	14.7	10.9	0.81	(1)	0.8	97.7	0.3	0.84	0.86	--	--	--
14	CO.019	15.2	--	--	(2)	-	--	--	0.80	--	--	--	--
15	CO.005	14.7	11.6	0.85	0.0	1.1	97.5	1.4	0.82	0.85	7.00	4.60	--
16	CO.002	15.4	12.6	0.89	4.4	1.6	92.8	1.2	0.79	0.84	4.43	2.88	--
17	CO.025	15.6	10.3	0.71	0.8	1.2	96.7	1.3	0.82	0.93	7.67	4.25	--
18	CO.004	15.0	14.7	1.06	4.1	1.2	93.2	1.4	0.80	0.83	6.17	3.75	--
19	CO.021	15.6	9.9	0.69	1.7	1.4	95.5	1.4	0.81	0.83	6.00	3.80	--
20	CO.041	15.8	12.7	0.88	1.9	1.2	95.9	1.0	0.83	0.86	9.00	4.20	--
21	CO.014	15.1	2.2	0.15	0.0	2.8	89.3	7.9	0.67	0.84	9.00	4.00	--
23	CO.047	15.8	11.9	0.81	2.9	0.9	94.1	2.1	0.82	0.88	7.33	4.75	--
24	CO.049	15.6	12.6	0.87	3.1	1.0	94.1	1.8	0.81	0.86	8.33	4.20	--
25	CO.047	15.6	10.8	0.75	3.0	1.0	94.2	1.8	0.81	0.90	8.00	4.75	--
26	CO.031	15.9	12.9	0.88	3.6	1.1	94.3	1.1	0.80	0.88	7.75	4.00	--
27	CO.029	15.9	12.0	0.82	1.9	0.9	95.4	1.9	0.83	0.90	8.33	4.75	--
29	CO.053	25.2	18.4	0.79	5.3	2.6	90.6	1.5	0.80	0.84	5.86	3.56	--
31	CO.055	15.0	14.7	1.06	5.5	1.4	91.7	1.4	0.78	0.83	5.71	3.22	--
32	CO.044	16.4	9.9	0.25	2.1	3.2	92.5	2.2	0.61	0.87	7.33	4.00	--
34	CO.060	15.6	13.5	0.94	4.3	1.8	92.5	1.5	0.77	0.85	7.00	4.67	--

Note: Catalyst Run 9 screened thru 170 x 400 mesh.
Catalysts for Runs 11 thru 20 and Run 27 (except Runs 21 and 22) screened thru 150 x 400 mesh.
Catalysts for Runs 21 and 22 screened thru 100 x 400 mesh.

(1) Weak TCD filaments in G.C. CH4 peaks smaller than expected.
(2) Internal valve in G.C. leaked. CH4 peak undetected.

Table IV
(Continued)

DATE: 03/31/95

M3 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
4	240 C	450psi	1.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-562 SLH, H2-119 SLH, CO-119 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons, C1+ (kg/kg cat.,hr)
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefin C6-18,
36	Co.032	15.9	9.5	0.65	1.4	1.2	96.5	0.87	0.83	--	7.67	4.50	--
37	Co.045	15.9	6.5	0.44	0.1	1.4	97.3	1.16	0.82	--	5.00	2.00	--
38	Co.058	15.9	12.7	0.87	3.2	1.3	94.5	1.01	0.81	--	7.25	4.40	--
39	Co.064	15.9	15.9	1.09	4.7	1.2	92.9	1.28	0.80	--	7.86	3.88	--

Note: All catalysts were screened thru 150 x 400 mesh.

Table V

DATE: 12/30/94

M3 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
5	240 C	600psi	1.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-562 SLH, H2-119 SLH, CO-119 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons, C1+ (kg/kg cat.,hr)
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefin C6-18,%
5	CO.003	15.1	13.4	0.97	3.9	1.1	93.7	1.3	0.81	--	5.26	3.45	30.1
6	CO.011	15.3	6.7	0.46	0.2	0.9	96.0	2.9	0.84	0.89	12.00	3.67	27.3
7	CO.012	15.8	4.3	0.28	0.1	2.1	91.6	6.3	0.75	0.82	8.50	3.50	--
8	CO.015	15.0	12.4	0.90	4.9	0.8	93.6	0.7	0.84	0.85	5.20	3.14	30.8
9	CO.011	15.0	8.7	0.63	1.4	1.1	96.4	1.1	0.83	0.87	5.00	2.67	30.5
11	CO.017	15.0	11.6	0.84	4.2	0.0	94.7	1.2	0.86	0.86	24.00	1.63	21.0
12	CO.018	15.6	13.0	0.90	3.2	0.0	94.9	1.9	0.80	0.85	--	--	38.5
13	CO.016	14.7	11.4	0.85	(1)	0.5	99.2	0.3	0.92	0.86	--	--	32.2
14	CO.019	15.2	5.9	0.41	(2)	1.5	96.1	2.4	0.80	--	--	--	--
15	CO.005	14.7	23.0	0.90	0.0	1.0	97.7	1.3	0.83	0.85	7.00	4.40	36.4
16	CO.002	15.4	13.1	0.92	3.6	1.4	93.9	1.1	0.81	0.84	4.29	2.75	25.2
17	CO.025	15.6	19.9	0.81	9.3	1.1	96.5	1.1	0.83	0.88	8.00	4.25	32.9
18	CO.004	15.0	15.0	1.09	3.6	1.1	94.1	1.2	0.82	0.83	5.67	4.00	33.6
19	CO.021	15.6	11.5	0.80	1.8	1.2	95.8	1.2	0.83	0.85	6.50	3.80	30.8
20	CO.041	15.8	13.2	0.91	2.0	1.0	96.1	0.9	0.84	0.87	7.00	3.50	31.5
21	Co.014	15.1	2.1	0.15	0.0	2.6	94.8	2.7	0.71	0.81	4.50	3.50	23.1
23	CO.047	15.8	11.8	0.80	2.6	0.8	94.6	2.0	0.82	0.87	7.00	3.60	38.5
24	CO.049	15.6	13.4	0.92	2.6	0.9	94.8	1.7	0.82	0.88	8.33	4.20	37.8
25	CO.047	15.6	12.4	0.86	2.2	0.8	95.6	1.3	0.83	0.86	7.33	4.50	36.4
26	CO.031	15.9	13.9	0.95	3.5	1.0	94.4	1.1	0.81	0.85	6.80	3.71	30.1
27	CO.029	15.9	12.1	0.82	1.7	0.9	95.6	1.8	0.83	0.89	7.67	4.75	39.9
29	CO.053	25.2	19.7	0.85	4.6	1.2	92.9	1.3	0.82	0.85	5.71	3.44	33.6
31	CO.055	15.0	16.1	1.16	4.7	1.2	92.8	1.3	0.80	0.83	6.17	3.11	33.6
34	CO.060	15.6	12.8	0.89	2.2	1.6	94.9	1.2	0.82	0.86	6.60	4.33	38.5

Note: Catalyst Run 9 screened thru 170 x 400 mesh.
Catalysts for Runs 11 thru 27 (except Runs 21 and 22) screened thru 150 x 400 mesh.
Catalyst for Run 21 screened thru 100 x 400 mesh.

(1) Weak TCD filaments in G.C. CH4 peaks smaller than expected.
(2) Internal valve in G.C. leaked. CH4 peak undetected.

Table VI

SUMMARY OF M4 SBCR RUN RESULTS

Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Conversion is total CO conversion over the period (%).
Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
Alpha: Based on GC analysis of offgas and liquid product.

Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
CO.002	15.2	1	25	35	240	450	2.0	20	29.4	1.42	17.3	2.2	79.4	1.01	0.73	0.82	0.91	0.60	17.5	
CO.002	15.2	2	73	83	220	450	2.0	20	11.8	0.56	4.7	1.0	93.7	0.59	0.81	0.90	2.71	1.63	--	G.C.Calib
CO.002	15.2	3	97	107	240	450	2.0	20	26.4	1.28	16.0	3.1	80.1	0.88	0.73	--	0.98	0.66	--	
CO.002	15.2	4	145	155	240	450	1.0	20	11.6	0.83	3.9	2.4	92.8	0.84	0.81	0.87	4.29	3.14	--	G.C.Calib
CO.002	15.2	5	182	203	240	600	1.0	20	12.9	0.92	4.0	1.5	93.5	0.91	0.81	0.82	4.29	2.75	24.5	
CO.002	15.2	6	217	226	240	450	2.0	20	24.2	1.17	17.1	3.1	79.0	0.83	0.71	--	1.03	0.70	--	
CO.024	15.4	1	20	37	240	450	2.0	20	25.5	1.21	8.6	2.0	89.0	0.43	0.79	0.84	2.93	1.93	21.7	
CO.024	15.4	2	68	85	220	450	2.0	0	9.5	0.45	0.0	2.1	97.6	0.27	0.83	0.91	5.33	4.00	--	No Synfl
CO.024	15.4	3	92	109	240	450	2.0	0	23.7	1.13	9.5	2.1	88.0	0.45	0.77	--	2.81	1.88	--	
CO.024	15.4	4	140	157	240	450	1.0	0	10.3	0.73	0.5	1.6	97.2	0.71	0.83	0.87	8.33	4.75	--	
CO.024	15.4	5	188	205	240	600	1.0	0	11.3	0.80	0.9	1.5	97.0	0.65	0.83	0.87	6.50	3.80	36.4	
CO.024	15.4	6	212	229	240	450	2.0	0	21.5	1.02	9.3	2.3	87.9	0.50	0.76	--	2.93	2.07	--	
CO.035	15.4	1	16	37	240	450	2.0	20	24.8	1.18	8.5	2.1	89.0	0.47	0.78	0.84	3.13	1.94	23.1	
CO.035	15.4	2	68	85	220	450	2.0	20	8.8	0.42	0.0	2.3	97.4	0.31	0.82	--	5.33	4.00	--	
CO.035	15.4	3	99	109	240	450	2.0	20	23.5	1.11	8.7	2.1	88.6	0.61	0.77	--	3.07	1.94	--	
CO.035	15.4	4	136	157	240	450	1.0	20	10.4	0.73	0.9	0.0	98.4	0.65	--	0.83	--	--	--	G.C.Calib
CO.035	15.4	5	184	205	240	600	1.0	20	10.7	0.76	0.7	1.4	97.1	0.75	0.84	0.88	6.25	4.50	27.3	
CO.035	15.4	6	212	228	240	450	2.0	20	19.4	0.92	7.8	2.3	89.4	0.56	0.79	--	3.08	1.77	--	
CO.028	15.4	1	23	40	240	450	2.0	20	21.2	1.00	6.1	1.6	91.3	1.01	0.81	0.83	4.86	3.00	28.7	
CO.028	15.4	2	67	88	220	450	2.0	20	6.6	0.31	0.0	1.9	97.4	0.72	0.83	0.90	5.50	4.00	--	
CO.028	15.4	3	95	112	240	450	2.0	20	20.1	0.94	5.8	1.6	91.6	1.02	0.81	--	4.25	2.67	--	
CO.028	15.4	4	139	160	240	450	1.0	20	9.2	0.65	0.0	1.3	97.3	1.46	0.85	0.88	9.50	3.75	--	
CO.028	15.4	5	189	208	240	600	1.0	20	9.5	0.67	0.0	1.1	97.5	1.36	0.85	0.88	6.00	3.50	40.6	
CO.028	15.4	6	213	232	240	450	2.0	20	18.0	0.84	5.7	1.6	91.5	1.12	0.80	--	4.57	2.88	--	
CO.043	15.4	1	18	39	240	450	2.0	20	13.0	0.61	3.7	1.8	93.4	1.06	0.79	0.85	5.60	3.17	27.3	
CO.043	15.4	2	53	63	220	450	2.0	20	4.3	0.20	0.0	1.4	96.3	2.25	0.81	0.91	4.00	3.00	--	
CO.043	15.4	3	94	111	240	450	2.0	20	12.3	0.58	3.0	1.5	93.9	1.58	0.80	--	5.00	2.83	--	
CO.043	15.4	4	138	159	240	450	1.0	20	5.2	0.37	0.0	0.0	99.4	0.64	0.83	0.89	7.00	5.00	--	
CO.043	15.4	5	191	207	240	600	1.0	20	5.9	0.41	0.0	2.2	94.8	2.99	0.82	0.89	6.00	3.75	30.1	G.C.Calib
CO.043	15.4	6	215	231	240	450	2.0	20	10.2	0.47	4.7	2.1	91.4	1.79	0.78	--	5.50	3.20	--	Repair G.C
CO.006	15.0	1	19	40	240	450	2.0	20	2.7	0.13	0.1	0.2	98.8	1.75	0.67	0.85	3.33	2.33	16.1	Shut down

Table VI
(Continued)

SUMMARY OF M4 SBCR RUN RESULTS

Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Conversion is total CO conversion over the period (%).
Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
Alpha: Based on GC analysis of offgas and liquid product.

Rn	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefins C6-18,%	Comments
9	CO.048	15.4	1	19	40	240	450	2.0	12	19.1	0.90	9.9	1.6	87.4	1.05	0.77	0.88	3.60	2.09	20.3	
9	CO.048	15.4	2	70	84	220	450	2.0	12	6.1	0.28	1.8	1.0	95.2	1.93	0.80	0.91	3.67	3.00	--	
9	CO.048	15.4	3	93	111	240	450	2.0	20	17.8	0.84	10.1	1.7	86.9	1.33	0.77	--	3.30	2.10	--	
9	CO.048	15.4	4	139	159	240	450	1.0	20	8.2	0.57	2.3	1.0	93.8	2.98	0.82	0.90	8.50	4.33	--	
9	CO.048	15.4	5	189	207	240	600	1.0	20	11.9	0.83	2.7	0.9	94.4	1.93	0.84	0.89	5.75	3.20	14.0	
9	CO.048	15.4	6	217	226	240	450	2.0	20	24.2	1.17	17.1	3.1	79.0	0.83	0.71	--	1.03	0.70	--	
0	CAL.02	15.9	1	19	40	240	450	2.0	20	34.5	1.58	12.9	2.0	83.9	1.23	0.75	0.84	1.66	1.06	21.0	
0	CAL.02	15.9	2	69	88	220	450	2.0	20	14.9	0.68	4.6	0.9	94.0	0.47	0.81	0.88	4.40	2.29	--	
0	CAL.02	15.9	3	91	112	240	450	2.0	20	34.2	1.57	12.6	2.0	84.4	1.00	0.75	--	1.71	1.06	--	
0	CAL.02	15.9	4	139	160	240	450	1.0	20	14.6	1.00	4.6	1.1	93.3	0.97	0.80	0.88	7.20	4.00	--	
0	CAL.02	15.9	5	187	201	240	600	1.0	20	16.4	1.12	4.2	1.0	94.0	0.89	0.82	0.86	5.83	3.86	35.7	
0	CAL.02	15.9	6	215	230	240	450	2.0	20	30.9	1.42	13.3	2.1	83.7	0.90	0.74	--	1.90	1.21	--	
1	CAL.03	15.6	1	19	40	240	450	2.0	20	29.7	1.39	13.5	2.1	83.4	1.08	0.74	0.86	1.65	1.03	18.2	ShutDown
2	CO.053	15.9	1	22	40	240	450	2.0	20	34.2	1.56	12.6	2.0	84.2	1.23	0.75	0.83	1.60	1.00	24.5	
2	CO.053	15.9	2	69	88	220	450	2.0	20	14.4	0.66	4.3	1.0	94.3	0.48	0.81	0.89	4.20	2.67	--	
2	CO.053	15.9	3	93	112	240	450	2.0	20	34.0	1.56	13.4	2.2	83.2	1.21	0.74	--	1.50	0.94	--	
2	CO.053	15.9	4	150	152	240	450	1.0	20	13.3	0.91	4.3	1.2	93.3	1.18	0.80	0.89	6.60	3.71	--	
2	CO.053	15.9	5	189	208	240	600	1.0	20	15.6	1.06	4.0	0.9	94.0	1.01	0.82	0.87	5.50	3.57	32.2	
2	CO.053	15.9	6	223	231	240	450	2.0	20	29.8	1.37	12.8	2.0	84.3	0.94	0.75	--	1.89	1.10	--	
3	CO.054	15.7	1	23	40	240	450	2.0	20	10.4	0.48	4.7	1.8	92.3	1.17	0.78	0.86	5.75	4.00	25.9	
3	CO.054	15.7	2	71	88	220	450	2.0	20	0.2	0.01	0.0	19.	60.8	19.5	0.33	0.94	8.00	5.00	--	
3	CO.054	15.7	3	102	112	240	450	2.0	20	10.6	0.49	4.5	1.5	92.8	1.23	0.79	--	5.50	3.75	--	
3	CO.054	15.7	4	143	160	240	450	1.0	20	5.2	0.36	0.0	1.2	97.0	1.85	0.83	0.95	6.00	4.50	--	
3	CO.054	15.7	5	191	208	240	600	1.0	20	5.0	0.34	0.0	1.3	96.9	1.78	0.82	0.93	6.50	3.33	30.8	
3	CO.054	15.7	6	223	230	240	450	2.0	20	8.8	0.40	4.7	2.0	91.7	1.54	0.78	--	5.00	3.50	--	
4	BlendA	20.0	1	25	39	240	450	2.0	20	29.3	1.41	10.1	1.6	86.3	2.02	0.77	0.86	2.23	1.35	23.1	
4	BlendA	20.0	2	69	87	220	450	2.0	20	12.4	0.60	4.3	0.9	93.9	0.95	0.81	0.91	3.80	2.33	--	
4	BlendA	20.0	3	93	111	240	450	2.0	20	27.5	1.33	10.5	1.7	86.4	1.44	0.76	--	2.09	1.32	--	
4	BlendA	20.0	4	143	158	240	450	1.0	20	12.7	0.91	3.4	1.0	94.0	1.61	0.81	0.86	7.50	3.83	--	
4	BlendA	20.0	5	191	207	240	600	1.0	20	14.1	1.02	3.7	1.0	93.8	1.45	0.82	0.89	6.40	3.43	32.9	
4	BlendA	20.0	6	215	231	240	450	2.0	20	27.0	1.29	11.5	1.9	85.5	1.12	0.76	--	2.04	1.30	--	

SUMMARY OF M4-SBCR RUN RESULTS

)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
)Conversion is total CO conversion over the period (%).
)Conversion and selectivities are calculated using N2 as an internal
standard in the GC analysis of the offgas.
)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
)Alpha: Based on GC analysis of offgas and liquid product.

un	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefins C6-18,%	Comments
15	CO.034	13.0	1	21	39	240	450	2.0	20	27.5	1.54	10.4	1.6	87.2	0.80	0.78	0.84	2.21	1.40	21.0	G.C.Calib
15	CO.034	13.0	2	45	87	220	450	2.0	20	11.0	0.61	4.0	0.9	94.5	0.59	0.82	0.90	4.00	3.00	--	
15	CO.034	13.0	3	95	111	240	450	2.0	20	26.6	1.49	11.5	1.9	85.9	0.82	0.76	--	2.10	1.33	--	
15	CO.034	13.0	4	141	159	240	450	1.0	20	11.2	0.94	3.9	1.0	94.0	1.02	0.82	0.87	8.33	4.00	--	
15	CO.034	13.0	5	189	207	240	600	1.0	20	11.8	0.99	3.9	1.1	94.0	1.03	0.83		5.75	3.80	37.8	
15	CO.034	13.0	6	215	231	240	450	2.0	20	21.6	1.19	10.9	1.9	86.3	0.87	0.76	--	3.33	2.15	--	
16	CAL.04	16.1	1	21	39	240	450	1.8	20	26.3	1.34	7.1	1.3	90.3	1.38	0.80	0.85	4.80	3.18	32.9	H2/CO:
16	CAL.04	16.1	2	54	163	220	450	1.8	20	8.4	0.42	2.6	1.0	94.1	2.31	0.80	0.88	5.00	4.00	--	1.76/1.0
17	CAL.08	15.0	1	21	39	240	450	1.8	20	16.9	0.93	5.9	1.0	91.7	1.36	0.82	0.88	5.20	3.33	28.7	H2/CO:
17	CAL.08	15.0	2	47	62	220	450	1.8	20	5.4	0.28	0.1	0.8	96.9	2.23	0.83	--	4.00	3.00	--	1.76/1.0
18	CAL.07	15.0	1	21	39	240	450	2.0	20	20.6	1.03	7.7	1.2	90.0	1.09	0.81	0.88	5.00	3.00	32.2	
18	CAL.07	15.0	2	47	62	220	450	2.0	20	6.7	0.33	1.8	1.4	95.0	1.81	0.84	--	4.00	3.00	--	
19	CAL.05	15.7	1	23	39	240	450	2.0	20	26.6	1.22	7.3	1.3	90.2	1.19	0.82	0.86	4.11	2.70	18.2	G.C.Calib
19	CAL.05	15.7	2	47	62	220	450	2.0	20	9.0	0.41	2.3	1.4	94.8	1.56	0.84	--	5.50	3.00	--	
20	CAL.06	15.0	1	15	30	240	450	2.0	20	5.6	0.26	3.1	2.1	92.0	2.86	0.80	0.90	4.50	3.50	30.8	G.C.Calib
20	CAL.06	15.0	2	55	63	240	450	2.0	20	3.5	0.16	0.0	3.3	92.8	3.87	0.80	0.85	3.00	2.50	--	
20	CAL.06	15.0	3	103	110	240	450	2.0	20	1.7	0.08	0.0	3.3	89.5	7.22	0.80	--	1.50	3.00	--	Cat.Loss
21	CO.004	15.9	1	23	40	240	450	2.0	20	39.3	1.80	15.2	2.3	81.2	1.38	0.74	0.89	1.16	0.73	23.1	
21	CO.004	15.9	2	71	88	220	450	2.0	20	16.1	0.74	8.1	1.2	90.2	0.48	0.78	0.87	3.38	2.22	--	
21	CO.004	15.9	3	105	110	240	450	2.0	20	37.6	1.47	16.4	2.3	80.2	1.20	0.73	--	1.10	0.70	--	
21	CO.004	15.9	4	136	138	240	450	1.0	20	14.9	1.02	7.4	1.4	89.9	1.29	0.77	0.84	4.67	2.82	--	
21	CO.004	15.9	5	166	184	240	600	1.0	20	18.4	1.26	6.1	1.1	91.9	0.94	0.81	0.84	5.25	2.91	--	G.C.Repair
21	CO.004	15.9	6	199	207	240	600	2.0	20	39.0	1.80	14.2	1.9	83.0	0.91	0.78	0.82	0.85	0.77		
21	CO.004	15.9	7	212	214	240	450	2.0	20	34.6	1.59	15.8	2.3	81.0	1.00	0.76	--	0.86	0.81	--	G.C.Repair
22	BlendB	30.5	1	23	39	240	450	2.0	20	35.6	1.64	12.7	1.6	79.4	6.29	0.75	0.81	1.40	0.81	27.3	
22	BlendB	30.5	2	78	87	240	450	1.0	20	15.8	1.07	1.5	0.9	90.5	7.06	0.80	0.83	5.00	2.22	38.5	G.C.Calib
22	BlendB	30.5	3	125	135	240	450	0.7	20	10.6	0.86	0.8	0.8	92.6	5.83	0.82	0.87	7.33	3.20	33.6	G.C.Calib
22	BlendB	30.5	4	150	158	240	450	1.0	20	14.1	0.99	3.9	1.0	91.0	4.07	0.80	--	5.40	2.25	--	
22	BlendB	30.5	5	174	183	240	450	2.0	20	30.1	1.44	13.2	1.8	82.4	2.56	0.75	--	1.33	0.69	--	
22	BlendB	30.5	6	191	207	260	450	1.0	20	23.5	1.63	10.0	1.9	82.1	6.02	0.74	--	2.92	1.15	--	
22	BlendB	30.5	7	223	232	280	450	1.0	20	26.9	1.79	17.8	3.1	68.4	10.7	0.64	--	3.00	1.88	--	
22	BlendB	30.5	8	247	255	280	450	0.7	20	17.1	1.34	8.8	2.6	78.8	9.8	0.70	--	6.00	3.53	--	
23	CAL.09	15.0	1	23	40	240	450	2.0	20	17.4	0.84	0.02	1.2	97.9	0.95	0.84	0.88	5.40	3.33	29.4	G.C.Calib
23	CAL.09	15.0	2	57	63	220	450	2.0	20	6.6	0.32	0.2	0.9	98.0	0.92	0.90	--	4.00	3.00	--	

Table VI
(Continued)

SUMMARY OF M4 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (%).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefins C6-18,%	Comments
24	CO.053	28.5	1	23	39	240	450	2.0	20	50.4	1.28	14.1	2.1	81.8	2.03	0.75	0.79	1.14	0.68	--	G.C.Calib
24	CO.053	28.5	2	54	63	250	450	2.0	20	53.5	1.34	24.2	3.6	67.9	4.24	0.66	--	0.66	0.48	--	
24	CO.053	28.5	3	78	87	260	450	2.0	30	55.3	1.36	38.2	5.2	49.0	7.64	0.53	--	0.53	0.47	--	
24	CO.053	28.5	4	102	110	260	450	2.0	30	52.8	2.13	29.1	4.0	62.1	4.79	0.64	--	0.68	0.49	--	
24	CO.053	28.5	5	126	135	260	450	2.0	30	58.9	1.90	28.5	3.9	62.8	4.90	0.65	--	0.70	0.48	--	
24	CO.053	28.5	6	146	158	260	450	2.0	30	42.6	1.74	26.9	3.8	66.3	2.96	0.65	--	0.99	0.67	--	
24	CO.053	28.5	7	175	182	260	450	2.0	30	51.5	1.31	31.6	4.5	60.0	3.90	0.60	--	0.94	0.65	--	
24	CO.053	28.5	8	199	208	260	450	2.0	30	58.1	1.89	27.6	3.7	65.1	3.67	0.66	--	0.88	0.56	--	
24	CO.053	28.5	9	218	231	260	450	2.0	30	62.9	2.05	23.2	3.0	70.6	3.20	0.71	--	0.93	0.58	--	
24	CO.053	28.5	10	259	263	275	450	2.0	30	72.1	2.24	39.1	5.0	46.4	9.53	0.57	--	0.41	0.34	--	
24	CO.053	28.5	11	290	304	260	450	2.0	30	48.8	1.62	29.0	3.8	65.4	1.83	0.65	--	1.78	1.09	--	

Feed Gas Rates

Per No	N2 SLH	H2 SLH	CO SLH	Total SLH
1	563	225	112	900
2	563	225	112	900
3	563	225	112	900
4	360	360	180	900
5	288	288	144	720
6	540	360	180	1080
7	563	225	112	900
8	200	288	144	632
9	108	288	144	540
10	108	288	144	540
11	108	288	144	540

Table VI
(Continued)

SUMMARY OF M4 SBCR RUN RESULTS

a)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b)Conversion is total CO conversion over the period (Z).
c)Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
e)Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Per No	Time Start	Time Stop	Temp C	Pres psi	H2: CO	Synfl cc/hr	Conv. Z	Prod. Rate	Selectivities ZCH4	ZC2	ZC3+	ZCO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefins C6-18,Z	Comments
26	CAL.10	15.6	1	23	39	240	450	2.0	20	21.9	1.01	5.4	1.5	91.9	1.25	0.79	0.85	3.60	2.27	25.9	
26	CAL.10	15.6	2	54	63	240	450	2.0	20	21.7	1.30	8.3	1.1	89.9	1.10	0.80	--	3.78	2.45	--	
26	CAL.10	15.6	3	78	87	240	450	2.0	20	17.2	1.04	11.7	1.4	86.1	1.39	0.76	--	3.57	2.30	--	
26	CAL.10	15.6	4	102	111	240	450	2.0	20	17.7	1.01	11.9	1.4	86.0	1.40	0.77	--	3.52	2.28	--	
26	CAL.10	15.6	5	118	126	240	450	2.0	20	16.2	0.75	4.9	1.7	92.3	1.10	0.77	--	4.29	2.75	--	

Feed Gas Rates

Per No	N2 SLH	H2 SLH	CO SLH	Total SLH
1	563	225	112	900
2	108	288	144	540
3	54	288	144	486
4	25	274	137	436
5	563	225	112	900

Table VI
(Continued)

SUMMARY OF M4 SBCR RUN RESULTS

)Unless otherwise noted, total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
)Conversion is total CO conversion over the period (%).
)Conversion and selectivities are calculated using N2 as an internal
standard in the GC analysis of the offgas.
)Prod. rate: Rate for production of total hydrocarbons,C1+ (kg/kg cat.,hr).
)Alpha: Based on GC analysis of offgas and liquid product.

ın Cat.	Cat.	Per	Time	Time	Temp	Pres	H2:	Synfl	Conv.	Prod.	Selectivities				Alpha	Alpha	Olefin/Paraf		Olefins	Comments
› No	wt,g	No	Start	Stop	C	psi	CO	cc/hr	%	Rate	%CH4	%C2	%C3+	%CO2	GC	Liq	C3	C4	C6-18,%	
25 CO.056	15.0	1	23	39	240	450	2.0	20	11.4	0.55	7.8	3.6	87.2	1.43	0.67	0.87	3.60	2.30	20.3	
25 CO.056	15.0	2	47	63	220	450	2.0	20	4.5	0.22	0.3	2.7	95.7	1.27	0.73	--	4.67	3.00	--	
26 CAL.10	15.6	1	23	39	240	450	2.0	20	21.9	1.01	5.4	1.5	91.9	1.25	0.79	0.85	3.60	2.27	25.9	
26 CAL.10	15.6	2	54	63	240	450	2.0	20	21.7	1.30	8.3	1.1	89.9	0.68	0.80	--	3.78	2.45	--	
26 CAL.10	15.6	3	78	87	240	450	2.0	20	17.2	1.04	11.7	1.4	86.1	0.78	0.76	--	3.57	2.30	--	
26 CAL.10	15.6	4	102	111	240	450	2.0	20	17.7	1.01	11.9	1.4	86.0	0.73	0.77	--	3.52	2.28	--	
26 CAL.10	15.6	5	118	126	240	450	2.0	20	16.2	0.75	4.9	1.7	92.3	1.10	0.77	--	4.29	2.75	--	
27 Co.050	14.6	1	23	39	240	450	2.0	20	20.4	1.01	6.8	1.9	90.2	1.04	0.78	0.87	2.50	1.69	18.9	
27 Co.050	14.6	2	78	87	220	450	2.0	20	8.1	0.39	0.0	4.8	92.6	2.56	0.79	0.87	8.50	3.00	--	
27 Co.050	14.6	3	102	111	240	450	2.0	20	19.8	0.98	9.1	2.6	87.0	1.30	0.76	--	2.50	1.69	--	
27 Co.050	14.6	4	142	157	240	450	1.0	20	8.4	0.61	1.1	2.9	93.3	2.78	0.79	0.90	6.25	5.00	--	
27 Co.050	14.6	5	173	182	240	450	2.0	20	17.3	0.87	9.9	3.0	85.4	1.74	0.75	--	2.50	1.75	--	
28 Co.057	15.8	1	23	40	240	450	2.0	20	18.7	0.86	5.3	1.5	92.3	0.98	0.81	0.85	3.27	2.36	23.1	
28 Co.057	15.8	2	71	88	220	450	2.0	20	6.0	0.27	0.0	1.9	97.2	0.93	0.79		5.50	4.00	--	G.C.Repair
28 Co.057	15.8	3	102	112	240	450	2.0	20	19.4	0.90	7.7	2.1	89.3	0.97	0.77	--	3.70	2.27	--	
28 Co.057	15.8	4	126	135	240	450	1.0	20	8.1	0.56	1.3	4.6	92.7	1.44	0.79	--	7.33	5.67	--	
28 Co.057	15.8	5	150	159	240	450	2.0	20	18.0	0.83	7.6	3.3	88.0	1.00	0.76	--	3.89	2.30	--	
28 Co.057	15.8	6	175	184	250	450	2.0	20	25.3	1.16	13.2	2.8	82.5	1.60	0.73	--	2.30	1.45	--	
28 Co.057	15.8	7	198	208	260	450	2.0	20	29.7	1.36	22.7	3.9	70.7	2.75	0.65	--	1.39	0.92	--	
28 Co.057	15.8	8	222	231	240	450	2.0	20	13.8	0.63	8.7	2.6	87.4	1.34	0.75	--	3.11	2.11	--	
29 Co.061	45.4	1	39	41	240	450	2.0	20	29.0	0.46	14.4	2.6	81.6	1.53	0.72	0.80	1.49	0.94	18.9	G.C.Calib
29 Co.061	45.4	2	54	64	220	450	2.0	20	11.8	0.19	3.9	1.9	93.5	0.73	0.77	--	3.67	2.29	--	Cat.Loss
29 Co.061	45.4	3	78	86	240	450	2.0	20	24.4	0.39	13.3	2.5	83.2	1.08	0.72	--	1.67	1.08	--	Cat.Loss
30 Co.011	15.9	1	23	40	240	450	2.0	20	8.0	0.36	5.8	3.9	87.8	2.49	0.71	0.89	5.75	3.00	22.4	G.C.Repair
30 Co.011	15.9	2	54	64	250	450	2.0	20	15.8	0.72	10.0	3.0	84.8	2.28	0.74	--	4.22	2.40	--	
30 Co.011	15.9	3	78	87	260	450	2.0	20	23.6	1.06	18.1	3.7	74.5	3.72	0.67	--	2.21	1.54	--	G.C.Repair
30 Co.011	15.9	4	102	111	270	450	2.0	20	28.3	1.26	26.5	3.4	64.9	5.23	0.60	--	1.67	1.14	--	
30 Co.011	15.9	5	126	135	278	450	2.0	20	28.5	1.27	34.5	4.0	55.1	6.43	0.53	--	1.84	1.26	--	
30 Co.011	15.9	6	150	159	280	450	2.0	20	36.0	0.95	40.3	4.5	47.9	7.32	0.48	--	1.77	1.20	--	
30 Co.011	15.9	7	174	183	280	450	2.0	20	38.5	0.77	43.7	4.7	43.7	7.90	0.45	--	1.93	1.29	--	
30 Co.011	15.9	8	198	207	280	450	2.0	20	36.0	1.15	38.5	4.5	50.9	6.07	0.52	--	2.18	1.43	--	
30 Co.011	15.9	9	222	230	240	450	2.0	20	4.4	0.20	6.9	4.0	85.5	3.63	0.66	--	6.00	3.67	--	

Table VII

DATE: 12/30/94

M4 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows:N2-563 SLH,H2-225 SLH,CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C1+ (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefin C6-18,%
3	CO.002	15.2	29.4	1.42	17.3	2.3	79.4	1.01	0.73	0.82	0.91	0.60	17.5
4	CO.024	15.4	25.5	1.21	8.6	2.0	89.0	0.43	0.79	0.84	2.93	1.93	21.7
5	CO.035	15.4	24.8	1.18	8.5	2.1	89.0	0.47	0.78	0.84	3.13	1.94	23.1
6	CO.028	15.4	21.2	1.00	6.1	1.6	91.3	1.01	0.81	0.83	4.86	3.00	28.7
7	CO.043	15.4	13.0	0.61	3.7	1.8	93.4	1.06	0.79	0.85	5.60	3.17	27.3
8	CO.006	15.0	2.7	0.25	0.1	0.2	98.8	1.75	0.67	0.85	3.33	2.33	16.1
9	CO.048	15.4	19.1	0.90	9.9	1.6	87.4	1.05	0.77	0.88	3.60	2.09	20.3
10	CAL.02	15.9	34.5	1.58	12.9	2.0	83.9	1.23	0.75	0.81	1.66	1.06	21.0
11	CAL.03	15.6	29.7	1.39	13.5	2.1	83.4	1.08	0.74	0.86	1.65	1.03	18.2
12	CO.053	15.9	34.2	1.56	12.6	2.0	84.2	1.23	0.75	0.83	1.60	1.00	24.5
13	CO.054	15.7	10.4	0.48	4.7	1.8	92.3	1.17	0.78	0.86	5.75	4.00	25.9
14	BlendA	20.0	29.3	1.41	10.1	1.6	86.3	2.02	0.77	0.86	2.23	1.35	23.1
15	CO.034	13.0	27.5	1.54	10.4	1.6	87.2	0.80	0.78	0.84	2.21	1.40	21.0
16	CAL.04	16.1	26.3	1.34	7.1	1.3	90.3	1.38	0.80	0.85	4.80	3.18	32.9
17	CAL.08	15.0	16.9	0.93	5.9	1.0	91.7	1.36	0.82	0.88	5.20	3.33	28.7
18	CAL.07	15.0	20.6	1.03	7.7	1.2	90.0	1.09	0.81	0.88	5.00	3.00	32.2
19	CAL.05	15.7	26.6	1.22	7.3	1.3	90.2	1.19	0.82	0.86	4.11	3.00	28.7
20	CAL.06	15.0	5.6	0.26	3.1	2.1	92.0	2.86	0.80	0.90	4.50	3.50	30.8
21	CO.004	15.9	39.3	1.80	15.2	2.3	81.2	1.38	0.74	0.80	1.16	0.73	23.1
23	CAL.09	15.0	17.4	0.84	0.0	1.2	97.9	0.95	0.83	0.88	5.40	3.33	29.4
24	CO.053	28.5	50.4	1.28	14.1	2.1	81.8	2.03	0.75	0.79	1.14	0.68	21.7
25	CO.056	15.0	11.4	0.55	7.8	3.6	87.2	1.43	0.67	0.87	3.60	2.30	20.3
26	CAL.10	15.6	21.9	1.01	5.4	1.5	91.9	1.25	0.79	0.85	3.60	2.27	25.9
27	Co.050	14.6	20.4	1.01	6.8	1.9	90.2	1.04	0.78	0.87	2.50	1.69	18.9

Note: Catalysts for Runs 3 thru 15 (except 8) screened through 150 x 400 mesh.
Catalyst for Run 8 screened thru 100 x 400 mesh.
Cat. Nos. CAL.08 and CAL.07 were prereduced and coated with wax.
H2 to CO ratio for Runs 16 and 17 was 1.76/1.0.
Cat. No. CAL.06 was H2 reduced and air stabilized.
Cat. No. CAL.09 was prereduced and coated with Soya.

Table VII
(Continued)

DATE: 03/31/95

M4 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
1	240 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows:N2-563 SLH,H2-225 SLH,CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C1+ (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefin C6-18,%
28	C0.057	15.8	18.7	0.86	5.3	1.5	92.2	0.98	0.81	0.85	3.27	2.36	23.1
29	Co.061	45.4	29.0	0.46	14.4	2.6	81.6	1.53	0.72	0.80	1.49	0.94	18.9
30	Co.011	15.9	8.0	0.36	5.8	3.9	87.8	2.49	0.71	0.89	5.75	3.00	22.4
31	CAL.12	15.9	27.6	1.26	7.9	1.0	90.0	1.11	0.79	0.84	3.50	2.07	25.2
32	CAL.11	15.9	30.6	1.40	7.8	1.4	89.6	1.18	0.80	0.84	3.91	3.33	26.6
33	CAL.13	15.9	28.1	1.28	6.4	1.4	90.9	1.29	0.81	0.85	3.64	2.15	23.8

Note: Catalysts for all runs were screened thru 150 x 400 mesh.
Catalyst No. Co.061 contains 30 % cobalt.

Table VIII

DATE: 03/31/95

M4 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
5	240 C	600psi	1.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
b) Conversion is total CO conversion over the period (%).
Flows: N2-562 SLH, H2-119 SLH, CO-119 SLH

c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C1+ (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefin C6-18,%
3	CO.002	15.2	12.9	0.92	4.0	1.5	93.5	0.91	0.81	0.82	4.29	2.75	24.5
4	CO.024	15.4	11.3	0.80	0.9	1.5	97.0	0.65	0.83	0.87	6.50	3.80	36.4
5	C0.035	15.4	10.7	0.76	0.7	1.4	97.1	0.75	0.84	0.88	6.25	4.50	27.3
6	C0.028	15.4	9.5	0.67	0.0	1.1	97.5	1.36	0.85	0.88	6.00	3.50	40.6
7	C0.043	15.4	5.9	0.41	0.0	2.2	94.8	2.99	0.82	0.89	6.00	3.75	30.1
9	CO.048	15.4	11.9	0.83	2.7	0.9	94.4	1.93	0.84	0.89	5.75	3.20	14.0
10	CAL.02	15.9	16.4	1.12	4.2	1.0	94.0	0.89	0.82	0.86	5.83	3.86	35.7
12	CO.053	15.9	15.6	1.06	4.0	0.9	94.0	1.0	0.82	0.87	5.50	3.57	32.2
13	CO.054	15.7	5.0	0.34	0.0	1.3	96.9	1.78	0.82	0.93	6.50	3.33	30.8
14	BlendA	20.0	14.1	1.02	3.7	1.0	93.8	1.45	0.82	0.89	6.40	3.43	32.9
15	CO.034	13.0	11.8	0.99	3.9	1.1	94.0	1.03	0.83	0.87	5.75	3.80	37.8
21	CO.004	15.9	18.4	1.26	6.1	1.1	91.9	0.94	0.81	0.84	5.25	2.91	32.2

Note: Catalysts for Runs 3 through 21 screened thru 150 x 400 mesh.

Table IX

DATE: 03/31/95

M4 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
4	240 C	450psi	1.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows: N2-562 SLH, H2-119 SLH, CO-119 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C1+ (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	Olefin/Paraf C4	Olefin C6-18,%
3	CO.002	15.2	11.6	0.83	3.9	2.4	92.8	0.84	0.81	0.87	4.29	3.14	--
4	CO.024	15.4	10.3	0.73	0.5	1.6	97.2	0.71	0.83	0.87	8.33	4.75	--
5	C0.035	15.4	10.4	0.73	0.9	0.0	98.4	0.65	--	0.83	--	--	--
6	C0.028	15.4	9.2	0.65	0.0	1.3	97.3	1.46	0.85	0.88	9.50	3.75	--
7	C0.043	15.4	5.2	0.37	0.0	0.0	99.4	0.64	0.83	0.89	7.00	5.00	--
9	CO.048	15.4	8.2	0.57	2.3	1.0	93.8	3.00	0.82	0.90	8.50	4.33	--
10	CAL.02	15.9	14.6	1.00	4.6	1.0	93.3	0.97	0.80	0.88	7.20	4.00	--
12	CO.053	15.9	13.3	0.91	4.3	1.2	93.3	1.18	0.80	0.89	6.60	3.71	--
13	CO.054	15.7	5.2	0.36	0.0	1.2	97.0	1.85	0.83	0.95	6.00	4.50	--
14	BlendA	20.0	12.7	0.91	3.4	1.0	94.0	1.61	0.81	0.86	7.50	3.83	--
15	CO.034	13.0	11.2	0.94	3.9	1.0	94.0	1.02	0.82	0.87	8.33	4.00	--
21	CO.004	15.9	14.9	1.02	7.4	1.4	89.9	1.29	0.77	0.84	4.67	2.82	--
27	Co.050	14.6	8.4	0.61	1.1	2.9	93.3	2.78	0.79	0.90	6.25	5.00	--
28	Co.057	15.8	8.1	0.56	1.3	4.6	92.7	1.44	0.79	--	7.33	5.67	--

Note: Catalysts for Runs 3 through 21 screened thru 150 x 400 mesh.

Table X

DATE: 03/31/95

M4 SBCR RUN RESULTS

COMPARISON OF CATALYST ACTIVITY AT SIMILAR RUN CONDITIONS

Period No.	Temp.	Pres.	H2/CO Ratio
2	220 C	450psi	2.0

a) Total flow is ca.15 L/min. STP, or 3 cm/sec linear gas flow.
Flows:N2-563 SLH, H2-225 SLH, CO-112.5 SLH
b) Conversion is total CO conversion over the period (%).
c) Conversion and selectivities are calculated using N2 as an internal standard in the GC analysis of the offgas.
d) Prod. rate: Rate for production of total hydrocarbons C1+ (kg/kg cat.,hr).
e) Alpha: Based on GC analysis of offgas and liquid product.

Run No	Cat. No	Cat. wt,g	Conv. %	Prod. Rate	Selectivities %CH4	%C2	%C3+	%CO2	Alpha GC	Alpha Liq	Olefin/Paraf C3	C4	Olefin C6-18,%
3	CO.002	15.2	11.8	0.56	4.7	1.0	93.7	0.59	0.81	0.90	2.71	1.63	--
4	CO.024	15.4	9.5	0.45	0.0	2.1	97.6	0.27	0.83	0.91	5.33	4.00	--
5	CO.035	15.4	8.8	0.42	0.0	2.3	97.4	0.31	0.82	--	5.33	4.00	--
6	C0.028	15.4	6.6	0.31	0.0	1.9	97.4	0.72	0.83	0.90	5.50	4.00	--
7	C0.043	15.4	4.3	0.20	0.0	1.4	96.3	2.25	0.81	0.91	4.00	3.00	--
9	CO.048	15.4	6.1	0.28	1.8	1.0	95.2	1.93	0.80	0.91	3.67	3.00	--
10	CAL.02	15.9	14.9	0.68	4.6	0.9	94.0	0.47	0.81	0.88	4.40	2.29	--
12	CO.053	15.9	14.4	0.66	4.3	1.0	94.3	0.48	0.81	0.89	4.20	2.67	--
13	CO.054	15.7	0.2	0.01	0.0	20.	60.8	19.5	0.33	0.94	8.00	5.00	--
14	BlendA	20.0	12.4	0.60	4.3	0.9	93.9	0.95	0.81	0.91	3.80	2.33	--
15	CO.034	13.0	11.0	0.61	4.0	0.9	94.5	0.59	0.82	0.90	4.00	3.00	--
16	CAL.04	16.1	8.4	0.42	2.6	1.0	94.1	2.31	0.80	0.88	5.00	4.00	--
17	CAL.08	15.0	5.4	0.28	0.1	0.8	96.9	2.23	0.83	--	4.00	3.00	--
18	CAL.07	15.0	6.7	0.33	1.8	1.4	95.0	1.81	0.85	--	4.00	3.00	--
19	CAL.05	15.7	9.0	0.41	2.3	1.4	94.8	1.56	0.84	--	5.50	3.00	--
20	CAL.06	15.0	3.5	0.16	0.0	3.3	92.8	3.87	0.80	0.85	3.00	2.50	--
21	CO.004	15.9	16.1	0.74	8.1	1.2	90.2	0.48	0.78	0.86	3.38	2.22	--
23	CAL.09	15.0	6.6	0.32	0.2	0.9	98.0	0.92	0.90	--	4.00	3.00	--
25	CO.056	15.0	4.5	0.22	0.3	2.7	95.7	1.27	0.73	--	4.67	3.00	--
27	Co.050	14.6	8.1	0.39	0.0	4.8	92.6	2.56	0.79	0.87	8.50	3.00	--
28	Co.057	15.8	6.0	0.28	0.0	1.8	97.2	0.93	0.79	--	5.50	4.00	--
29	Co.061	45.4	11.8	0.19	3.9	1.9	93.5	0.73	0.77	--	3.67	2.29	--

Note: Catalysts for Runs 3 through 15 screened thru 150 x 400 mesh.
Blend A contains 15.0 gm of Cat. No. CO.005 plus 5.0 gm of Cat. No. WGS.03.
Cat. NOs. CAL.08 and CAL.07 were prereduced and wax coated.
H2 to CO for Runs 16 and 17 was 1.76/1.0.
Cat. No. CAL.06 was H2 reduced and air stabilized before charging.
Cat. No. CAL.09 was prereduced and coated with Soya.
Cat. No. Co.061 contains 30 % cobalt.