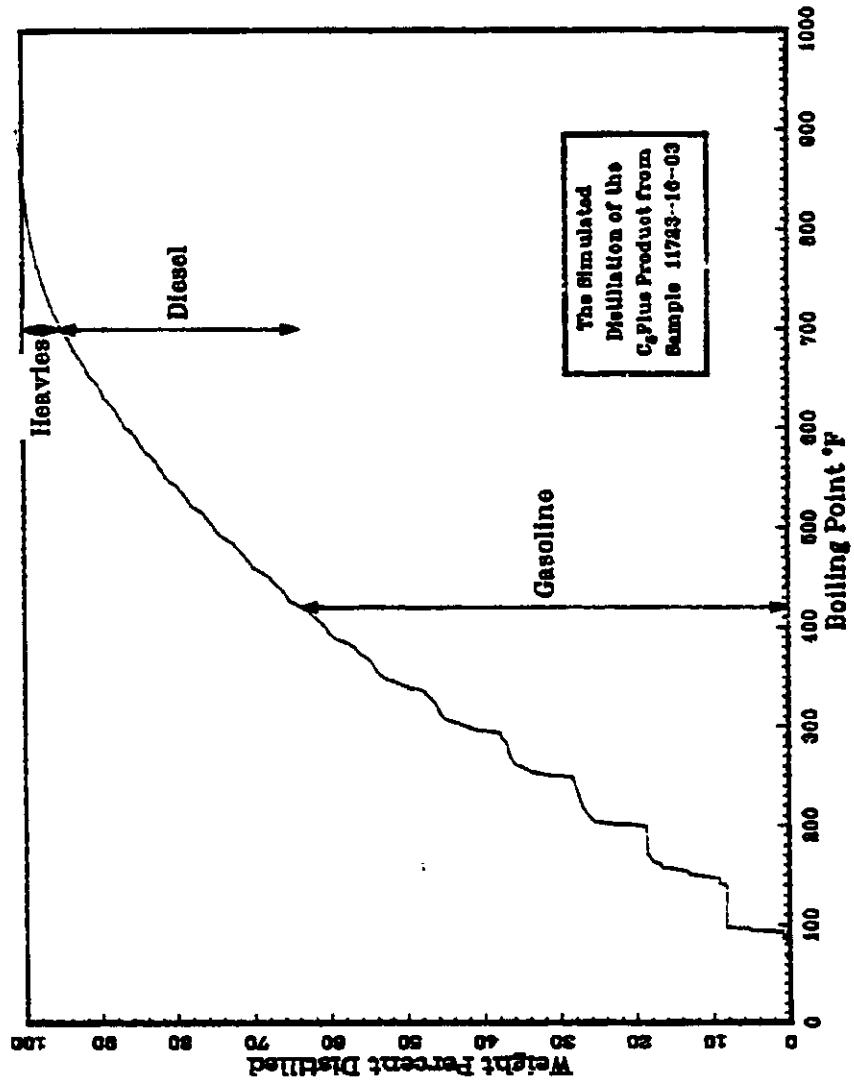
The Simulated Distillation of the C5 Plus Product from Sample 11723--16-03
Heavies
Diesel
Gasoline
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
0
10
20
30
40
50
60
70
80
90
100

Fig. A69

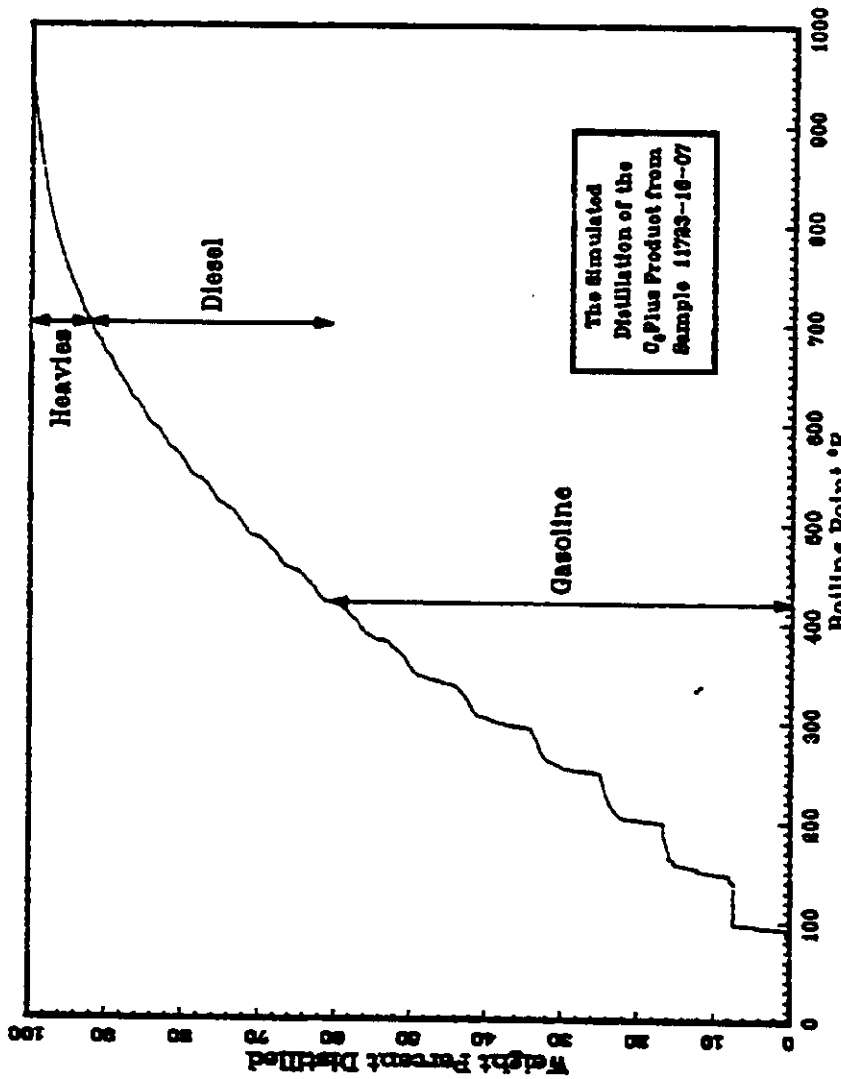
Heavies
Diesel
Gasoline
The Simulated Distillation of the C5 Plus Product from Sample 11793-16-07
Weight Percent Distilled
Boiling Point °F
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
800
900
1000

Fig. A70

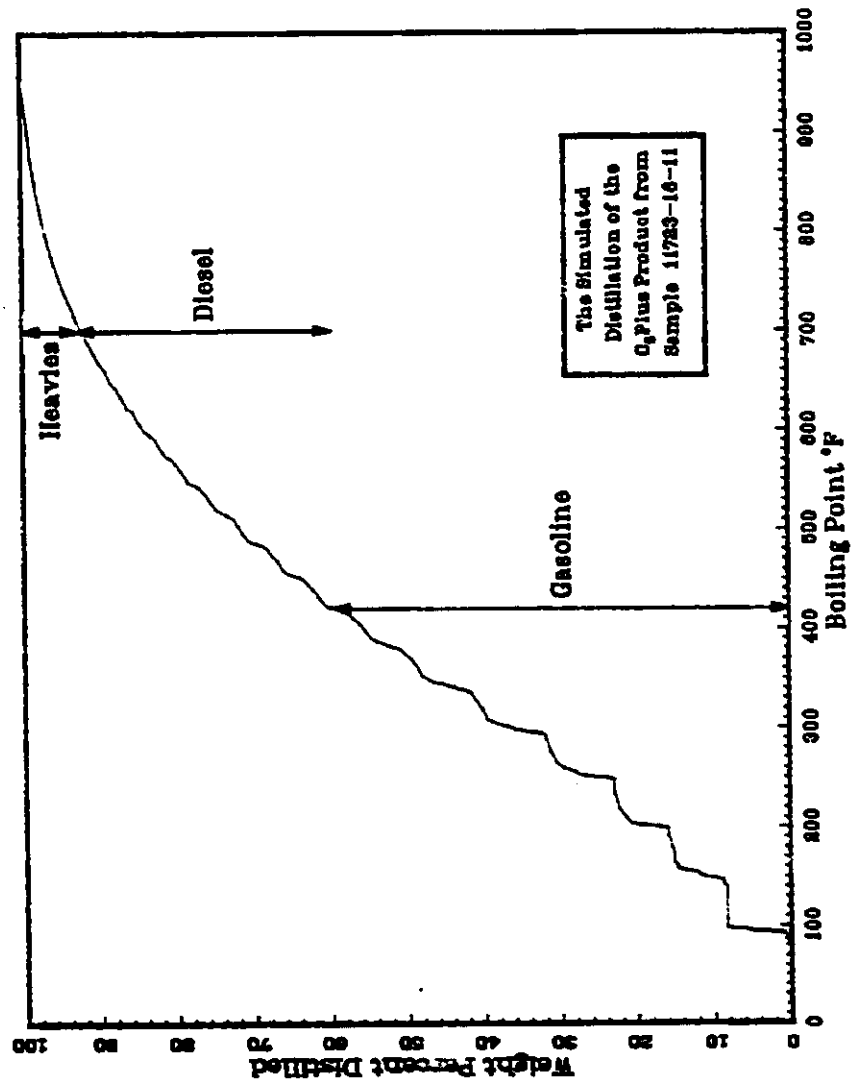
Heavies
Diesel
Gasoline
The Simulated Distillation of the C9 Plus Product from Sample 11723-16-11
Boiling Point °F
Weight Percent Distilled
0
100
200
300
400
500
600
700
800
900
1000
0
10
20
30
40
50
60
70
80
90
100

Fig. A71

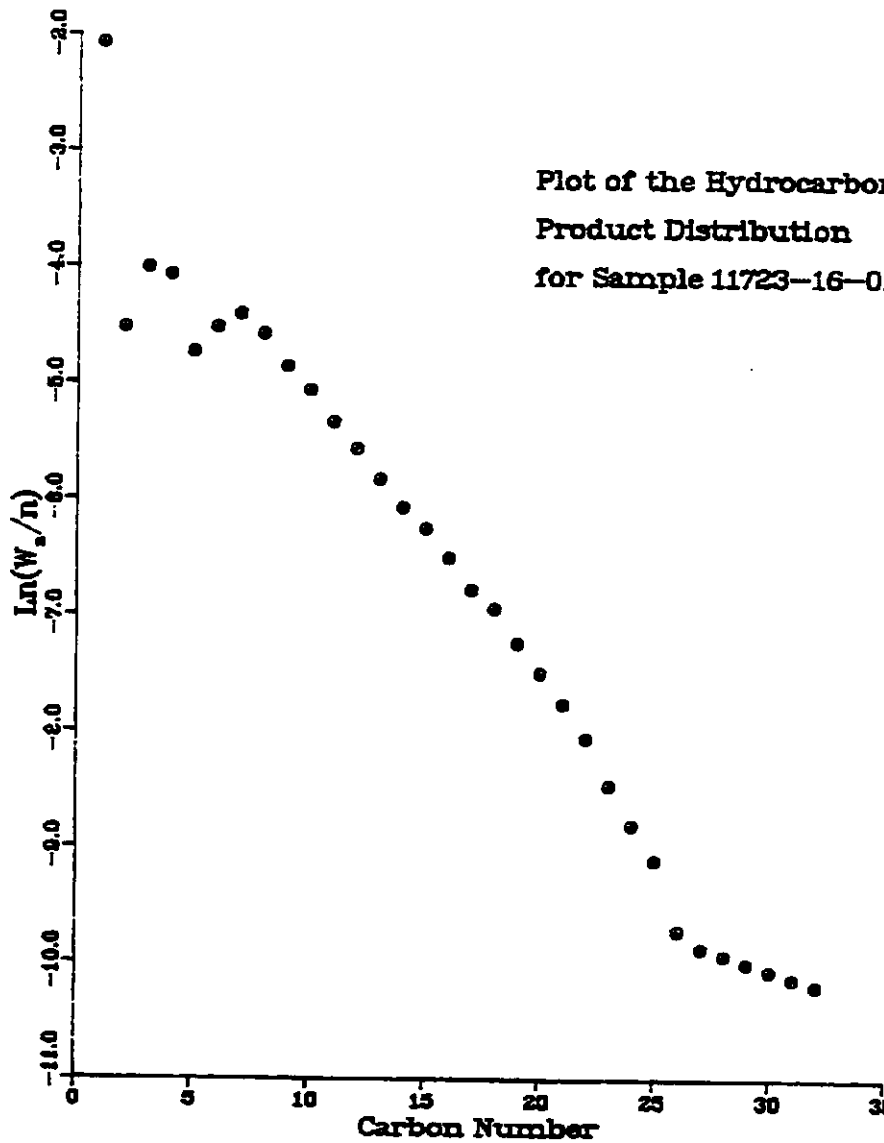
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-01
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. A72

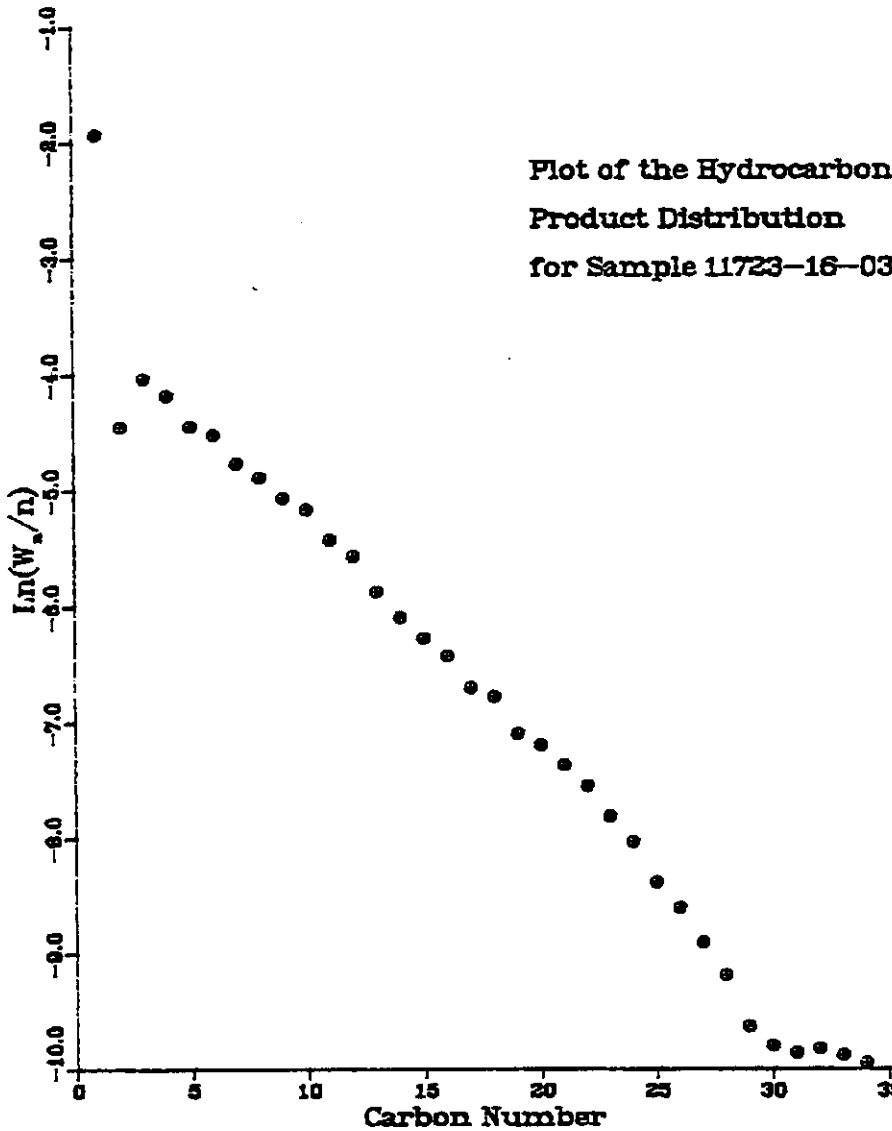
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-03
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
0
5
10
15
20
25
30
35
Carbon Number

Fig. A73

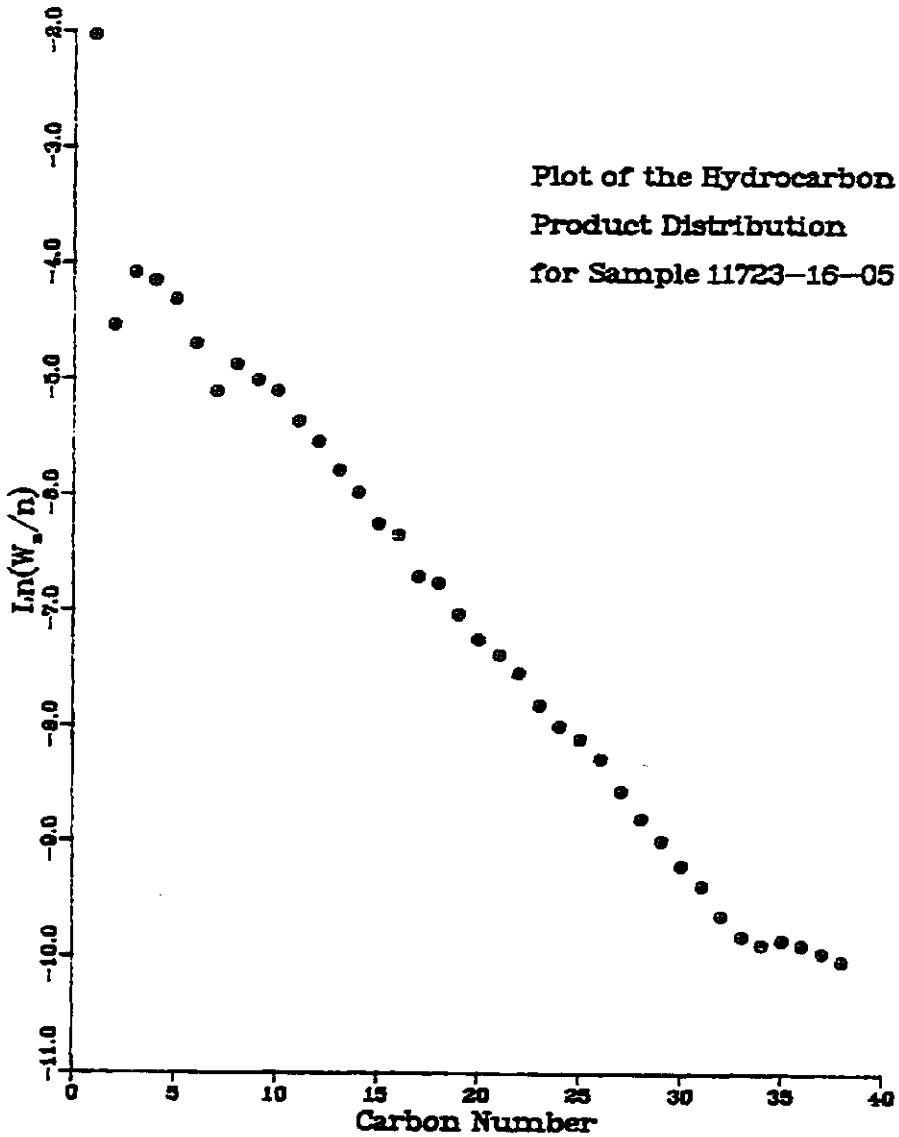
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-05
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A74

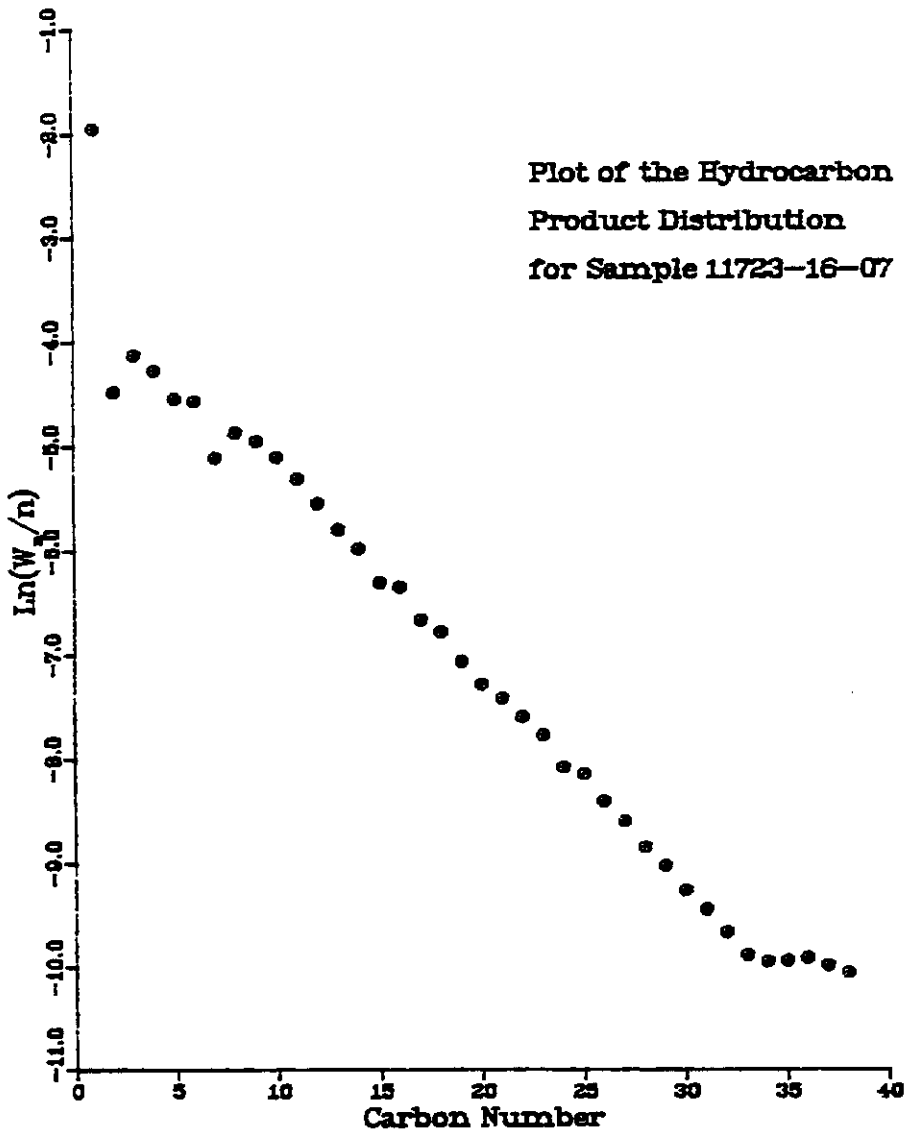
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-07
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A75

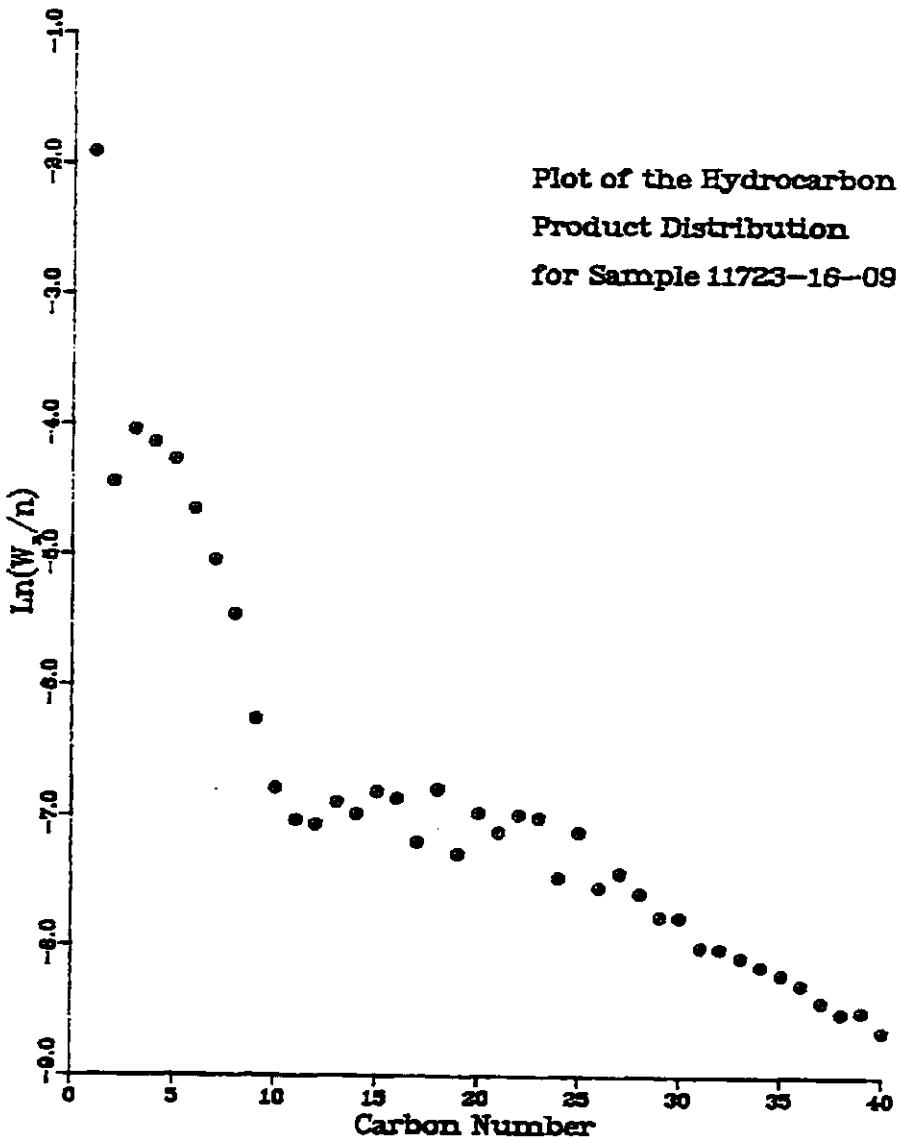
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-09
Ln(W_n/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A76

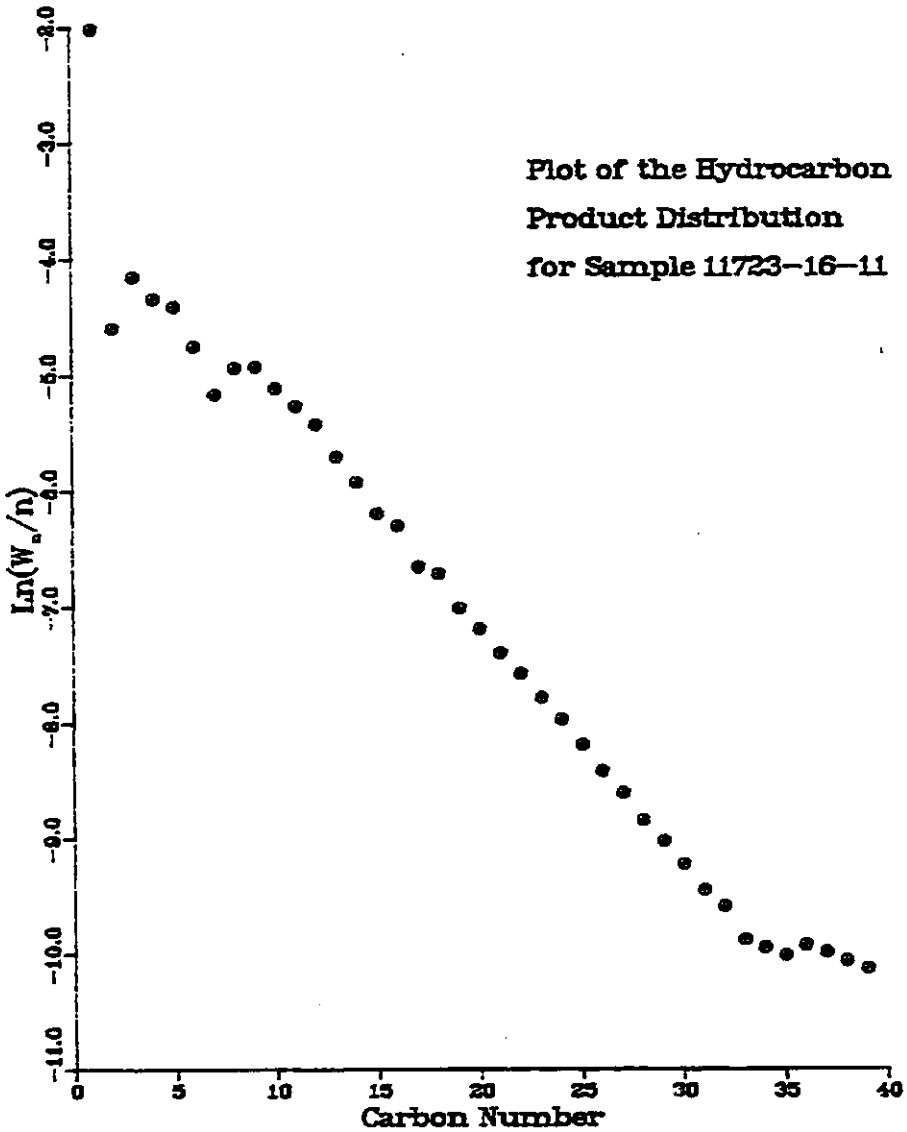
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-11
Ln(W_n/n)
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A77

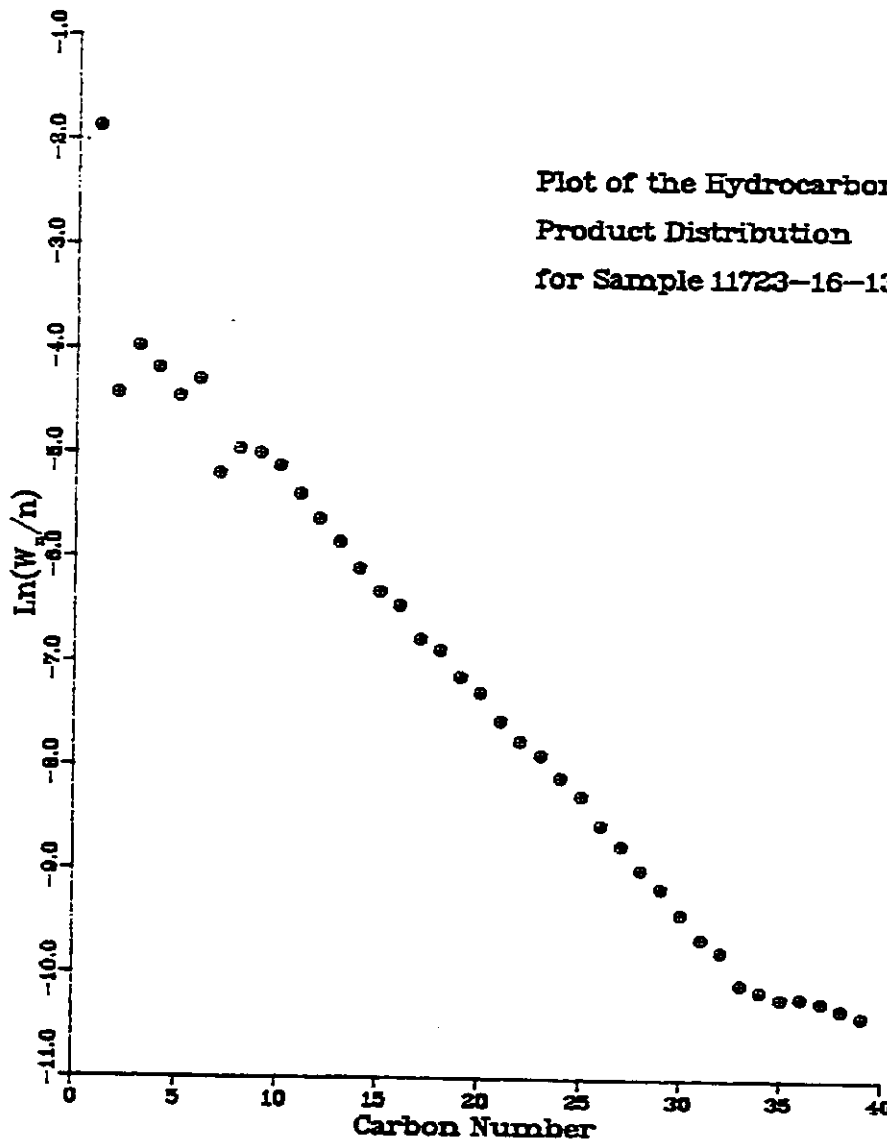
Plot of the Hydrocarbon
Product Distribution
for Sample 11723-16-13
Ln(Wn/n)
-1.0
-2.0
-3.0
-4.0
-5.0
-6.0
-7.0
-8.0
-9.0
-10.0
-11.0
0
5
10
15
20
25
30
35
40
Carbon Number

Fig. A78

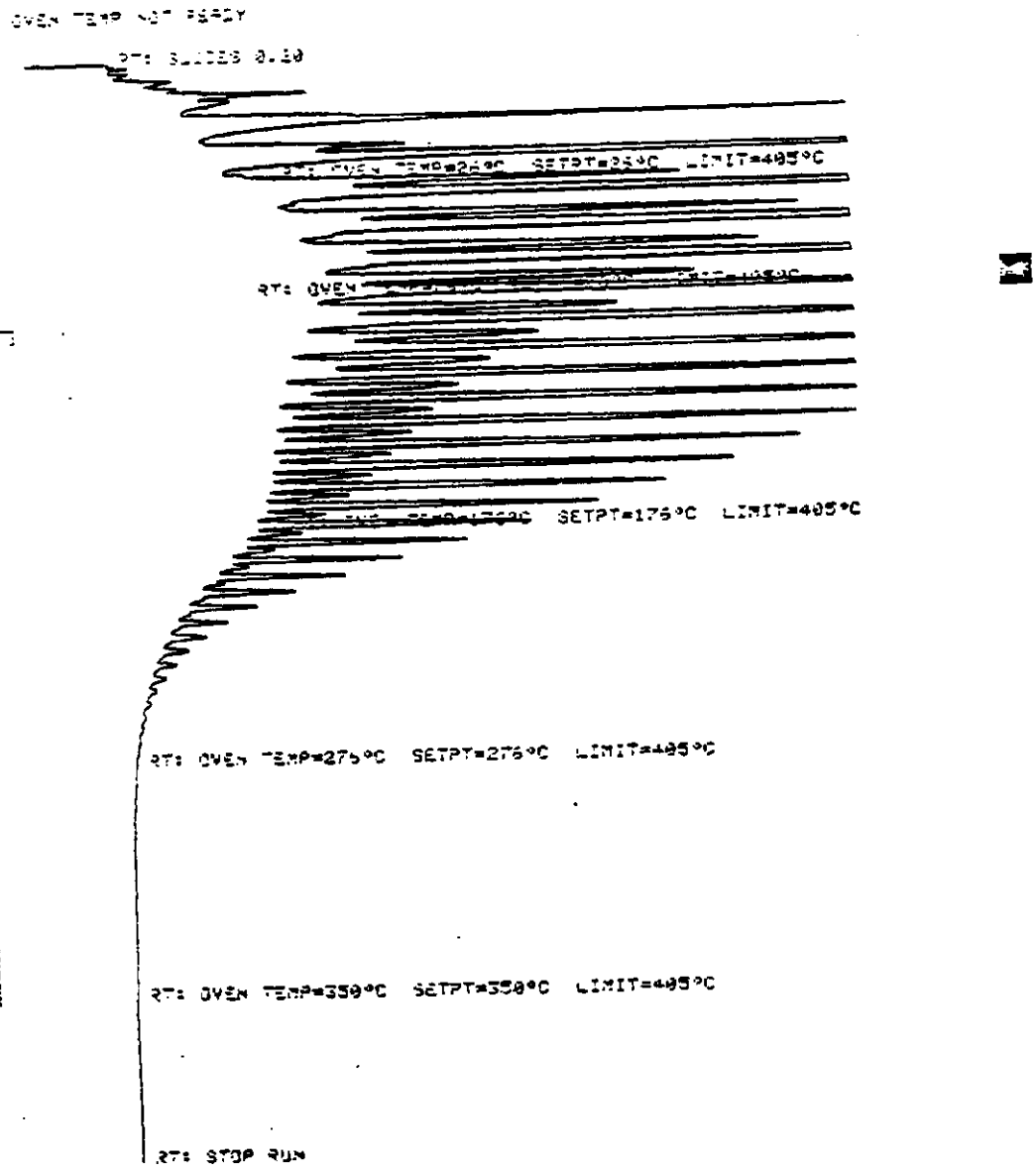
OVEN TEMP NOT READY
RT: SETTING 0.50
SETPT=250°C LIMIT=405°C
RT: OVEN
SETPT=175°C LIMIT=405°C
RT: OVEN TEMP=275°C SETPT=275°C LIMIT=405°C
RT: OVEN TEMP=350°C SETPT=350°C LIMIT=405°C
RT: STOP RUN
SAMPLE:D11723-16-3L

Fig. A79

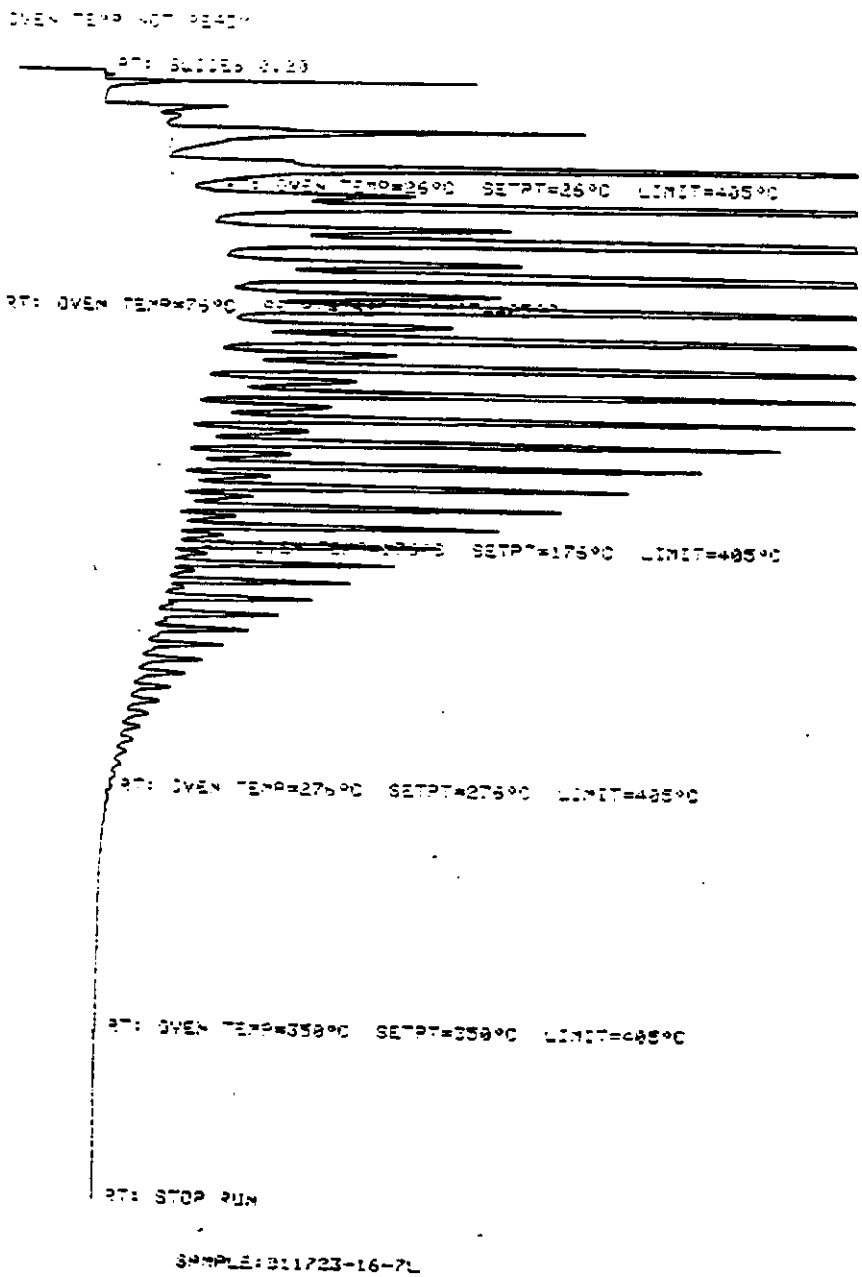
RT: OVEN TEMP=26°C SETPT=26°C LIMIT=405°C
RT: OVEN TEMP=175°C SETPT=175°C LIMIT=405°C
RT: OVEN TEMP=275°C SETPT=275°C LIMIT=405°C
RT: OVEN TEMP=350°C SETPT=350°C LIMIT=405°C
RT: STOP RUN

Fig. A80

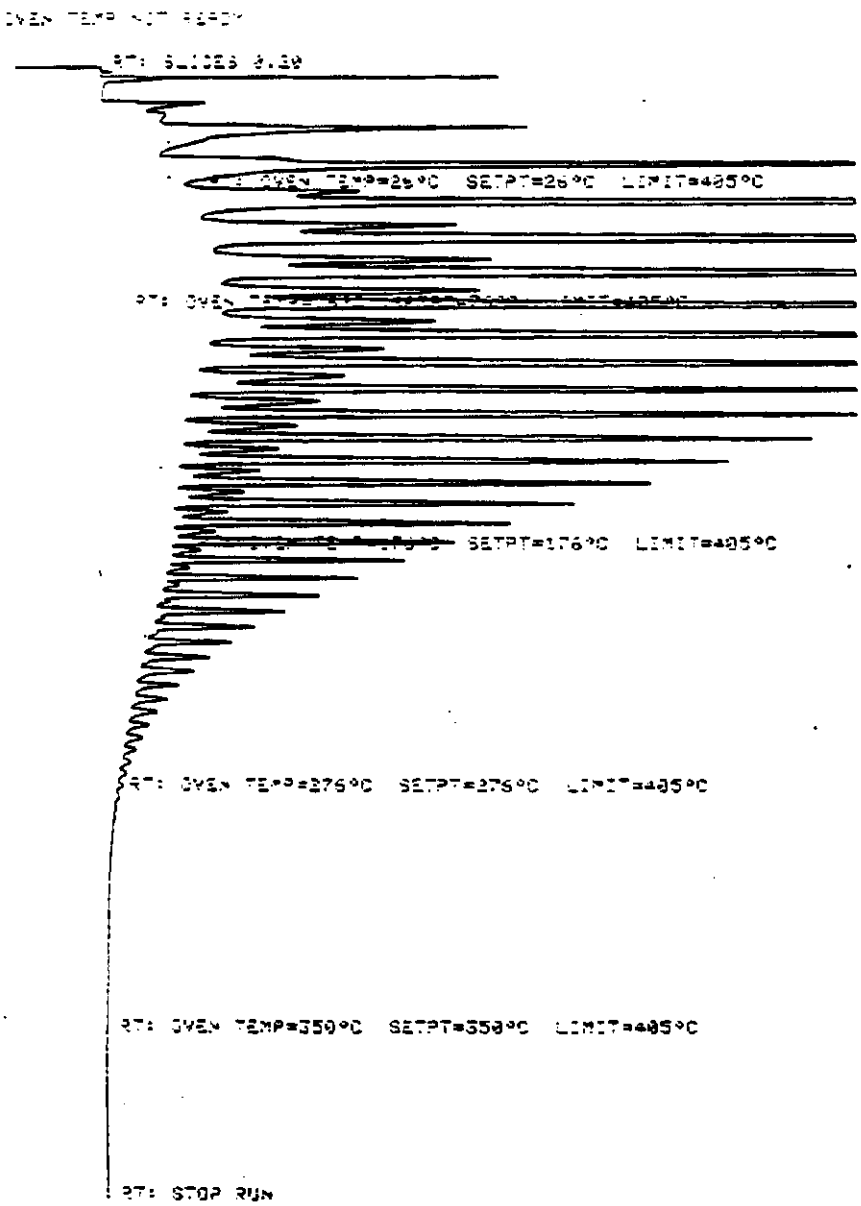
RT: OVEN TEMP=25°C SETPT=25°C LIMIT=405°C
RT: OVEN TEMP=176°C SETPT=176°C LIMIT=405°C
RT: OVEN TEMP=275°C SETPT=275°C LIMIT=405°C
RT: OVEN TEMP=350°C SETPT=350°C LIMIT=405°C
RT: STOP RUN

Fig. A81

Table A9

RESULT OF SYNGAS OPERATION

RUN NO. 11723-16
CATALYST Co/Th/X8-U103+U101 11864-22C 250 CC 104.3G(121.2 @END +17. G)
FEED H2:CO:ARGON OF 50:50:0 @ 1260 CC/MN OR 302 GHSV

RUN & SAMPLE NO.	11723-16-01	723-16-03	723-16-05	723-16-07	723-16-09
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	22.5	46.5	70.5	94.5	119.5
PRESSURE,PSIG	294	295	293	293	296
TEMP. C	262	264	263	263	263
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	22.50	24.00	24.00	24.00	25.00
EFFLNT GAS LITER	657.80	769.30	802.75	825.70	869.04
GM AQUEOUS LAYER	222.18	231.85	227.72	223.60	228.87
GM OIL	67.67	82.32	100.76	94.87	93.44
MATERIAL BALANCE					
GM ATOM CARBON %	82.83	87.71	93.98	92.82	93.14
GM ATOM HYDROGEN %	89.80	94.44	100.62	99.48	99.64
GM ATOM OXYGEN %	91.89	94.73	95.52	95.77	95.34
RATIO CHX/(H2O+CO2)	0.7718	0.8197	0.9595	0.9209	0.9401
RATIO X IN CHX	2.3549	2.3929	2.3696	2.3910	2.4007
USAGE H2/CO PRODT	2.1641	2.1394	2.0177	2.0725	2.0592
FEED H2/CO FRM EFFLNT	1.0841	1.0767	1.0707	1.0718	1.0697
RESIDUAL H2/CO RATIO	0.3457	0.3811	0.3969	0.4173	0.4222
RATIO CO2/(H2O+CO2)	0.0754	0.0723	0.0665	0.0626	0.0629
K SHIFT IN EFFLNT	0.0282	0.0297	0.0283	0.0279	0.0284
SPECIFIC ACTIVITY SA	2.9811	2.2191	2.3902	2.0695	1.9791
CONVERSION					
ON CO %	40.61	39.56	41.57	39.54	39.55
ON H2 %	81.06	78.61	78.34	76.46	76.14
ON CO+H2 %	61.65	59.81	60.58	58.64	58.46
PRDT SELECTIVITY,WT %					
CH4	12.63	14.45	13.09	14.27	14.75
C2 HC'S	2.17	2.34	2.15	2.27	2.35
C3H8	2.97	3.07	2.93	2.89	3.11
C3H6=	2.47	2.27	2.13	1.97	2.14
C4H10	2.63	2.43	2.64	2.34	2.42
C4H8=	4.21	3.69	3.65	3.22	3.99
C5H12	2.74	2.37	2.40	2.36	2.80
C5H10=	1.63	3.48	4.30	2.98	4.18
C6H14	2.97	2.79	2.52	2.59	2.68
C6H12= & CYCLO'S	3.50	3.75	2.96	3.64	3.07
C7+ IN GAS	18.21	11.40	9.93	10.18	10.28
LIQ HC'S	43.87	47.95	51.31	51.28	48.22
TOTAL	100.00	100.00	100.00	100.00	100.00

Table A9 (continued)

SUB-GROUPING					
C1 -C4	27.08	28.25	26.59	26.97	28.76
C5 -420 F	50.84	45.14	44.17	44.32	43.99
420-700 F	20.17	22.42	23.32	22.97	21.99
700-END PT	1.91	4.20	5.92	5.75	5.26
C5+-END PT	72.92	71.75	73.41	73.05	71.24
ISO/NORMAL MOLE RATIO					
C4	0.2297	0.0911	0.1314	0.0726	0.0677
C5	0.1918	0.0984	0.1006	0.0699	0.0894
C6	0.4511	0.2920	0.2504	0.1537	0.1725
C4=	0.0811	0.0659	0.0830	0.0659	0.2604
PARAFFIN/OLEFIN RATIO					
C3	1.1507	1.2933	1.3099	1.4005	1.3837
C4	0.6047	0.6371	0.6992	0.7006	0.5855
C5	1.6353	0.6625	0.5430	0.7716	0.6521
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.7845	0.8178	0.8263	0.8246	0.8861 ?
RATIO CH4/(1-A)**2	2.7201	4.3525	4.3365	4.6380	11.3738 ?
ALPHA FRM CORRELATION	0.8624	0.8576	0.8557	0.8532	0.8526
ALPHA (EXPTL/CORR)	0.9096	0.9536	0.9656	0.9664	1.0393
W%CH4 FRM CORRELATION	10.9116	12.8319	13.2211	13.9813	14.1579
W%CH4 (EXPTL/CORR)	1.1578	1.1264	0.9901	1.0210	1.0420
LIQ HC COLLECTION					
PHYS. APPEARANCE	YLW OIL	YLW WAXY	YLW WAXY	YLW WAXY	YLW WAXY
DENSITY	0.757	0.758	0.758	0.758	0.758
N, REFRACTIVE INDEX	1.4256	1.4270	1.4272	1.4273	1.4264
SIMULT'D DISTILATN					
10 WT % @ DEG F	259	261	269	268	481 ?
16	294	302	304	303	539
50	421	445	453	451	757
84	588	640	658	652	988
90	634	690	717	711	1034 ?
RANGE(16-84 %)	294	338	354	349	449
WT % @ 420 F	49.67	44.50	43.00	44.00	43.50
WT % @ 700 F	95.65	91.25	88.46	88.79	89.10
					5.55
					39.00
REMARKS:					SIMU.DISTN
NEW FORMAT JAN 25,85					DATA OFF

Table A10

RESULT OF SYNGAS OPERATION

RUN NO. 11723-16
CATALYST Co/Th/X8-U103+U101 11864-22C 250 CC 104.3G(121.2 @END +17. G)
FEED H2:CO:ARGON OF 50:50:0 @ 1260 CC/MN OR 302 GHSV

RUN & SAMPLE NO.	11723-16-11	723-16-13
FEED H2:CO:AR	50:50: 0	50:50: 0
HRS ON STREAM	143.0	166.5
PRESSURE,PSIG	292	293
TEMP. C	263	263
FEED CC/MIN	1260	1260
HOURS FEEDING	23.50	23.50
EFFLNT GAS LITER	839.22	848.94
GM AQUEOUS LAYER	189.37	208.46
GM OIL	107.19	83.61
MATERIAL BALANCE		
GM ATOM CARBON %	97.68	94.52
GM ATOM HYDROGEN %	100.44	99.54
GM ATOM OXYGEN %	92.58	96.28
RATIO CHX/(H2O+CO2)	1.1563	0.9506
RATIO X IN CHX	2.3747	2.4140
USAGE H2/CO PRODT	1.8924	2.0627
FEED H2/CO FRM EFFLNT	1.0282	1.0531
RESIDUAL H2/CO RATIO	0.4334	0.4305
RATIO CO2/(H2O+CO2)	0.0639	0.0609
K SHIFT IN EFFLNT	0.0296	0.0279
SPECIFIC ACTIVITY SA	2.0770	1.8865
CONVERSION		
ON CO %	40.77	38.15
ON H2 %	75.03	74.71
ON CO+H2 %	58.14	56.90
PRDT SELECTIVITY,WT %		
CH4	13.37	15.38
C2 HC'S	2.03	2.38
C3H8	2.86	3.38
C3H6=	1.87	2.23
C4H10	2.22	2.60
C4H8=	2.98	3.47
C5H12	2.40	2.81
C5H10=	3.69	2.97
C6H14	2.46	2.83
C6H12= & CYCLO'S	2.70	5.34
C7+ IN GAS	9.47	9.88
LIQ HC'S	53.94	46.74
TOTAL	100.00	100.00

Table A10 (continued)

SUB-GROUPING		
C1 -C4	25.33	29.45
C5 -420 F	44.46	44.38
420-700 F	24.27	21.03
700-END PT	5.93	5.14
C5+-END PT	74.67	70.55
ISO/NORMAL MOLE RATIO		
C4	0.0548	0.0506
C5	0.0862	0.0786
C6	0.1537	0.1350
C4=	0.0658	0.0708
PARAFFIN/OLEFIN RATIO		
C3	1.4542	1.4461
C4	0.7201	0.7226
C5	0.6322	0.9188
SCHULZ-FLORY DISTRBTN		
ALPHA (EXP(SLOPE))	0.8265	0.8152
RATIO CH4/(1-A)**2	4.4392	4.5042
ALPHA FRM CORRELATION	0.8514	0.8517
ALPHA (EXPTL/CORR)	0.9708	0.9571
W%CH4 FRM CORRELATION	14.5536	14.4522
W%CH4 (EXPTL/CORR)	0.9184	1.0645
LIQ HC COLLECTION		
PHYS. APPEARANCE	GRN WAXY	WAXY
DENSITY	0.758	0.756
N, REFRACTIVE INDEX	1.4260	1.4260
SIMULT'D DISTILATN		
10 WT % @ DEG F	275	276
16	304	304
50	452	451
84	648	646
90	709	709
RANGE(16-84 %)	344	342
WT % @ 420 F	44.00	44.00
WT % @ 700 F	89.00	89.00
REMARKS:	AQ.SAMPLE SPILLED	
NEW FORMAT JAN 25,85		

V. Run 4 (11885-01) with Catalyst 4 (Co/Th/X_4/X_8/UCC-103+UCC-101)

This catalyst combines the two additives X_4 and X_8. Per gram cobalt it contains 0.01 gram each of X_4 and X_8, and 0.18 gram thorium. The level of X_4 was intended to be higher; in Catalyst 1 it was 0.15 gram per gram cobalt. The source of the X_4 used this time, however, contained catalyst poisons which had to be removed before formulating the catalyst, and in this process most of the X_4 was lost. The UCC-103 and the metal components were intimately mixed, then physically mixed with UCC-101 and formed as 1/8-inch extrudate. The final cobalt content was just over 8 percent.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C_4's are plotted against time on stream in Figs. A82-85. Simulated distillations of the C_5^+ product are plotted in Figs. A86-88. Carbon number product distributions are plotted in Figs. A89-100. Chromatograms from simulated distillations are reproduced in Figs. A101-103. Detailed material balances appear in Tables A11-13.

The catalyst appeared to deactivate rapidly at first, possibly due in part to the poor material balance in Sample 1. The activity decreased steadily during the run at a rate of one percentage point every 27 hours, approximately the same rate as with the Co/Th+UCC-103 catalyst of Run 10225-16 (Eleventh Quarterly

Report Catalyst 7). The low levels of combined X_4 and X_8 evidently do not improve selectivity. As usual, the conversion of H_2 deactivated more rapidly than that of CO--one percentage point every 18 hours for H_2, every 48 hours for CO. Catalyst 3, with the same level of X_8 and without X_4, was twice as stable. The initial specific activity per gram cobalt (calculated from Sample 3 owing to the unreliability of Sample 1) was lower than that of Catalyst 2. Although it was higher initially than that of Catalyst 3, this advantage quickly disappeared with rapid deactivation.

The production of methane was low initially--9.7 percent for sample 3, 11 percent for sample 7--and increased at a rate of one percentage point every 52 hours, about the same as with Catalysts 1-3. Production of C_5^+ was not as steady as with the previous catalysts, decreasing at a rate of one percentage point every 32 hours. This is again mostly due to decreasing production of diesel fuels, at a rate of one percentage point every 36 hours with a loss of heavies at a rate of one percentage point every 150 hours, while production of gasoline was increasing at a rate of one percentage point every 300 hours. Total motor fuel production thus decreased at a rate of one percentage point every 41 hours, with an increasing ratio of gasoline to diesel. The cause of the instability in the liquid product before 90 hours on stream is unknown.

Once again there was little isomerization activity and the usual high proportion of olefins.

The combination of X_4 and X_8 at these low levels--one percent of the cobalt content--is not effective. In many ways Catalyst 3, with the same X_8 content but without X_4, is superior to this one.

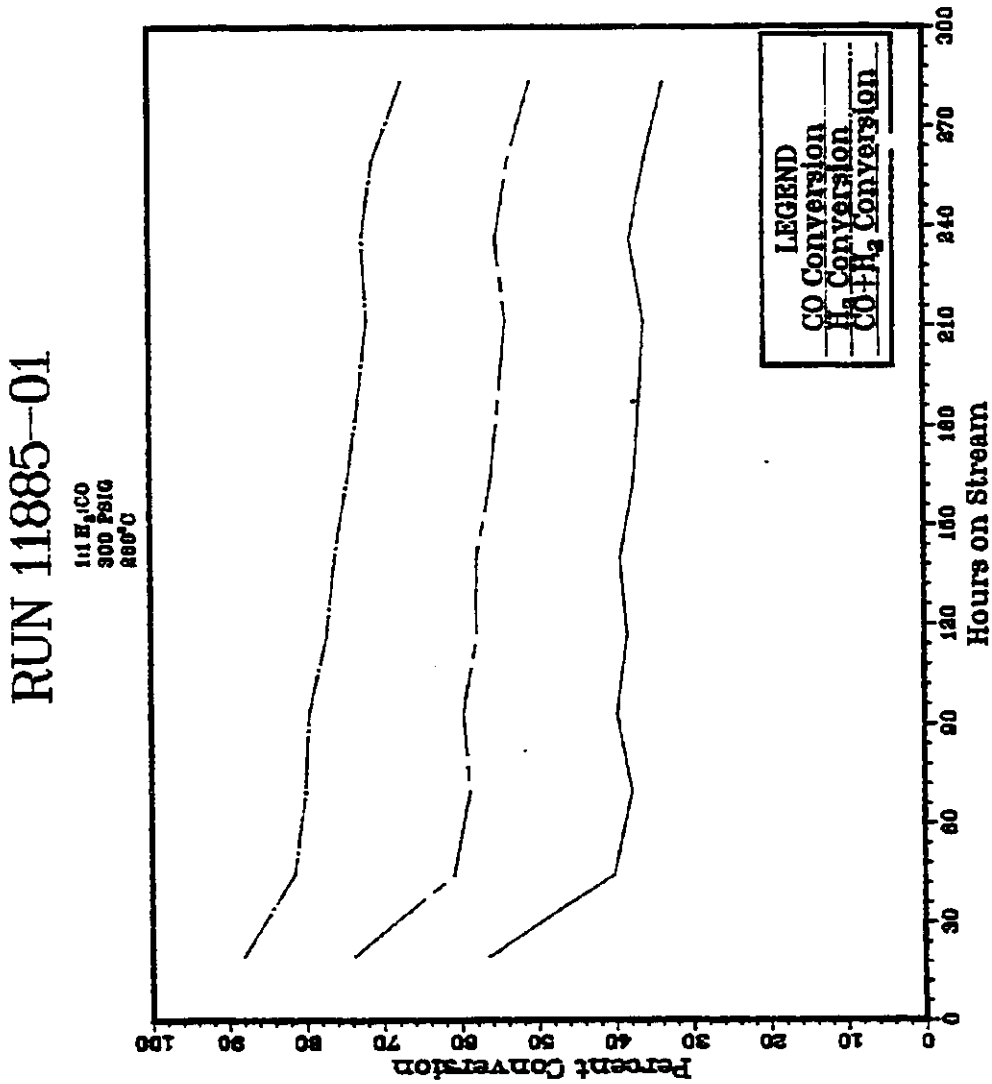
RUN 11885-01
1:1 H_2:CO
300 PSIG
280°C
LEGEND
CO Conversion
H_2 Conversion
$CO+H_2$ Conversion
Percent Conversion
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
30
60
90
120
150
180
210
240
270
300

Fig. A82

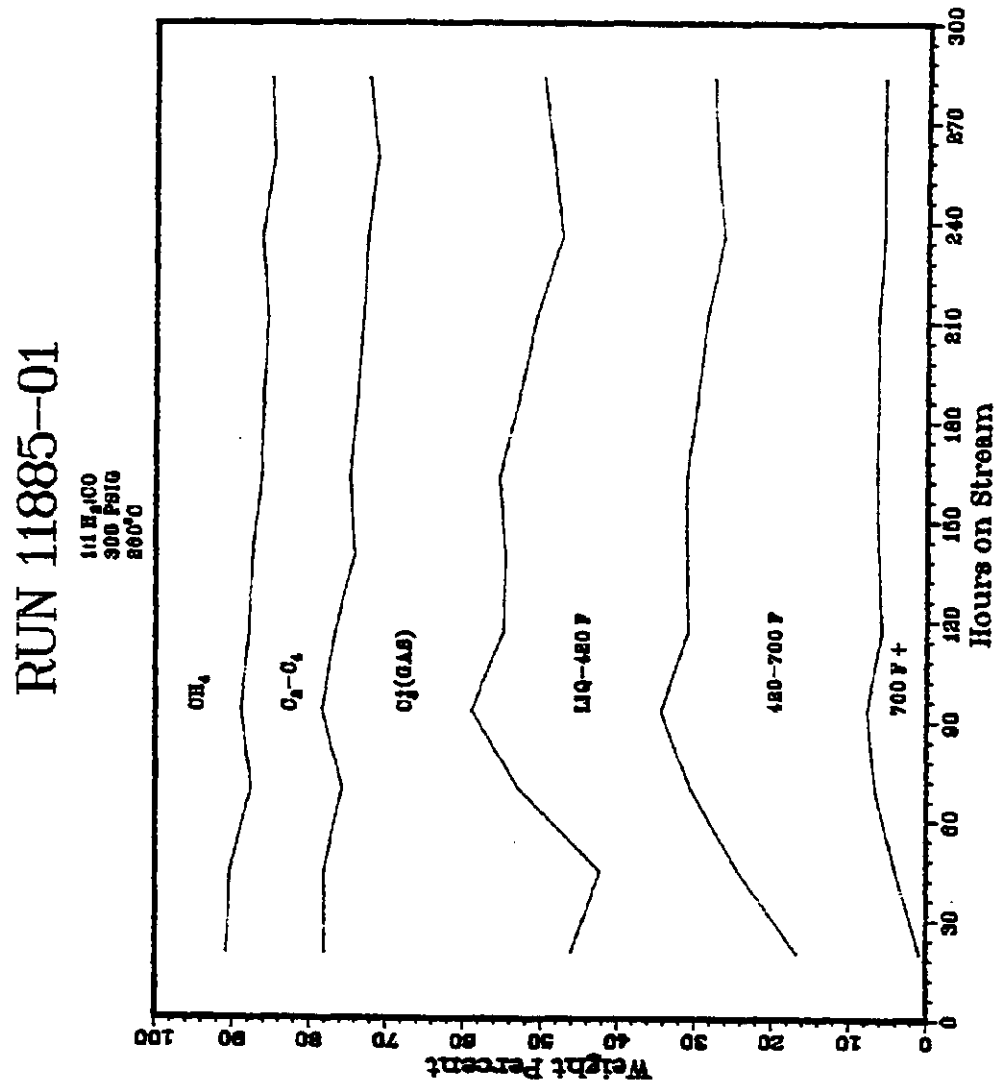
RUN 11885-01
1:1 H2/CO
300 PSIG
260°C
CH4
C2-C4
C5(GAS)
150-420 F
420-700 F
700 F +
Weight Percent
Hours on Stream
0
10
20
30
40
50
60
70
80
90
100
0
30
60
90
120
150
180
210
240
270
300

Fig. A83

RUN 11885-01

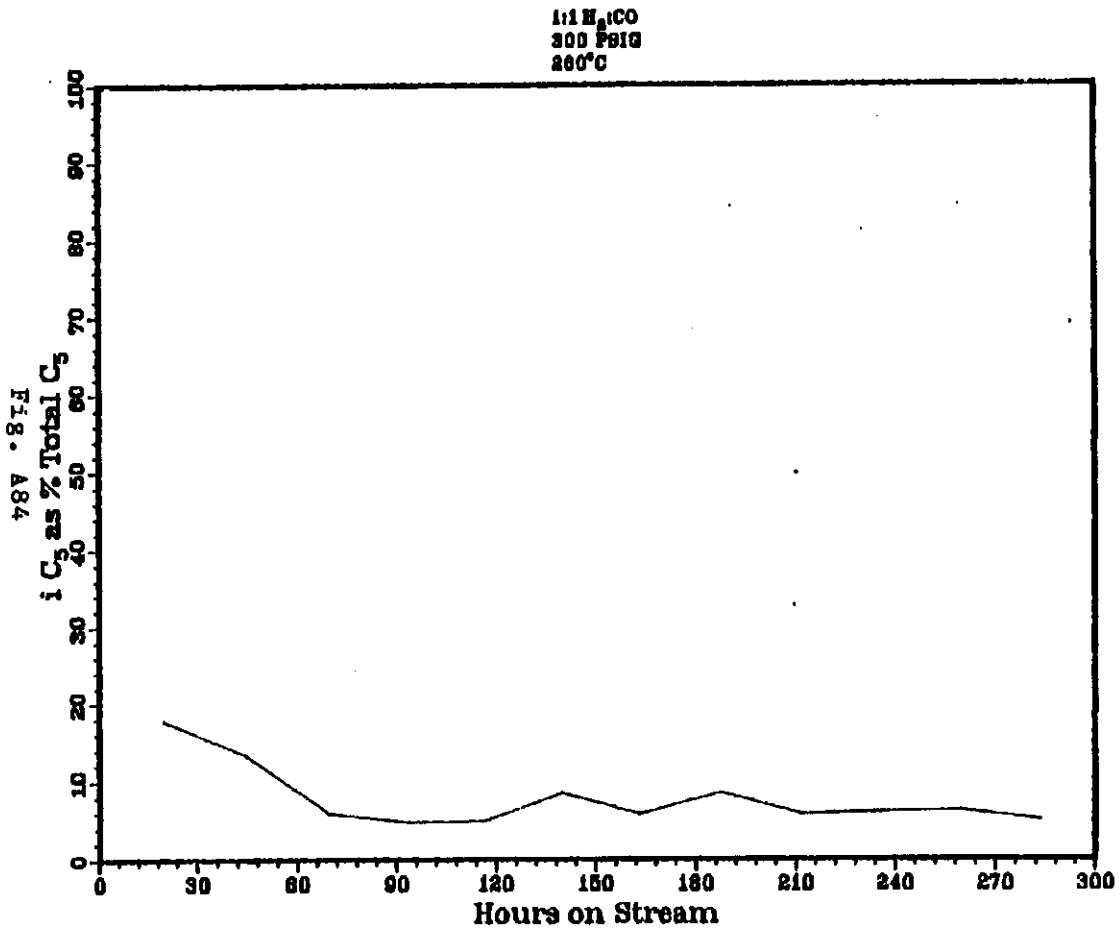

Fig. A84

RUN 11885-01

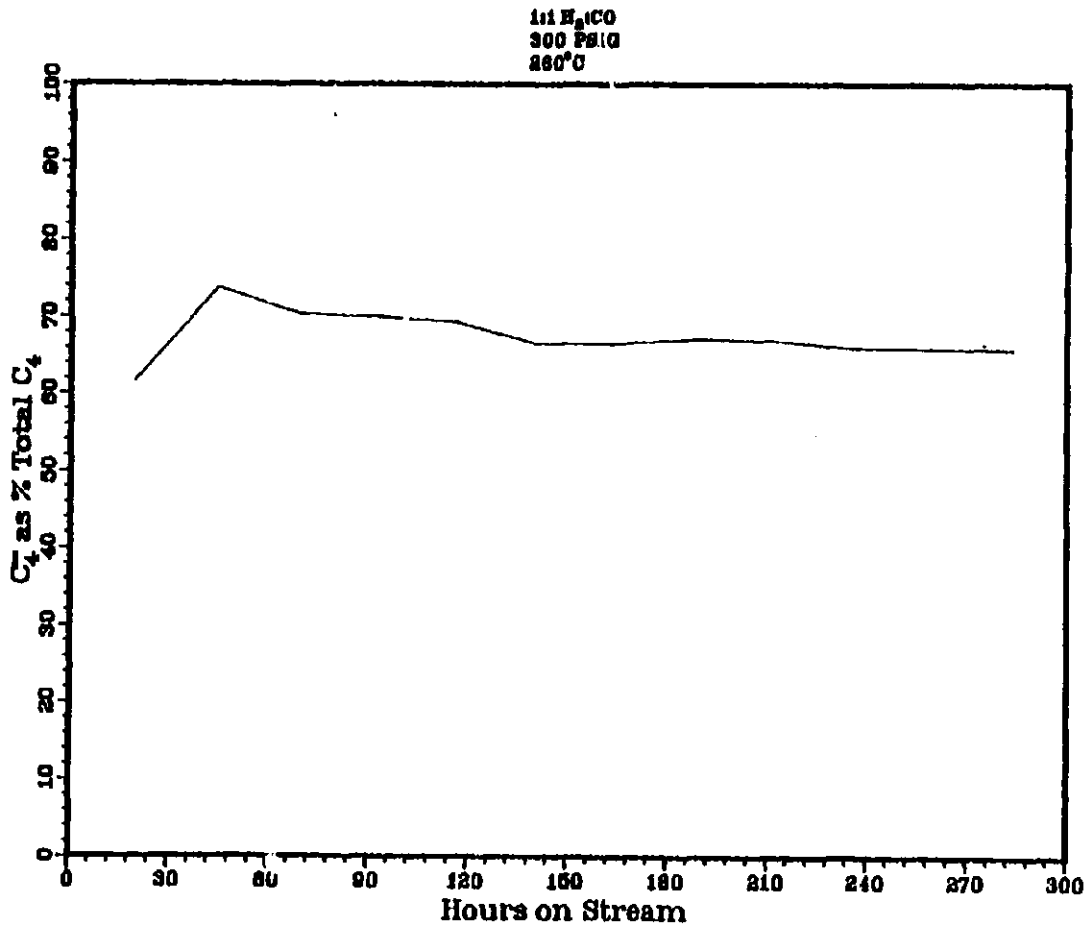

Fig. A85

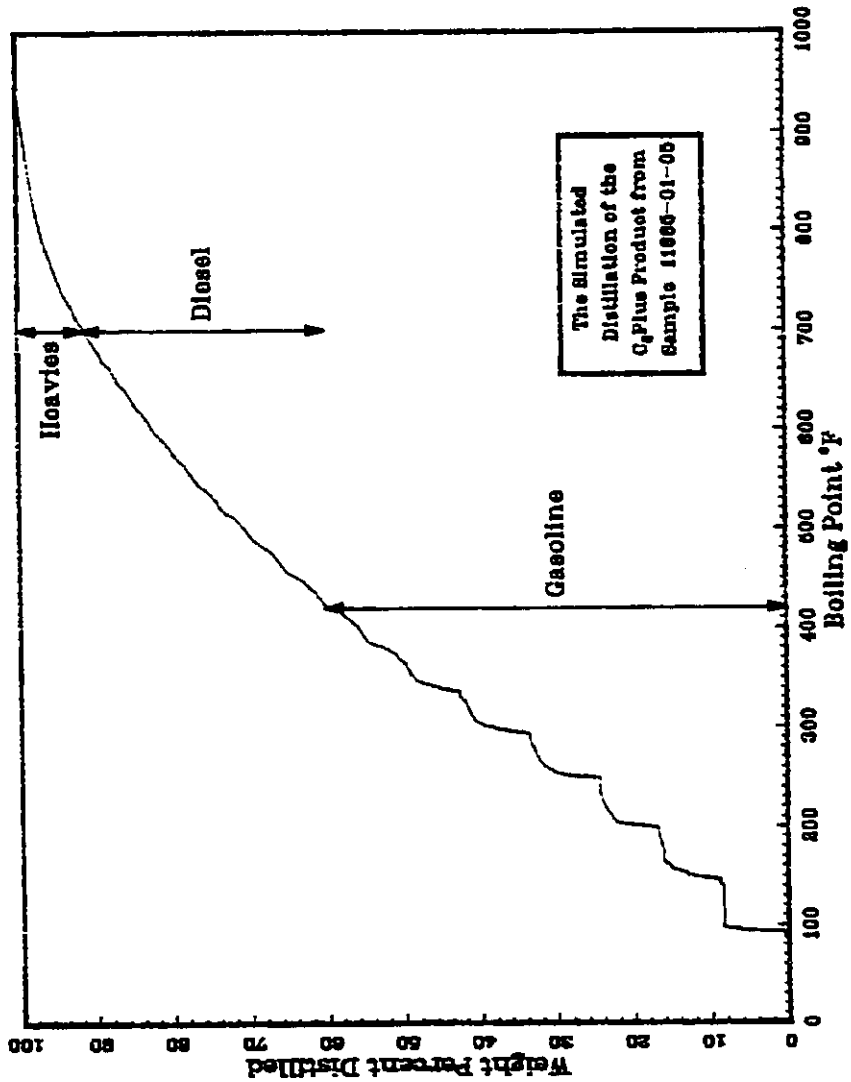
Weight Percent Distilled
0
10
20
30
40
50
60
70
80
90
100
Boiling Point, °F
0
100
200
300
400
500
600
700
800
900
1000
Gasoline
Diesel
Heavies
The Simulated Distillation of the C5 Plus Product from Sample 11866-01-05

Fig. A86