

Fig. 20

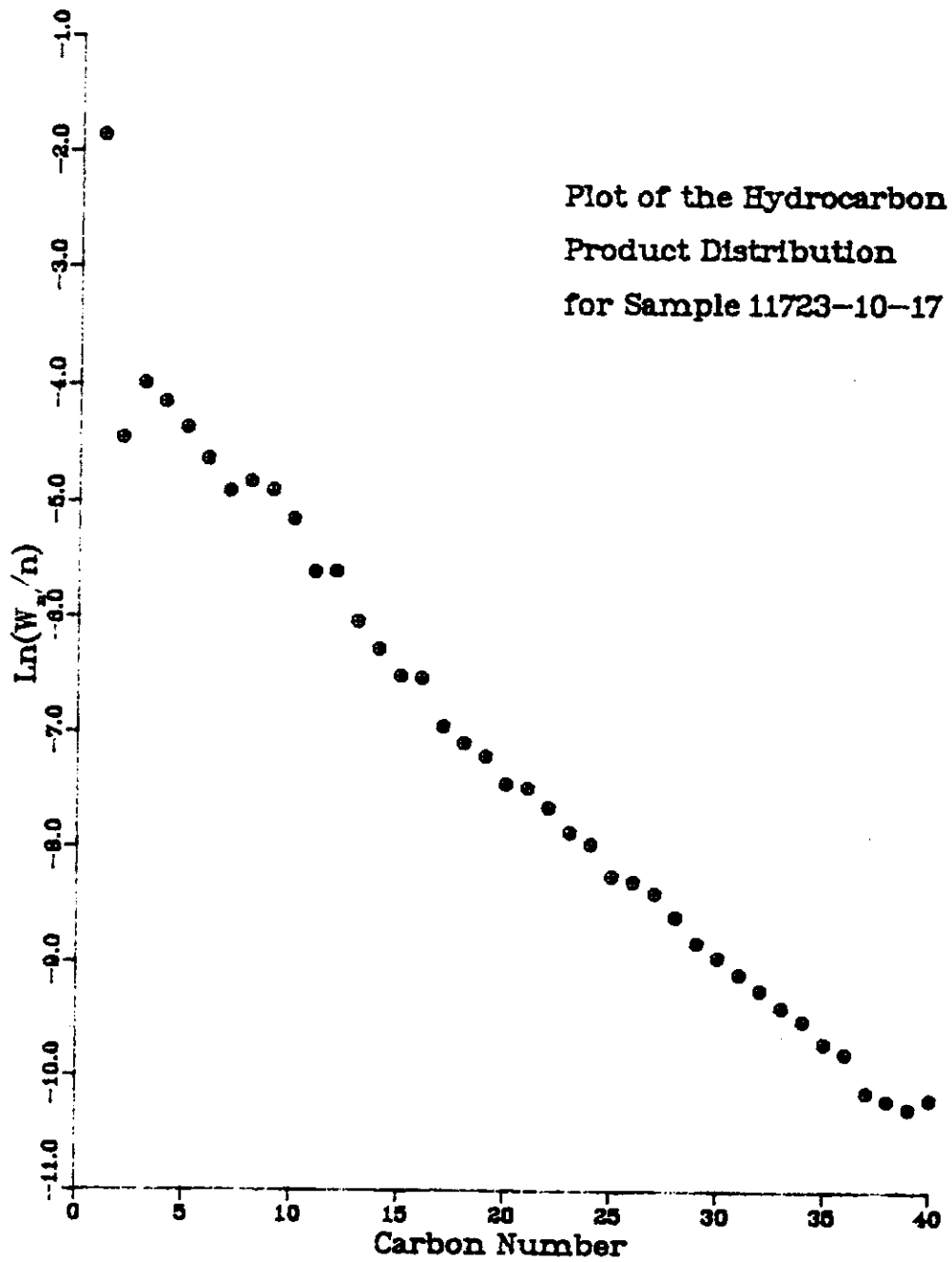


Fig. 21

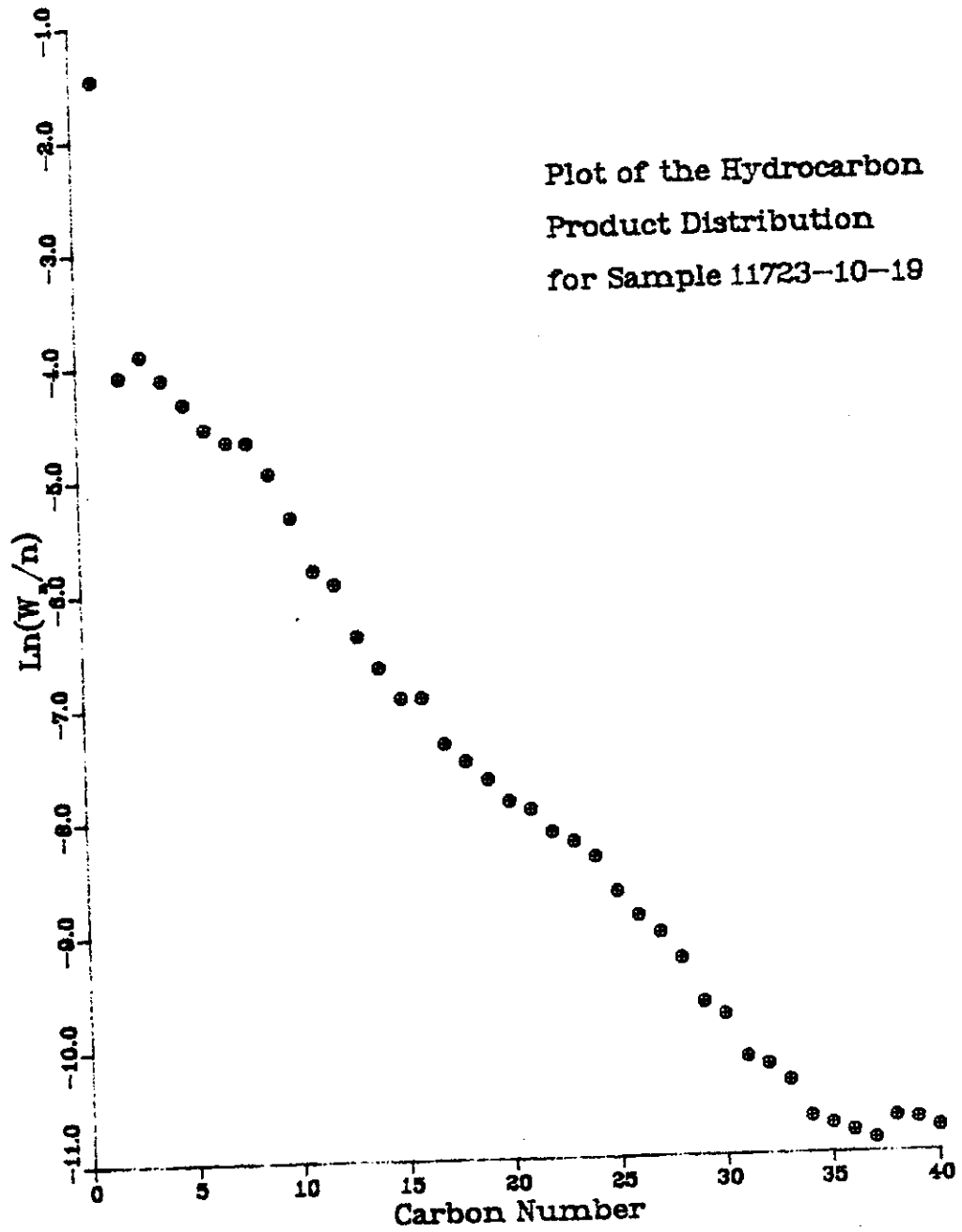


Table 1

RESULT OF SYNGAS OPERATION

RUN NO.	11723-10				
CATALYST	HiCoThU103+U101 11684-70C 250CC 112. G(132.2AFTER RUN +21 G)				
FEED	H2:CO:ARGON OF 50/50/0 @ 1260 CC/MN OR 302 GHSV				
RUN & SAMPLE NO.	11723-10-01	723-10-02	723-10-03	723-10-04	723-10-05
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	22.8	28.8	46.2	53.2	69.7
PRESSURE,PSIG :	302	302	301	301	302
TEMP. C	264	265	264	264	265
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	22.84	6.00	17.33	7.00	23.50
EFFLNT GAS LITER	606.69	168.44	506.90	207.85	702.67
GM AQUEOUS LAYER	224.89	61.19	175.28	70.92	238.08
GM OIL	94.93	26.91	71.66	29.13	97.80
MATERIAL BALANCE					
GM ATOM CARBON %	87.89	93.16	91.23	92.44	94.76
GM ATOM HYDROGEN %	91.96	98.14	96.48	97.28	100.38
GM ATOM OXYGEN %	93.30	97.09	96.84	97.82	97.27
RATIO CHX/(H2O+CO2)	0.8766	0.9136	0.8719	0.8778	0.9427
RATIO X IN CHX	2.2679	2.2792	2.3114	2.3127	2.3012
USAGE H2/CO PRDPT	1.7490	1.7282	1.8366	1.8289	1.7971
FEED H2/CO FRM EFFLNT	1.0463	1.0535	1.0575	1.0524	1.0593
RESIDUAL H2/CO RATIO	0.2831	0.2952	0.3153	0.3153	0.3217
RATIO CO2/(H2O+CO2)	0.1676	0.1694	0.1432	0.1448	0.1396
K SHIFT IN EFFLNT	0.0570	0.0602	0.0527	0.0534	0.0522
SPECIFIC ACTIVITY SA	4.8577	4.4400	3.6892	3.6301	3.5309
CONVERSION					
ON CO %	52.06	52.92	48.79	48.70	49.99
ON H2 %	87.03	86.81	84.73	84.63	84.81
ON CO+H2 %	69.94	70.31	67.26	67.12	67.90
PRDPT SELECTIVITY,WT %					
CH4	11.62	12.08	13.58	13.64	12.95
C2 HC'S	2.03	2.10	2.31	2.32	2.21
C3H8	2.33	2.52	2.70	2.71	2.85
C3H6=	2.03	2.19	2.12	2.13	2.25
C4H10	1.88	1.96	2.12	2.12	2.26
C4H8=	4.04	4.07	4.16	4.18	4.37
C5H12	2.26	2.33	2.38	2.39	2.59
C5H10=	4.43	4.47	4.43	4.45	4.59
C6H14	2.48	2.55	2.62	2.63	2.58
C6H12= & CYCLO'S	3.99	3.82	3.81	3.82	3.37
C7+ IN GAS	14.26	13.46	11.27	11.32	14.72
LIQ HC'S	48.66	48.46	48.49	48.28	45.25
TOTAL	100.00	100.00	100.00	100.00	100.00

Table 1 (continued)

SUB-GROUPING					
C1 -C4	23.92	24.91	27.00	27.11	26.90
C5 -420 F	52.04	49.40	47.30	46.96	48.80
420-700 F	21.19	21.63	20.21	19.82	18.58
700-END PT	2.85	4.06	5.49	6.10	5.72
C5+-END PT	76.08	75.09	73.00	72.89	73.10
ISO/NORMAL MOLE RATIO					
C4	0.1038	0.1134	0.0815	0.0815	0.0835
C5	0.1841	0.1716	0.1484	0.1484	0.1490
C6	0.3453	0.3397	0.2563	0.2563	0.1974
C4=	0.0598	0.0623	0.0634	0.0634	0.0671
PARAFFIN/OLEFIN RATIO					
C3	1.0947	1.0985	1.2154	1.2154	1.2084
C4	0.4492	0.4662	0.4907	0.4907	0.4998
C5	0.4960	0.5058	0.5216	0.5216	0.5481
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8093	0.8219	0.8286		0.8269
RATIO CH4/(1-A)**2	3.1943	3.8086	4.6250		4.3209
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLDY	CLDY	CLDY		CLDY
DENSITY	0.7568	0.7606	0.7606		0.7594
N, REFRACTIVE INDEX	1.4276	1.4286	1.4286		1.4286
SIMULT'D DISTILATN					
10 WT % @ DEG F	256	258	258		259
16	286	296	297		299
50	417	441	441		445
84	614	644	659		672
90	659	687	714		729
RANGE(16-84 %)	328	348	362		373
WT % @ 420 F	50.60	47.00	47.00	46.30	46.30
WT % @ 700 F	94.14	91.63	88.67	87.36	87.36

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Table 2

RESULT OF SYNGAS OPERATION

RUN NO. 11723-10
 CATALYST HiCoThU103+U101 11684-70C 250CC 111.84G(132.3AFTER RUN +21 G)
 FEED H2:CO:ARGON OF 50:50:0 @ 1260 CC/MN OR 302 GHSV

RUN & SAMPLE NO.	11723-10-06	723-10-07	723-10-08	723-10-09	723-10-10
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	77.2	93.7	101.2	119.2	125.2
PRESSURE, PSIG	300	300	301	301	301
TEMP. C	262	262	262	262	262
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	7.50	24.00	7.50	25.50	6.00
EFFLNT GAS LITER	230.08	747.03	237.40	790.20	193.50
GM AQUEOUS LAYER	75.96	243.06	69.35	235.80	58.10
GM OIL	32.45	103.83	31.94	108.62	24.13
MATERIAL BALANCE					
GM ATOM CARBON %	94.46	93.36	94.49	92.82	94.14
GM ATOM HYDROGEN %	99.18	99.95	97.57	99.37	97.90
GM ATOM OXYGEN %	97.43	96.90	96.08	92.09	97.01
RATIO CHX/(H2O+CO2)	0.9296	0.9156	0.9607	1.0191	0.9284
RATIO X IN CHX	2.2808	2.2855	2.3343	2.3551	2.3112
USAGE H2/CO PRDCT	1.8771	1.9069	1.7975	1.8727	1.9283
FEED H2/CO FRM EFFLNT	1.0500	1.0706	1.0325	1.0705	1.0399
RESIDUAL H2/CO RATIO	0.3294	0.3612	0.3556	0.3751	0.3533
RATIO CO2/(H2O+CO2)	0.1095	0.1033	0.1410	0.1015	0.0965
K SHIFT IN EFFLNT	0.0405	0.0416	0.0584	0.0424	0.0377
SPECIFIC ACTIVITY SA	3.5404	3.0640	3.2037	2.9303	2.8895
CONVERSION					
ON CO %	46.56	45.90	46.95	46.43	43.59
ON H2 %	83.24	81.75	81.73	81.23	80.84
ON CO+H2 %	65.35	64.43	64.61	64.42	62.58
PRDCT SELECTIVITY, WT %					
CH4	12.16	12.32	14.72	12.76	13.78
C2 HC'S	2.16	2.26	2.42	2.10	2.15
C3H8	2.49	2.53	2.78	2.76	2.61
C3H6=	1.99	1.95	1.99	2.32	1.96
C4H10	1.97	1.97	2.18	2.39	1.89
C4H8=	3.78	3.72	3.10	3.63	3.41
C5H12	2.24	2.31	2.41	2.44	2.30
C5H10=	4.15	4.04	3.57	4.51	4.17
C6H14	2.53	2.57	2.64	2.69	2.40
C6H12= & CYCLO'S	3.59	3.82	3.68	3.44	3.41
C7+ IN GAS	13.53	12.03	11.24	12.39	13.41
LIQ HC'S	49.41	50.46	49.27	48.57	48.50
TOTAL	100.00	100.00	100.00	100.00	100.00

Table 2 (continued)

SUB-GROUPING					
C1 -C4	24.55	24.76	27.19	25.96	25.81
C5 -420 F	48.91	48.14	47.84	49.43	49.11
420-700 F	20.32	20.75	18.39	18.13	18.87
700-END PT	6.22	6.35	6.57	6.48	6.21
C5+-END PT	75.45	75.24	72.81	74.04	74.19
ISO/NORMAL MOLE RATIO					
C4	0.0673	0.0645	0.0623	0.1067	0.1287
C5	0.1133	0.1088	0.1190	0.1520	0.1048
C6	0.1930	0.1932	0.2119	0.2674	0.1639
C4=	0.0613	0.0625	0.0875	0.0812	0.0649
PARAFFIN/OLEFIN RATIO					
C3	1.1938	1.2371	1.3334	1.1369	1.2719
C4	0.5022	0.5118	0.6791	0.6370	0.5343
C5	0.5253	0.5552	0.6579	0.5256	0.5351
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))		0.8313		0.8296	
RATIO CH4/(1-A)**2		4.3313		4.3929	
LIQ HC COLLECTION					
PHYS. APPEARANCE		CLDY/SLD		CLDY/SLD	
DENSITY		0.7586		0.7582	
N, REFRACTIVE INDEX		1.4283		1.4276	
SIMULT'D DISTILATN					
10 WT % @ DEG F		260		256	
16		300		289	
50		443		426	
84		669		674	
90		730		737	
RANGE(16-84 %)		369		385	
WT % @ 420 F	46.30	46.30	49.33	49.33	48.30
WT % @ 700 F	87.42	87.42	86.66	86.66	87.20

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Table 3

RESULT OF SYNGAS OPERATION

RUN NO.	11723-10				
CATALYST	HiCoThU103+U101 11684-70C 250CC 111.84(132.2AFTER RUN +21 G)				
FEED	H2:CO:ARGON OF 50:50:0 @ 1260 CC/MN OR 302 GHSV				
RUN & SAMPLE NO.	11723-10-11	723-10-12	723-10-13	723-10-14	723-10-15
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	141.7	148.2	166.2	171.7	190.4
PRESSURE,PSIG	299	298	302	301	301
TEMP. C	263	263	263	263	263
FEED CC/MIN	1260	1260	1260	1260	1260
HOURS FEEDING	22.50	6.50	24.50	5.50	24.25
EFFLNT GAS LITER	732.65	215.20	800.30	182.50	797.60
GM AQUEOUS LAYER	217.86	62.80	236.70	53.77	237.10
GM OIL	90.47	27.60	104.03	25.04	110.39
MATERIAL BALANCE					
GM ATOM CARBON %	93.22	95.67	94.74	97.26	96.90
GM ATOM HYDROGEN %	97.78	99.41	99.44	101.80	101.73
GM ATOM OXYGEN %	97.41	98.58	97.28	98.78	98.02
RATIO CHX/(H2O+CO2)	0.8960	0.9281	0.9368	0.9626	0.9725
RATIO X IN CHX	2.3385	2.3333	2.3285	2.3236	2.3195
USAGE H2/CO PRODT	1.9497	1.9140	1.9173	1.8941	1.8974
FEED H2/CO FRM EFFLNT	1.0490	1.0391	1.0497	1.0467	1.0498
RESIDUAL H2/CO RATIO	0.3655	0.3622	0.3677	0.3657	0.3643
RATIO CO2/(H2O+CO2)	0.1019	0.1051	0.1009	0.1020	0.0976
K SHIFT IN EFFLNT	0.0415	0.0426	0.0413	0.0415	0.0394
SPECIFIC ACTIVITY SA	2.6087	2.6809	2.6334	2.6961	2.7432
CONVERSION					
ON CO %	43.14	43.62	44.01	44.56	44.71
ON H2 %	80.19	80.35	80.38	80.63	80.81
ON CO+H2 %	62.11	62.34	62.64	63.01	63.20
PRDT SELECTIVITY,WT %					
CH4	15.05	14.71	14.61	14.39	14.23
C2 HC'S	2.42	2.44	2.32	2.31	2.29
C3H8	2.71	2.80	2.70	2.64	2.56
C3H6=	1.96	1.98	1.96	1.88	1.81
C4H10	2.06	2.07	2.04	2.01	1.93
C4H8=	3.41	3.57	3.33	3.31	3.30
C5H12	2.34	2.48	2.34	2.33	2.25
C5H10=	4.23	4.27	3.65	4.18	3.94
C6H14	2.38	2.37	2.36	2.28	2.30
C6H12= & CYCLO'S	3.30	3.50	3.39	3.27	2.98
C7+ IN GAS	10.32	9.11	10.79	9.35	10.61
LIQ HC'S	49.82	50.70	50.52	52.04	51.79
TOTAL	100.00	100.00	100.00	100.00	100.00

Table 3 (continued)

SUB-GROUPING					
C1 -C4	27.60	27.58	26.96	26.55	26.12
C5 -420 F	46.64	45.16	45.88	45.00	45.56
420-700 F	19.38	20.17	20.10	20.06	19.97
700-END PT	6.38	7.10	7.07	8.39	8.35
C5+-END PT	72.40	72.42	73.04	73.45	73.88
ISO/NORMAL MOLE RATIO					
C4	0.0556	0.0497	0.0503	0.0524	0.0509
C5	0.0983	0.0977	0.1014	0.0939	0.0907
C6	0.1625	0.1482	0.1499	0.1755	0.1522
C4=	0.0664	0.0701	0.0686	0.0688	0.0703
PARAFFIN/OLEFIN RATIO					
C3	1.3172	1.3515	1.3137	1.3387	1.3469
C4	0.5836	0.5609	0.5909	0.5871	0.5644
C5	0.5364	0.5652	0.6242	0.5426	0.5567
SCHULZ-FLORY DISTRBTN					
ALPHA (EXP(SLOPE))	0.8275		0.8328		0.8381
RATIO CH4/(1-A)**2	5.0583		5.2263		5.4281
LIQ HC COLLECTION					
PHYS. APPEARANCE	CLDY/SLD		CLDY/SLD		CLDY/SLD
DENSITY	0.7625		0.7578		0.7552
N, REFRACTIVE INDEX	1.4291		1.4292		1.4307
SIMULT'D DISTILATN					
10 WT % @ DEG F	260		261		260
16	300		299		299
50	432		444		447
84	665		679		701
90	737		752		773
RANGE(16-84 %)	365		380		402
WT % @ 420 F	48.30	46.22	46.22	45.33	45.33
WT % @ 700 F	87.20	86.00	86.00	83.88	83.88

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Table 4

RESULT OF SYNGAS OPERATION

RUN NO.	11723-10			
CATALYST	HiCoThU103+U101 11684-70C 250CC 111.84G(132.2AFTER RUN +21 G)			
FEED	H2:CO:ARGON OF 50:50:0 @ 1260 CC/MN OR 302 GHSV			
RUN & SAMPLE NO.	11723-10-16	723-10-17	723-10-18	723-10-19
	*****	*****	*****	*****
FEED H2:CO:AR	50:50: 0	50:50: 0	50:50: 0	50:50: 0
HRS ON STREAM	194.7	213.7	221.2	237.7
PRESSURE,PSIG	301	297	300	300
TEMP. C	263	263	271	278
FEED CC/MIN	1260	1260	1260	1260
HOURS FEEDING	4.25	23.25	7.50	24.00
EFFLNT GAS LITER	139.60	806.50	242.90	756.50
GM AQUEOUS LAYER	39.70	217.17	67.31	215.40
GM OIL	16.93	92.60	25.30	80.99
MATERIAL BALANCE				
GM ATOM CARBON %	94.33	98.10	95.11	98.13
GM ATOM HYDROGEN %	98.05	101.13	96.62	104.20
GM ATOM OXYGEN %	96.11	99.07	96.86	97.45
RATIO CHX/(H2O+CO2)	0.9543	0.9753	0.9562	1.0156
RATIO X IN CHX	2.3421	2.3529	2.4225	2.5173
USAGE H2/CO PRODT	1.9128	1.8952	1.7962	1.6278
FEED H2/CO FRM EFFLNT	1.0395	1.0309	1.0159	1.0618
RESIDUAL H2/CO RATIO	0.3678	0.3786	0.3298	0.3315
RATIO CO2/(H2O+CO2)	0.1003	0.1033	0.1576	0.2379
K SHIFT IN EFFLNT	0.0410	0.0436	0.0617	0.1035
SPECIFIC ACTIVITY SA	2.6069	2.4922	2.2653	2.1354
CONVERSION				
ON CO %	43.47	43.01	46.79	56.34
ON H2 %	80.00	79.07	82.73	86.37
ON CO+H2 %	62.09	61.31	64.90	71.80
PRDT SELECTIVITY,WT %				
CH4	14.99	15.57	18.89	23.22
C2 HC'S	2.41	2.33	2.93	3.39
C3H8	2.97	3.05	3.43	4.07
C3H6=	2.44	2.50	2.32	2.02
C4H10	2.42	2.53	2.44	2.87
C4H8=	3.80	3.80	3.98	3.72
C5H12	2.63	2.48	2.70	3.04
C5H10=	4.43	3.84	4.53	3.59
C6H14	2.48	2.54	2.54	3.06
C6H12= & CYCLO'S	3.24	3.27	3.20	3.31
C7+ IN GAS	10.18	11.41	13.76	14.42
LIQ HC'S	48.02	46.67	39.28	33.29
TOTAL	100.00	100.00	100.00	100.00

Table 4 (continued)

SUB-GROUPING				
C1 -C4	29.02	29.78	33.99	39.29
C5 -420 F	44.67	44.65	47.20	44.77
420-700 F	18.83	18.30	14.41	12.21
700-END PT	7.48	7.27	4.40	3.73
C5+-END PT	70.98	70.22	66.01	60.71
ISO/NORMAL MOLE RATIO				
C4	0.0807	0.1001	0.0552	0.0778
C5	0.1078	0.1203	0.0996	0.1538
C6	0.1923	0.1811	0.1709	0.3435
C4=	0.0824	0.0818	0.0781	0.0986
PARAFFIN/OLEFIN RATIO				
C3	1.1635	1.1618	1.4106	1.9184
C4	0.6148	0.6416	0.5911	0.7436
C5	0.5777	0.6277	0.5786	0.8233
SCHULZ-FLORY DISTRBTN				
ALPHA (EXP(SLOPE))		0.8301	0.8036	0.8039
RATIO CH4/(1-A)**2		5.3951	4.8970	6.0363
LIQ HC COLLECTION				
PHYS. APPEARANCE		CLDY/SLD		CLDY/SLD
DENSITY		0.7623		0.7569
N, REFRACTIVE INDEX		1.4301		1.4266
SIMULT'D DISTILATN				
10 WT % @ DEG F		261		254
16		300		285
50		447		413
84		695		649
90		768		714
RANGE(16-84 %)		395		364
WT % @ 420 F	45.20	45.20	52.11	52.11
WT % @ 700 F	84.42	84.42	88.80	88.80

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III. Run 2 (11677-14) with Catalyst 2 (Co/Th/UCC-103+UCC-101)

This catalyst is of the same composition and preparation as Catalyst 1 except that it was reduced in hydrogen at the usual temperature of 350C instead of 400C. It was run in a smaller charge than usual (80cc vs. 250cc), and for a shorter period (92 hours), to test whether the lower reduction temperature might affect its initial activity.

Conversion, product selectivity, isomerization of the pentane, and percent olefins of the C₄'s are plotted against time on stream in Figs. 22-25. Simulated distillations of the C₅⁺ product are plotted in Figs. 26-28. Carbon number product distributions are plotted in Figs. 29-32. Detailed material balances appear in Tables 5-6.

The run was too short to yield much useful information about deactivation. In terms of material balances, and of product selectivity as a function of time on stream, only the last two samples fairly represent the catalyst's activity. Comparison of Sample 7 with Sample 7 of Catalyst 1 shows similar levels of conversion and a small difference in water gas shift activity. The usage ratio of this catalyst was 1.8 as against 1.9 for Catalyst 1, which accounts for the difference in specific activity.

The differences in selectivity, however, were significant. As compared with Catalyst 1, at 92 hours on stream this catalyst

was producing just over 10 percent methane against 12 percent, 4 percent more C₅⁺, 10 percent less gasoline, 4 percent more diesel fuel, and 10 percent more heavies. During this short run, at least, the lower reduction temperature materially improved the production of heavier hydrocarbons.

RUN 11677-14

1:1 H₂:CO
300 PSIG
280°C

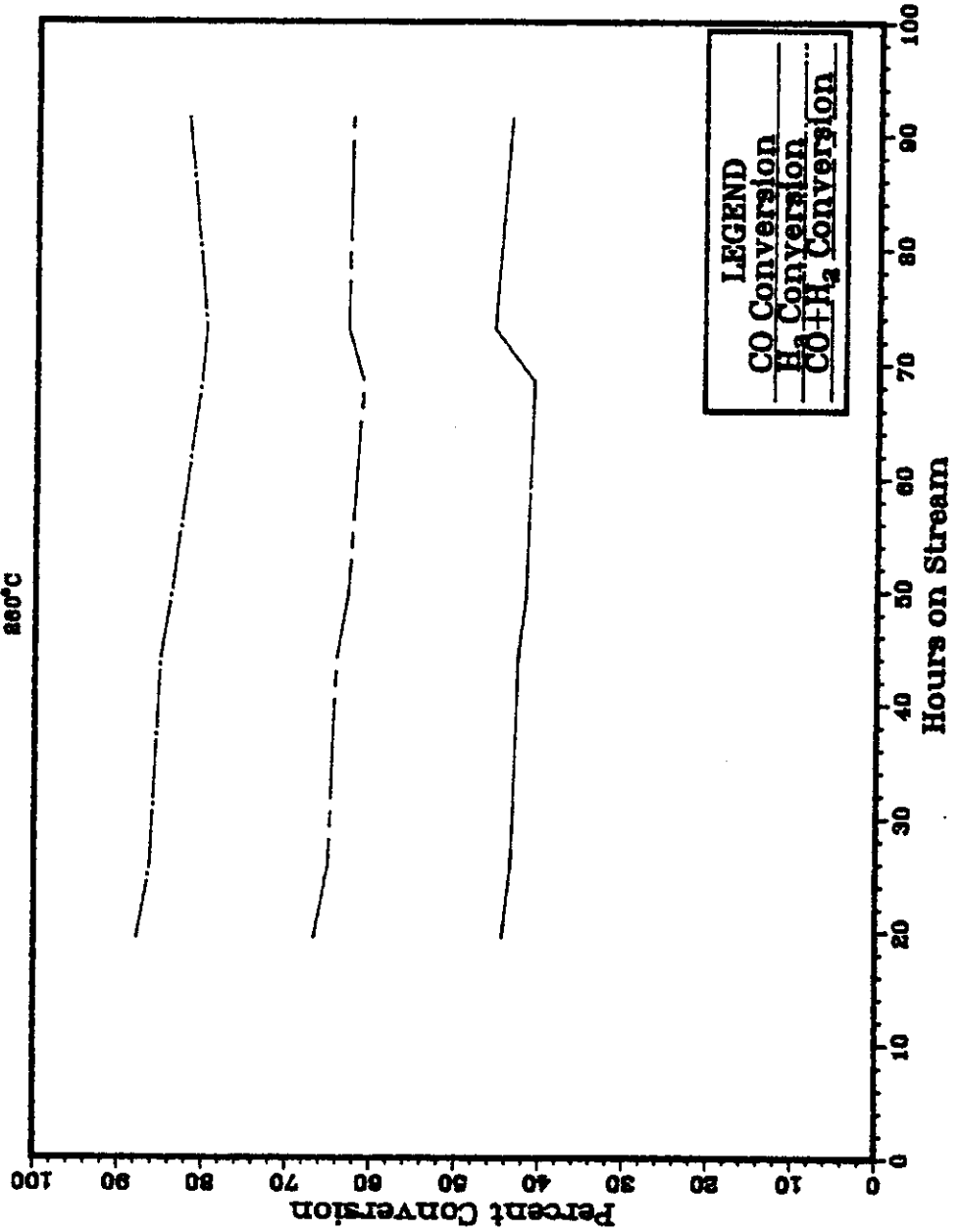


Fig. 22

Fig. 23

RUN 11677-14

1:1 H₂:CO
300 PSIG
280°C

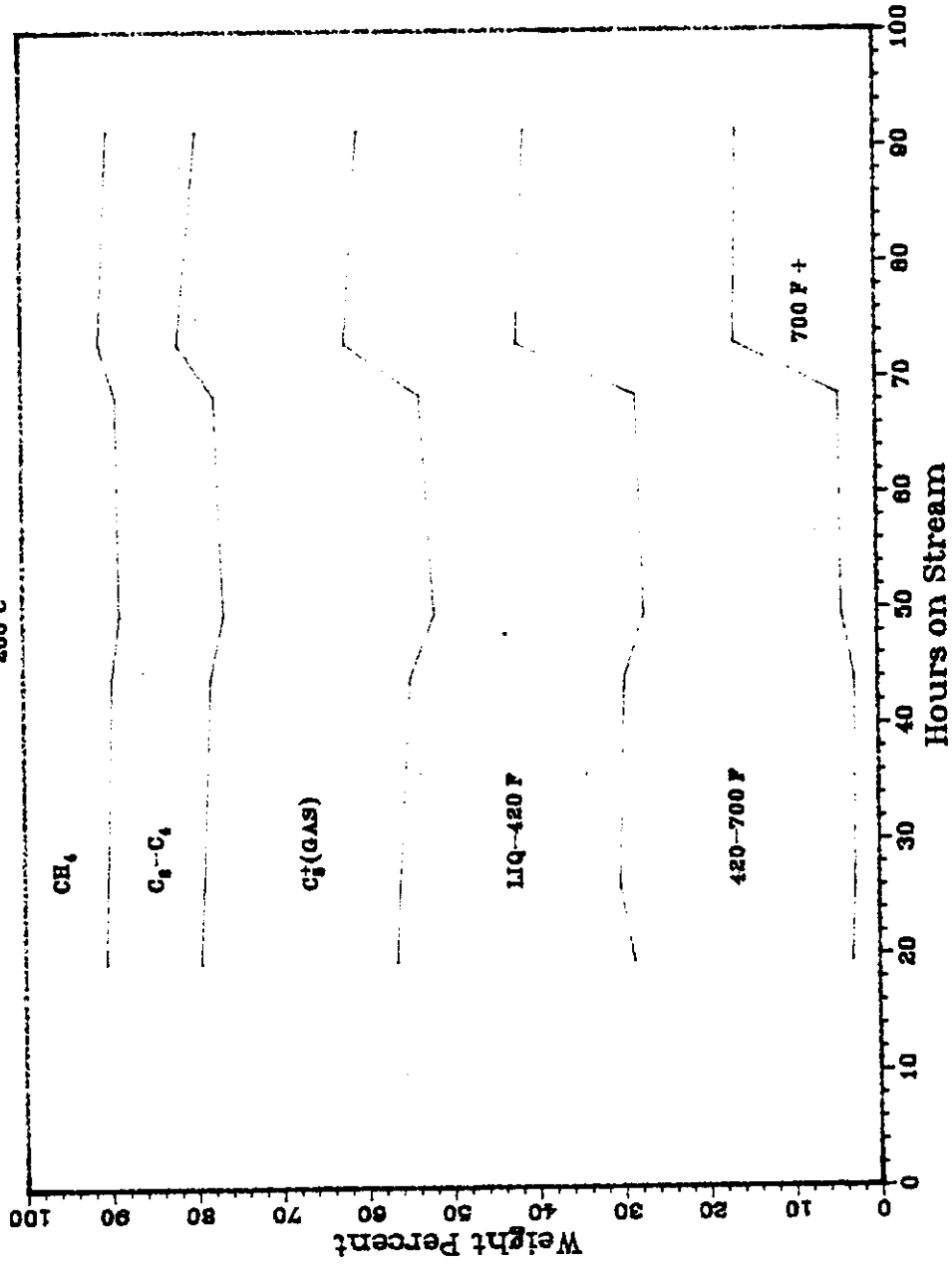


Fig. 24

RUN 11677-14

1:1 H₂:CO
300 Psig
200°C

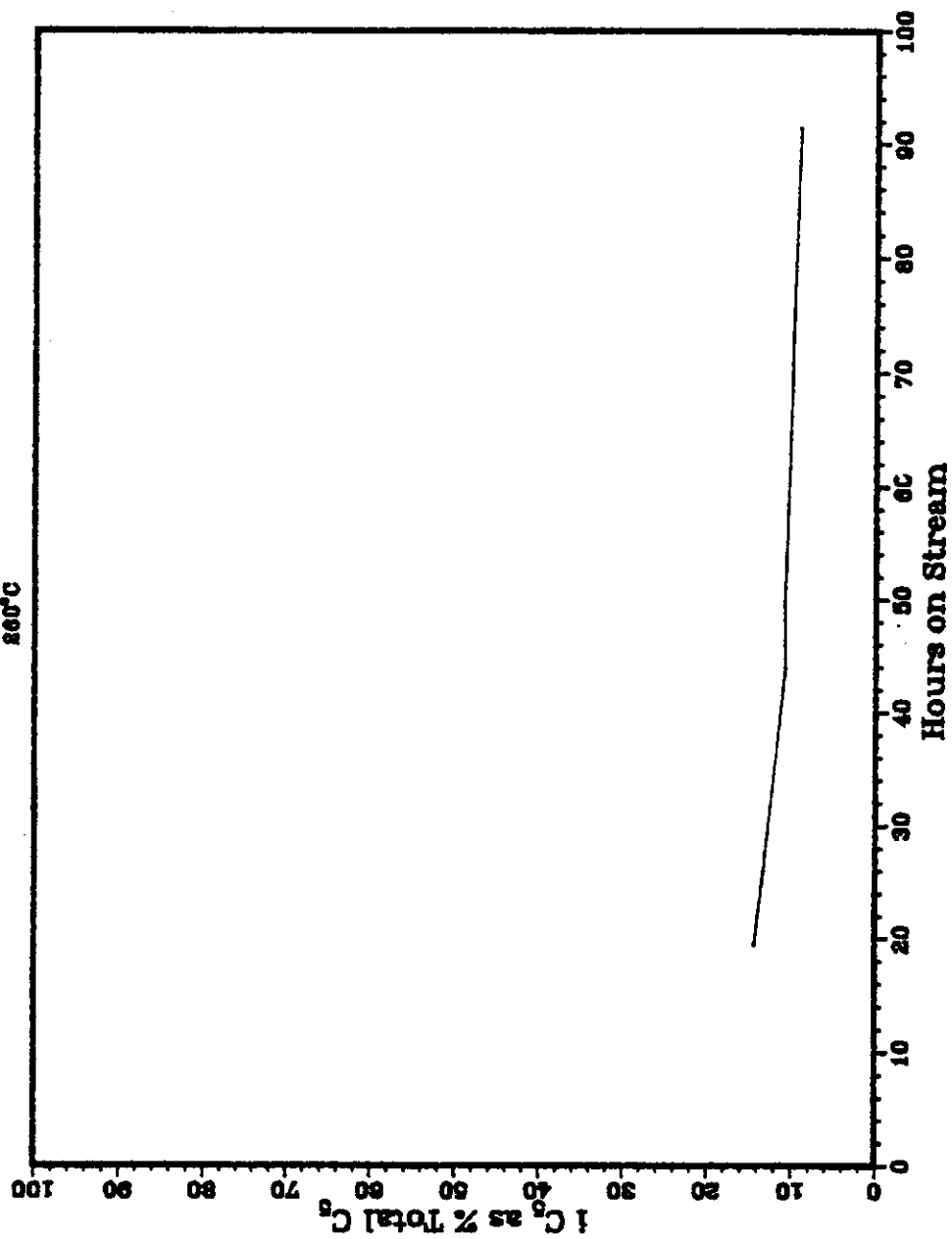


Fig. 25

RUN 11677-14

1:1 H₂O
300 PSIG
200°C

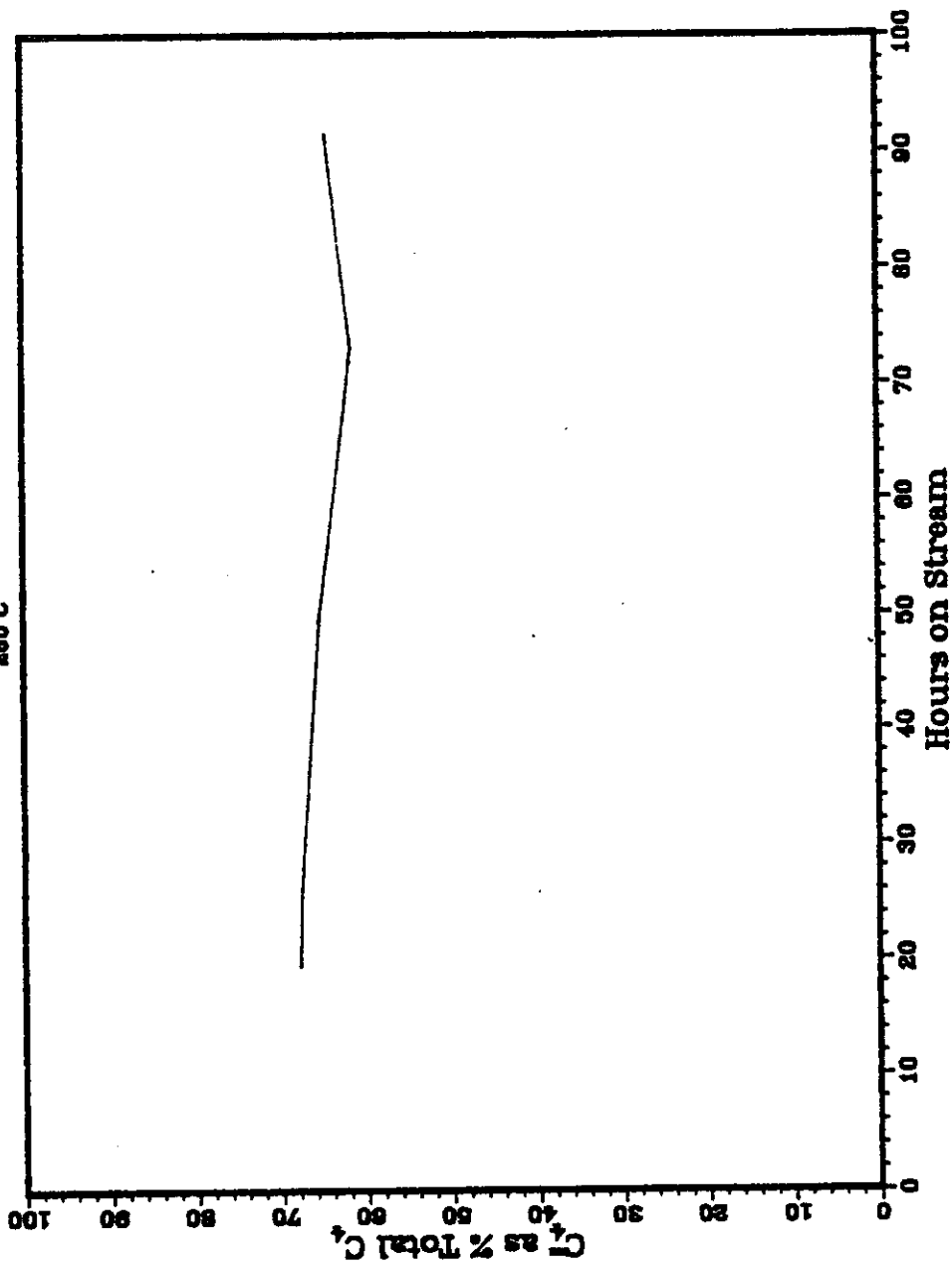


Fig. 26

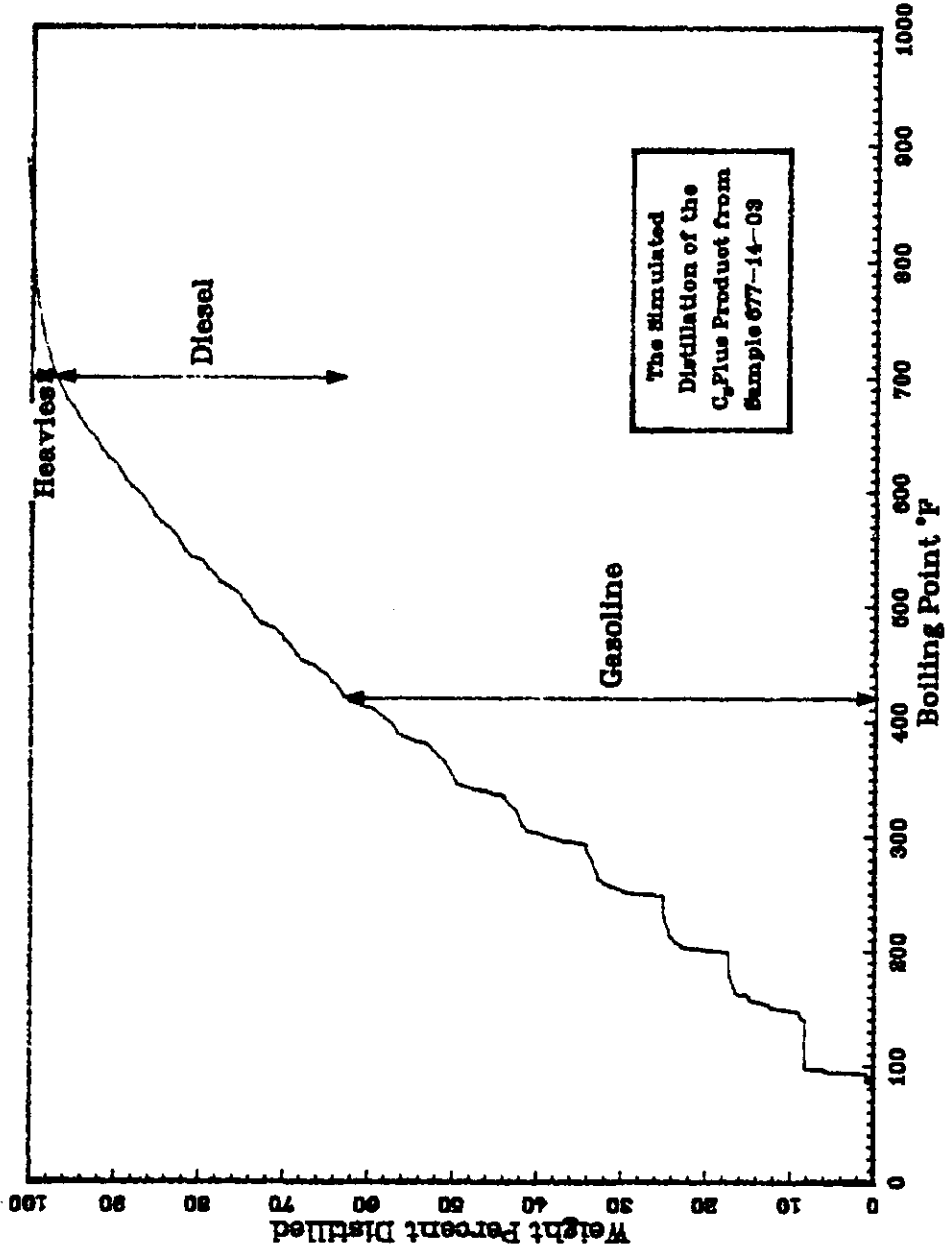


Fig. 27

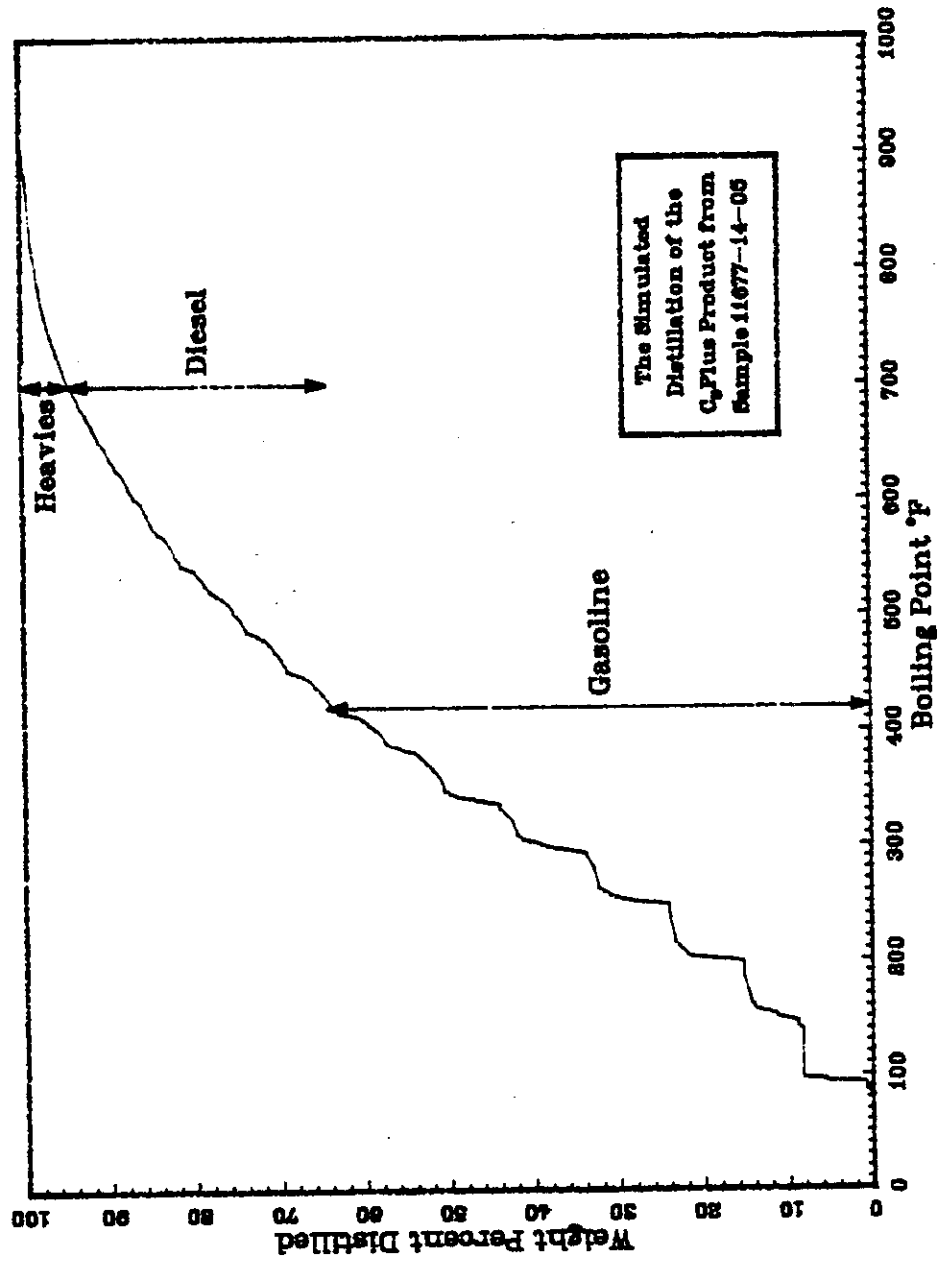


Fig. 28

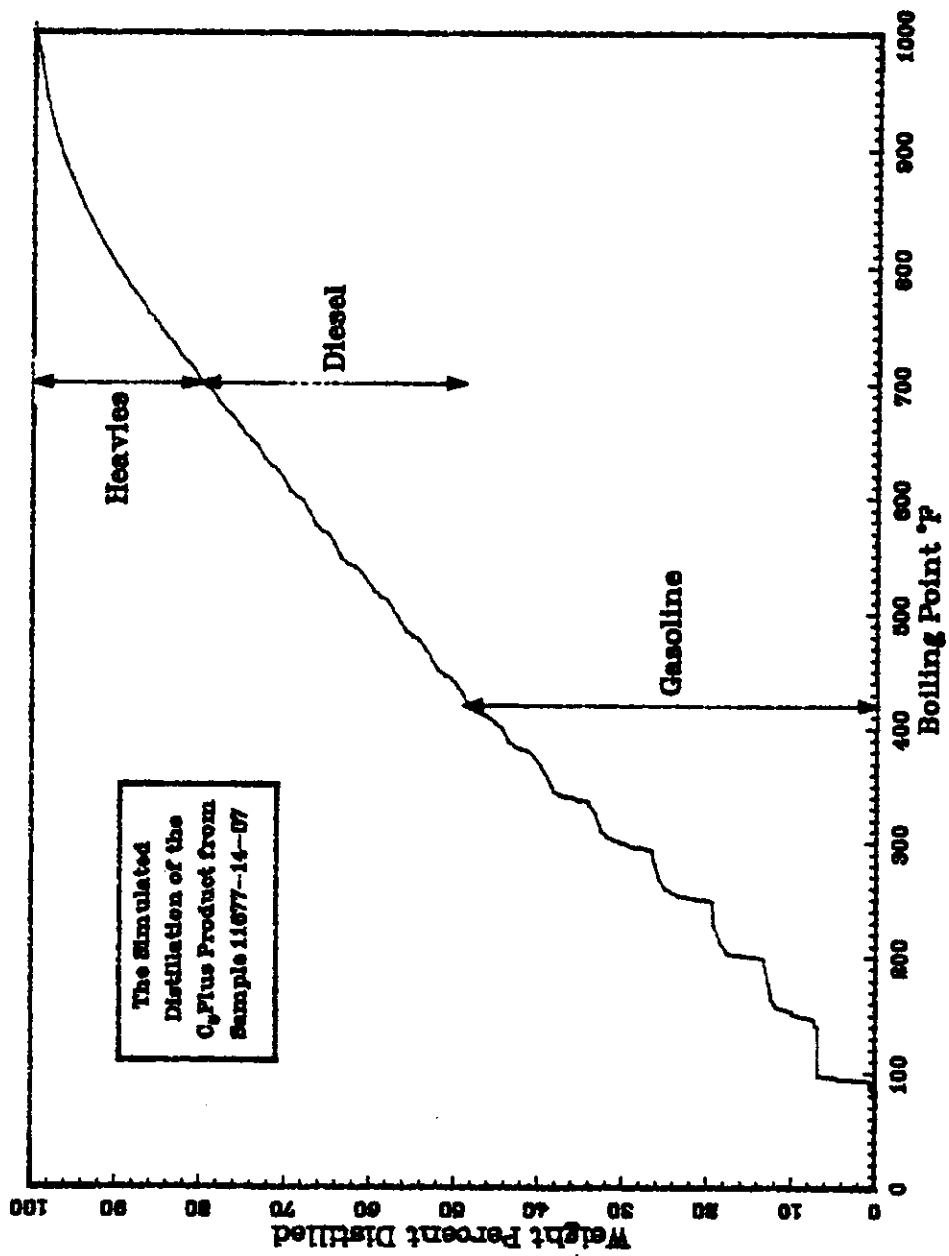


Fig. 29

