

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	913.5	901.5	1045	666.3
Net Btu Recovery, 1000 Btu/lb	4.152	2.625	4.418	3.117
Product Gas Yield, SCF/lb	21.59	13.70	22.66	17.93
Hydrocarbon Yield, SCF/lb	4.84	4.06	4.71	3.24
Carbon Oxides Yield, SCF/lb	1.64	1.15	2.58	2.08
Net Reacted Hydrogen, SCF/lb	4.21	5.65	3.30	2.65
Residuc, lb/lb coal ^h	0.713	0.751	0.556	0.625
Liquid Products, lb/lb coal ⁱ	0.624	0.562	0.542	0.224
Net MAF Coal Hydrogasified, wt % ^j	39.3	26.9	47.0	32.5
Carbon Gasified, wt %	30.9	24.6	33.8	26.3
Steam Decomposed, lb/hr ^k	0.29	1.072	1.026	1.26
Steam Decomposed, % of steam fed	1.12	2.84	4.08	13.7
Steam Decomposed, % of total equivalent fed ^m	17.9	23.3	21.9	48.6
Overall Material Balance, %	102.2	98.5	99.0	95.0
Carbon Balance, %	113.2	109.1	96.0	97.0
Hydrogen Balance, %	100.4	93.0	99.4	92.0
Oxygen Balance, %	97.2	88.2	105.6	87.8

PRODUCT GAS PROPERTIES

Gas Composition, mole %				
Nitrogen	35.2	17.7	33.4	35.7
Carbon Monoxide	4.1	4.0	5.7	8.4
Carbon Dioxide	3.5	4.4	5.7	3.2
Hydrogen	34.6	44.2	34.2	34.4
Methane	21.6	28.7	20.2	17.7
Ethane	0.6	0.7	0.5	0.3
Propane	0.2	0.2	0.1	0.1
Butane	0.0	0.0	0.0	---
Benzene	0.2	0.1	0.2	0.2
Hydrogen Sulfide	0.0	0.0	0.0	---
Total	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	559	560	521	510
Specific Gravity (Air = 1.00)	0.594	0.481	0.615	0.609
Nitrogen Purge Rate, SCF/hr	322	160	349	238

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in. for Runs HT-173 and HT-224.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature) / cross-sectional area of reactor.
- h. By ash balance for Runs HT-138 and HT-173; by weight of residue recovered for Run HT-224 and based on moisture-, ash-free coal conversion to gas and liquids for Run HT-154.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt feed gas in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

Table 2-A7, Part 1, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRE-TREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL, HYDROGEN + METHANE STEAM FEED GAS (Runs HT-95, -96, -104, -105, -106, and -109)

Coal Source	Ireland Mine Bituminous Coal IGT Pretreater Runs FP-46, FP-50, and FP-54 10/80	Ireland Mine Bituminous Coal IGT Pretreater Runs FP-46, FP-50, and FP-54 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-53 10/80	Ireland Mine Bituminous Coal IGT Pretreater Runs FP-56 and FP-57 10/80	Ireland Mine Bituminous Coal IGT Pretreater Runs FP-56 and FP-57 10/80	Ireland Mine Bituminous Coal IGT Pretreater Runs FP-56 and FP-57 10/80
Sieve Size, USS Feed Gas	Hydrogen + Methane + Steam					
Run No.	HT-95	HT-96	HT-104	HT-105	HT-106	HT-109
Duration of Test, hr	4	1-1/2	8-3/4	5-1/2	4	5
Steady-State Operating Period, min ^a	117-243	85-95	383-490	378-416	320-340	215-305
OPERATING CONDITIONS						
Bed Height, ft	3.5	3.5	3.5	3.5	3.5	3.5
Reactor Pressure, psig	1035	1052	998	978	1009	1017
Reactor Temperature, °F						
62-1/2 in.	----	----	1375	1395	1410	1320
73 in.	----	----	1420	1420	1455	1365
83 in.	----	----	1450	1440	1495	1410
94-1/2 in.	----	----	1340	1450	1515	1510
104 in.	----	----	1245	1455	1530	1595
114 in.	1160	1150	----	----	----	----
124-1/2 in.	1155	1110	----	----	----	----
135 in.	1145	1100	----	----	----	----
145 in.	1225	1110	----	----	----	----
155-1/2 in.	1310	1130	----	----	----	----
Average	1200	1120	1365	1430	1480	1440
Coal Rate, lb/hr ^b	24.37	21.82	52.71	46.60	46.9	59.0
Feed Gas Rate, SCF/hr ^c	906.2	1060	1123	736	718.5	1071
Steam Rate, lb/hr	4.00	19.26	23.34	16.45	17.50	23.65
Steam, mole % of hydrogen-steam mixture	8.5	27.6	30.4	31.9	33.8	31.7
Hydrogen/Coal Ratio, % of stoichiometric ^c	55.1	76.1	37.3	27.2	27.9	31.9
Hydrogen/Steam Ratio, mole/mole	6.704	1.643	1.546	1.422	1.317	1.476
Bed Pressure Differential, in. wc	----	----	----	----	----	----
Coal Space Velocity, lb/cu ft-hr	78.77	70.52	170.4	150.8	151.5	191.0
Feed Gas Residence Time, min ^e	0.419	0.297	0.225	0.317	0.318	0.220
Superficial Feed Gas Velocity, ft/sec ^f	0.139	0.193	0.260	0.184	0.184	0.258

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1257	1711	1571	1207	1141	1453
Net Btu Recovery, 1000 Btu/lb	2.940	5.744	2.578	2.375	1.987	2.120
Product Gas Yield, SCF/lb	51.57	78.41	29.45	25.88	24.30	24.60
Hydrocarbon Yield, SCF/lb	3.45	3.84	3.91	3.47	3.63	3.66
Gaseous Hydrocarbon Space-Time Yield, SCF/cu ft-hr ^g	271.9	271.5	666	523	551.0	671.0
Carbon Oxides Yield, SCF/lb	0.390	0.452	0.823	0.725	0.779	0.688
Net Reacted Hydrogen, SCF/lb	1.59	Nil	4.98	3.36	3.94	4.45
Residue, lb/lb coal ^h	0.687	0.629	0.669	0.766	0.785	0.626
Liquid Products, lb/lb coal ⁱ	0.213	0.820	0.510	0.407	0.408	0.452
Net MAF Coal Hydrogasified, wt % ^j	19.9	16.6	22.7	19.8	25.2	20.7
Carbon Gasified, wt %	17.1	19.5	21.3	16.8	20.5	17.9
Steam Decomposed, lb/hr ^k	Nil	2.40	Nil	Nil	Nil	Nil
Steam Decomposed, % of steam fed ^k	Nil	12.4	Nil	Nil	Nil	Nil
Steam Decomposed, % of total equivalent fed ^m	13.7	19.4	14.2	7.8	13.8	7.53
Overall Material Balance, %	96.3	97.9	96.9	99.2	101.1	93.4
Carbon Balance, %	93.1	98.8	98.3	103.2	107.8	90.2
Hydrogen Balance, %	98.9	107.1	95.5	97.6	94.7	94.2
Oxygen Balance, %	97.0	83.8	94.1	101.5	97.1	100.8

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product
Nitrogen	1.5	24.6	1.3	26.9	1.0	29.0	1.1	36.6	1.0	35.7	1.0	29.0
Carbon Monoxide	0.0	0.5	0.0	0.2	0.0	1.7	0.0	1.8	---	2.0	---	1.8
Carbon Dioxide	0.2	0.4	0.2	0.5	0.2	1.1	0.2	1.0	0.2	1.2	0.2	1.0
Hydrogen	62.1	41.7	62.7	45.3	67.5	31.9	66.9	27.8	67.3	26.1	68.4	31.8
Methane	33.3	30.5	33.0	25.1	28.9	35.1	29.3	31.9	29.1	34.0	27.9	34.9
Ethane	2.1	2.1	2.0	1.5	1.7	0.8	1.7	0.7	1.7	0.7	1.8	1.1
Propane	0.6	0.2	0.6	0.4	0.5	0.1	0.6	0.2	0.5	0.1	0.5	0.1
Butane	0.2	---	0.2	0.1	0.2	0.0	0.2	0.0	0.2	---	0.2	---
Benzene	---	---	---	---	0.0	0.3	0.0	0.0	---	0.2	---	0.3
Hydrogen Sulfide	---	---	---	---	0.0	0.0	0.0	0.0	---	---	---	---
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	598	637	594	595	557	683	563	678	563	670	553	687
Specific Gravity (Air= 1.00)	0.281	0.473	0.277	0.466	0.250	0.550	0.254	0.595	0.251	0.606	0.246	0.552
Nitrogen Purge Rate, SCF/hr		296		446		450		433		400		410

- a. From start of coal feed.
- b. Operating conditions and results based on weight of dry feed.
- c. Hydrogen and methane mixture.
- d. Percent of the stoichiometric hydrogen/coal ratio - the net feed hydrogen/coal ratio required to convert all the carbon to methane.
- e. $\frac{\text{Coal Bed Volume}}{\text{CF/min Feed Gas at Reactor Pressure and Temperature}}$
- f. $\frac{\text{CF/sec Feed Gas at Reactor Pressure and Temperature}}{\text{Cross-sectional Area of Reactor}}$
- g. Reactor volume of 0.309 cu ft.
- h. By ash balance.
- i. Includes condensed, undecomposed steam.
- j. $100 \left[\frac{\text{Wt of Product Gas} - \text{Wt Feed Gas in} - \text{Wt Decomposed Steam} - \text{Wt Nitrogen in}}{\text{Wt of Moisture-, Ash-Free Coal}} \right]$
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char), and the measured liquid water rate leaving the reactor.
- n. Gross - gas saturated at 60°F, 30 in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30 in. Hg pressure.

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Table 2-A7, Part 1, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS:
 PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL, SYNTHESIS GAS +
 STEAM FEED GAS (Runs HT-168, -169, -171, -193, and -194)

Coal Source	Ireland Mine Bituminous Coal IGT Pretreater Run FP-85		Ireland Mine Bituminous Coal IGT Pretreater Runs FP-81, FP-82c, and FP-83		Ireland Mine Bituminous Coal IGT Pretreater Runs FP-80, FP-81, FP-83 and FP-84a		Ireland Mine Bituminous Coal IGT Pretreater Run FP-127		Ireland Mine Bituminous Coal IGT Pretreater Run FP-127	
Sieve Size, USS Gas Feed	10/80		10/80		10/80		10/80		10/80	
Run No.	<u>A HT-168 B</u>		<u>HT-169</u>		<u>HT-171</u>		<u>HT-193</u>		<u>HT-194</u>	
Duration of Test, hr	3-1/2		5-1/2		6		4		3	
Steady-State Operating Period, min ^a	143-203		183-334		217-354		125-235		132-177	
OPERATING CONDITIONS										
Bed Height, ft	3.5 ^P	7.0 ^P	3.5	3.5	7.0	7.0	7.0	7.0	7.0	7.0
Reactor Pressure, psig	1049	1050	1026	1006	991	1007	1007	1007	1007	1007
Reactor Temperature, °F ^b										
31-1/2 in.	1190	1200	----	----	----	----	----	----	----	----
36-3/4 in.	1240	1165	----	----	----	----	----	----	----	----
42 in.	1315	1270	----	----	----	----	----	----	----	----
47 in.	1505	1500	----	----	----	----	----	----	----	----
52 in.	1570	1575	----	----	----	----	----	----	----	----
57-1/4 in.	1570	1580	----	----	----	----	----	----	----	----
62-1/2 in.	1570	1580	1660	1555	1600	1645	1600	1645	1600	1645
67-3/4 in.	1580	1590	1560	1525	1600	1680	1600	1645	1600	1680
73 in.	1635	1645	1585	1550	1645	1600	1600	1575	1600	1600
78-1/4 in.	1615	1590	1610	1570	1575	1575	1575	1525	1575	1575
83-1/2 in.	----	1590	1605	1560	1550	1590	1550	1550	1550	1590
89 in.	----	1585	1605	1575	1555	1560	1555	1555	1560	1560
94-1/2 in.	----	1590	1620	1615	1580	1630	1580	1580	1630	1630
100 in.	----	1585	1635	1635	1600	1600	1600	1600	1600	1600
104 in.	----	1575	1655	1635	1595	1620	1595	1595	1620	1620
114 in.	----	----	----	----	1460	1490	1460	1460	1490	1490
124-1/2 in.	----	----	----	----	1562	1600	1562	1562	1600	1600
135 in.	----	----	----	----	1505	1550	1505	1505	1550	1550
145 in.	----	----	----	----	1575	1600	1575	1575	1600	1600
Average	1480	1515	1615	1575	1565	1600	1565	1565	1600	1600
Coal Rate, lb/hr ^c	53.93	53.93	46.05	26.41	40.02	52.94	40.02	40.02	52.94	52.94
Feed Gas Rate, SCF/hr ^d	530.4	524.5	512.6	604.0	543.4	695.5	543.4	543.4	695.5	695.5
Steam Rate, lb/hr	25.00	25.00	25.06	25.57	22.49	14.42	22.49	22.49	14.42	14.42
Steam, mole % of hydrogen-steam mixture	49.8	50.0	50.7	47.1	46.5	30.3	46.5	46.5	30.3	30.3
Hydrogen/Coal Ratio, % of stoichiometric ^e	14.8	14.6	15.4	33.6	18.4	17.4	18.4	18.4	17.4	17.4
Hydrogen/Steam Ratio, mole/mole	0.575	0.567	0.500	0.638	0.591	1.166	0.591	0.591	1.166	1.166
Bed Pressure Differential, in. wc	17.43	87.15	148.8	85.4	64.68	85.55	64.68	64.68	85.55	85.55
Coal Space Velocity, lb/cu ft-hr	0.340	0.672	0.316	0.288	0.640	0.650	0.288	0.288	0.650	0.650
Feed Gas Residence Time, min ^f	0.172	0.174	0.185	0.203	0.182	0.179	0.182	0.182	0.179	0.179
Superficial Feed Gas Velocity, ft/sec ^g										

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(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	920.6	968.9	1012.3	923.6	974.2	1032.2
Net Btu Recovery, 1000 Btu/lb	2.012	2.340	2.917	2.275	3.217	2.389
Product Gas Yield, SCF/lb	17.07	17.97	21.98	34.97	24.34	19.50
Hydrocarbon Yield, SCF/lb	3.35	3.67	4.12	6.09	4.08	3.72
Carbon Oxides Yield, SCF/lb	0.363	0.623	0.767	Nil	1.872	0.631
Net Reacted Hydrogen, SCF/lb	2.90	2.65	2.06	6.85	1.45	2.95
Residue, lb/lb coal ^h	0.710	0.667	0.610	0.632	0.654	0.665
Liquid Products, lb/lb coal ⁱ	0.480	0.480	0.506	0.996	0.436	0.267
Net MAF Coal Hydrogasified, wt % ^j	30.9	35.7	37.3	39.8	40.1	32.9
Carbon Gasified, wt %	18.1	20.8	23.8	23.10	28.4	20.8
Steam Decomposed, lb/hr ^k	Nil	Nil	2.67	Nil	5.36	0.717
Steam Decomposed, % of steam fed	Nil	Nil	10.65	Nil	23.8	4.97
Steam Decomposed, % of total equivalent fed ^m	24.0	24.0	27.1	10.19	37.0	36.5
Overall Material Balance, %	98.9	98.8	97.11	99.5	100.3	97.8
Carbon Balance, %	99.3	96.6	95.5	107.3	101.5	99.0
Hydrogen Balance, %	96.0	98.2	94.8	100.4	97.8	97.5
Oxygen Balance, %	98.6	101.2	102.5	102.7	102.6	101.8

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product
Nitrogen	----	37.2	----	36.3	----	36.2	0.0	40.8	5.2	28.4	2.9	27.3
Carbon Monoxide	37.7	9.3	37.8	9.0	44.3	10.0	38.4	7.3	38.8	13.4	41.1	18.2
Carbon Dioxide	5.3	17.6	5.3	17.8	4.3	18.1	4.6	16.5	4.6	18.5	5.2	16.2
Hydrogen	56.9	15.8	56.8	16.0	51.3	16.6	56.7	17.5	51.4	22.7	50.8	19.1
Methane	0.1	19.0	0.1	19.9	0.1	18.2	0.3	17.1	----	16.4	----	18.6
Ethane	----	0.6	----	0.5	----	0.5	0.0	0.4	----	0.3	----	0.4
Propane	----	0.1	----	0.1	----	0.1	0.0	0.1	----	0.1	----	0.1
Butane	----	0.0	----	0.0	----	0.0	0.0	0.0	----	----	----	----
Benzene	----	0.2	----	0.2	----	0.2	0.0	0.2	----	0.1	----	0.1
Hydrogen Sulfide	----	0.2	----	0.2	----	0.1	0.0	0.1	----	0.1	----	----
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	302	462	302	463	305	447	305	449	303	405	239	436
Specific Gravity (Air = 1.00)	0.488	0.852	0.488	0.848	0.530	0.851	0.483	0.839	0.532	0.804	0.541	0.814
Nitrogen Purge Rate, SCF/hr		342		352		366		377		248		262

- | | |
|---|---|
| a. From start of coal feed. | i. Includes condensed, undecomposed steam. |
| b. Tube wall temperatures. Bottom of coal bed at 62 in. | j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal). |
| c. Operating conditions and results based on weight of dry feed. | k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor. |
| d. Synthesis gas. | m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor. |
| e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane. | n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure. |
| f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature). | p. Bottom of bed 31 in. above furnace bottom. |
| g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor. | q. Bottom of bed 62 in. above furnace bottom. |
| h. By ash balance for Runs HT-169 and HT-171; based on moisture-, ash-free coal conversion to gas and liquids for Runs HT-168, HT-193 and HT-194. | |

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Table 2-A7, Part 1, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRE-TREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL, SYNTHESIS GAS + STEAM FEED GAS (Runs HT-202, -203, -204, -205, and -206)

Coal Source	Ireland Mine Bituminous Coal IGT Pretreater Run FP-129 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-130 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-130 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-130 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-130 10/80
Sieve Size, USS Feed Gas	Synthesis Gas + Steam				
Run No.	HT-202	HT-203	HT-204	HT-205	HT-206
Duration of Test, hr	2	3	2	2-1/2	4-1/2
Steady-State Operating Period, min ^a	100-114	95-174	88-105	84-103	85-266
OPERATING CONDITIONS					
Bed Height, ft	3.5	3.5	3.5	3.5	3.5
Reactor Pressure, psig ^b	1046	1039	1022	1009	1040
Reactor Temperature, °F ^b					
62-1/2 in.	1320	1320	1510	1465	1420
67-3/4 in.	1365	1405	1430	1510	1425
73 in.	1490	1540	1565	1560	1660
78-1/4 in.	1480	1600	1530	1570	1585
83-1/2 in.	1420	1590	1540	1610	1645
89 in.	1470	1585	1550	1625	1650
94-1/2 in.	1505	1560	1525	1610	1630
100 in.	1540	1620	1585	1695	1700
104 in.	1565	1600	1585	1695	1695
Average	1460	1535	1535	1595	1600
Coal Rate, lb/hr ^c	77.75	51.05	75.42	48.27	49.35
Feed Gas Rate, SCF/hr ^d	680.9	425.9	765.6	520.1	576.8
Steam Rate, lb/hr	15.53	29.83	14.57	11.38	11.56
Steam, mole % of hydrogen-steam mixture	32.4	59.5	28.6	31.5	29.6
Hydrogen/Coal Ratio, % of stoichiometric ^e	10.73	10.71	14.06	15.22	16.44
Hydrogen/Steam Ratio, mole/mole	0.972	0.323	1.286	1.118	1.247
Bed Pressure Differential, in. wc	-----	-----	-----	-----	-----
Coal Space Velocity, lb/cu ft-hr	251.3	165.0	243.8	156.0	159.5
Feed Gas Residence Time, min ^f	0.359	0.328	0.317	0.430	0.408
Superficial Feed Gas Velocity, ft/sec ^g	0.168	0.178	0.186	0.136	0.143

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1247.4	888.8	1092.5	820.0	912.7
Net Btu Recovery, 1000 Btu/lb	1.970	2.924	2.025	1.822	2.426
Product Gas Yield, SCF/lb	16.04	17.41	16.03	16.99	18.49
Hydrocarbon Yield, SCF/lb	2.78	3.27	3.14	2.99	3.37
Carbon Oxides Yield, SCF/lb	0.290	1.62	0.261	1.27	0.627
Net Reacted Hydrogen, SCF/lb	1.434	0.436	2.317	2.582	2.752
Residue, lb/lb coal ^a	0.705	0.635	0.735	0.688	0.643
Liquid Products, lb/lb coal ⁱ	0.1641	0.432	0.205	0.219	0.265
Net MAF Coal Hydrogasified, wt % ^j	23.2	27.7	29.1	36.9	32.7
Carbon Gasified, wt %	15.2	24.3	17.2	21.3	19.8
Steam Decomposed, lb/hr ^k	2.78	8.65	0.400	1.443	nil
Steam Decomposed, % of steam fed	17.9	29.0	2.75	12.7	nil
Steam Decomposed, % of total equivalent fed ^m	53.5	42.4	40.0	45.1	34.1
Overall Material Balance, %	94.8	95.1	99.4	100.2	97.1
Carbon Balance, %	96.3	95.5	97.7	99.8	93.6
Hydrogen Balance, %	101.7	91.9	95.6	86.7	97.1
Oxygen Balance, %	88.7	93.3	99.4	108.2	100.6

PRODUCT AND FEED GAS PROPERTIES

	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product
Gas Composition, mole %										
Nitrogen	3.4	37.0	3.6	28.0	1.9	31.2	1.6	27.5	3.5	31.7
Carbon Monoxide	46.6	13.5	45.5	12.5	43.4	15.1	43.6	16.1	39.0	17.0
Carbon Dioxide	3.4	15.0	3.3	20.2	3.3	16.1	3.4	21.2	5.0	14.2
Hydrogen	46.6	16.5	47.6	20.3	51.4	17.8	51.4	17.4	52.5	18.3
Methane	----	16.6	----	18.0	----	18.8	----	16.8	----	17.5
Ethane	----	0.5	----	0.6	----	0.6	----	0.6	----	0.5
Propane	----	0.2	----	0.2	----	0.2	----	0.2	----	0.2
Butane	----	----	----	----	----	----	----	----	----	----
Benzene	----	0.1	----	0.2	----	0.2	----	0.2	----	0.3
Hydrogen Sulfide	----	----	----	----	----	----	----	----	----	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	306	441	307	426	307	458	307	410	299	420
Specific Gravity (Air = 1.00)	0.568	0.845	0.559	0.830	0.524	0.827	0.525	0.867	0.524	0.812
Nitrogen Purge Rate, SCF/hr	438		234		363		226		269	

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.

- h. By ash balance, except Run HT-204 based on moisture-, ash-free coal conversion to gas and liquids.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 1, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRE-TREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL, SYNTHESIS GAS + STEAM FEED GAS (Runs HT-208, -209, -210, -225, and -242)

Coal Source	Ireland Mine Bituminous Coal IGT Pretreater Run FP-132 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-132 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-135 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-138 10/80	Ireland Mine Bituminous Coal IGT Pretreater Run FP-142 10/80
Feed Gas	Synthesis Gas + Steam				
Run No.	HT-208	HT-209	HT-210	HT-225	HT-242
Duration of Test, hr	4-3/4	4-1/2	6	4	4-3/4
Steady-State Operating Period, min ^a	103-283	72-268	175-364	68-247	101-266
OPERATING CONDITIONS					
Bed Height, ft	3.5	3.5	7.0	3.5	3.5
Reactor Pressure, psig	1020	1011	987	1478	1556
Reactor Temperature, °F ^b					
62-1/2 in.	1575	1530	1525	715	925
67-3/4 in.	1610	1570	1485	1150	1125
73 in.	1690	1690	1660	1380	1215
78-1/4 in.	1590	1675	1545	1405	1250
83-1/2 in.	1635	1630	1545	1470	1415
89 in.	1640	1615	1545	1445	1370
94-1/2 in.	1620	1605	1500	1425	1340
100 in.	1680	1710	1585	1635	1595
104 in.	1690	1690	1580	1660	1555
114 in.	----	----	1600	----	----
124-1/2 in.	----	----	1585	----	----
135 in.	----	----	1585	----	----
145 in.	----	----	1515	----	----
Average	1635	1630	1560	1365	1310
Coal Rate, lb/hr ^c	41.08	35.53	15.61	63.49	42.58
Feed Gas Rate, SCF/hr ^d	443.5	502.5	542.9	626.5	674.0
Steam Rate, lb/hr	30.00	26.31	26.96	33.06	32.41
Steam, mole % of hydrogen-steam mixture	58.7	52.4	51.1	33.1	50.3
Hydrogen/Coal Ratio, % of stoichiometric ^e	15.96	18.15	49.3	13.0	24.8
Hydrogen/Steam Ratio, mole/mole	0.394	0.441	0.514	0.443	0.567
Bed Pressure Differential, in. wc	----	----	76.0	----	----
Coal Space Velocity, lb/cu ft-hr ^f	132.8	114.8	25.22	202.0	137.6
Feed Gas Residence Time, min ^g	0.301	0.305	0.586	0.405	0.422
Superficial Feed Gas Velocity, ft/sec ^g	0.194	0.192	0.199	0.144	0.138

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(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	958.6	982.4	924.1	1020.4	1132.8
Net Btu Recovery, 1000 Btu/lb	3.576	4.157	3.762	1.983	2.636
Product Gas Yield, SCF/lb	23.33	27.65	59.21	16.33	26.60
Hydrocarbon Yield, SCF/lb	3.80	4.34	6.10	2.69	3.46
Carbon Oxides Yield, SCF/lb	2.18	1.81	2.63	0.662	0.929
Net Reacted Hydrogen, SCF/lb	0.305	Nil	1.95	1.17	1.78
Residue, lb/lb coal ^h	0.555	0.592	0.571	0.697	0.669
Liquid Products, lb/lb coal ⁱ	0.630	0.602	1.350	0.436	0.638
Net MAF Coal Hydrogasified, wt % ^j	43.6	43.3	51.6	22.1	29.2
Carbon Gasified, wt %	28.2	29.2	41.7	17.4	24.5
Steam Decomposed, lb/hr ^k	4.88	5.51	6.12	6.46	6.01
Steam Decomposed, % of steam fed	16.3	20.9	22.7	19.5	18.54
Steam Decomposed, % of total equivalent fed ^m	31.5	42.3	28.6	36.5	45.2
Overall Material Balance, %	97.7	98.7	100.6	95.3	97.6
Carbon Balance, %	93.2	96.9	96.4	95.1	99.9
Hydrogen Balance, %	98.0	103.7	97.1	92.7	95.1
Oxygen Balance, %	97.8	99.0	101.2	92.3	96.2

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product
Nitrogen	---	28.8	---	25.2	---	29.7	---	24.7	---	30.3
Carbon Monoxide	38.4	11.3	47.0	15.1	41.3	13.2	45.6	15.0	37.3	12.4
Carbon Dioxide	5.6	18.4	4.5	17.8	5.1	18.5	5.3	20.3	5.4	16.5
Hydrogen	56.0	24.6	48.5	25.5	53.6	28.2	49.1	23.0	57.3	27.4
Methane	---	15.7	---	15.2	---	10.1	---	15.8	---	12.4
Ethane	---	0.5	---	0.4	---	0.2	---	0.4	---	0.5
Propane	---	0.1	---	0.1	---	---	---	0.3	---	0.1
Butane	---	---	---	---	---	---	---	---	---	---
Benzene	---	0.2	---	0.2	---	0.1	---	0.3	---	0.4
Hydrogen Sulfide	---	0.4	---	0.5	---	---	---	0.2	---	---
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	300	406	303	398	302	341	301	404	301	396
Specific Gravity (Air = 1.00)	0.496	0.791	0.557	0.782	0.515	0.779	0.556	0.818	0.483	0.772
Nitrogen Purge Rate, SCF/hr		276		248		274		252		343

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance, except by weight of residue recovered for Run HT-225.

- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt feed gas in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 1, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRE-TREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL, SYNTHESIS GAS + METHANE STEAM FEED GAS (Run HT-200)

Coal	Ireland Mine
Source	Bituminous Coal
Sieve Size, USS	IGT Pretreater
Feed Gas	Run FP-127
	10/80
	Synthesis Gas +
	Methane + Steam
<u>Run No.</u>	<u>HT-200</u>
Duration of Test, hr	5
Steady-State Operating Period, min ^a	126-303
OPERATING CONDITIONS	
Bed Height, ft	3.5
Reactor Pressure, psig	1012
Reactor Temperature, °F ^b	
62-1/2 in.	1235
67-3/4 in.	1275
73 in.	1380
78-1/4 in.	1380
83-1/2 in.	1380
89 in.	1395
94-1/2 in.	1405
100 in.	1475
104 in.	1505
Average	1380
Coal Rate, lb/hr ^c	47.09
Feed Gas Rate, SCF/hr ^d	710.1
Steam Rate, lb/hr	16.54
Steam, mole % of hydrogen-steam mixture	32.9
Hydrogen/Coal Ratio, % of stoichiometric	15.4
Hydrogen/Steam Ratio, mole/mole	0.768
Bed Pressure Differential, in. wc	56.0
Coal Space Velocity, lb/cu ft-hr	152.2
Feed Gas Residence Time, min ^f	0.345
Superficial Feed Gas Velocity, ft/sec ^g	0.169

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr.	1063.7
Net Btu Recovery, 1000 Btu/lb	1,813
Product Gas Yield, SCF/lb	22.59
Hydrocarbon Yield, SCF/lb	2.41
Carbon Oxides Yield, SCF/lb	0.648
Net Reacted Hydrogen, SCF/lb	1.536
Residue, lb/lb coal ^a	0.663
Liquid Products, lb/lb coal ⁱ	0.398
Net MAF Coal Hydrogasified, wt % ^j	22.3
Carbon Gasified, wt %	14.5
Steam Decomposed, lb/hr ^k	Nil
Steam Decomposed, % of steam fed	Nil
Steam Decomposed, % of total equivalent fed ^m	20.4
Overall Material Balance, %	95.9
Carbon Balance, %	93.2
Hydrogen Balance, %	97.8
Oxygen Balance, %	98.4

PRODUCT GAS FEED AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product
Nitrogen	1.5	27.3
Carbon Monoxide	20.4	11.7
Carbon Dioxide	16.5	15.8
Hydrogen	37.6	18.3
Methane	21.9	25.9
Ethane	1.4	0.6
Propane	0.5	0.2
Butane	0.1	---
Benzene	---	0.2
Hydrogen Sulfide	---	---
Total	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	453	519
Specific Gravity (Air = 1.00)	0.638	0.791
Nitrogen Purge Rate, SCF/hr		280

- | | |
|--|---|
| a. From start of coal feed. | h. Based on moisture-, ash-free coal conversion to gas and liquids. |
| b. Tube wall temperatures. Bottom of coal bed at 62 in. | i. Includes condensed, undecomposed steam. |
| c. Operating conditions and results based on weight of dry feed. | j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal) |
| d. Synthesis gas + methane. | k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor. |
| e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane. | m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor. |
| f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature). | n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure. |
| g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor. | |

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Table 2-A7, Part 2. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PARTIALLY HYDROGASIFIED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-99, -100A, and -111A)

Coal Source Sieve Size, USS Feed Gas	Partially Hydrogasified Ireland Mine Bituminous Coal Runs HT-97 and HT-98 10/80	Partially Hydrogasified Ireland Mine Bituminous Coal Run HT-99 10/80	Partially Hydrogasified Ireland Mine Bituminous Coal Runs HT-104 and HT-105 10/80
	Hydrogen + Steam		
<u>Run No.</u>	<u>HT-99</u>	<u>HT-100A</u>	<u>HT-111A</u>
Duration of Test, hr	3-3/4	4-1/4	5-1/2
Steady-State Operating Period, min ^a	52-219	108-185	115-331
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1038	1016	1015
Reactor Temperatures, °F			
Bottom	----	----	----
62-1/2 in.	----	----	1685
67-3/4 in.	----	----	----
73 in.	----	----	1690
78-1/4 in.	----	----	----
83-1/2 in.	----	----	1690
89 in.	----	----	----
94-1/2 in.	----	----	1740
100 in.	----	----	----
104 in.	----	----	1780
114 in.	1360	1645	----
124-1/2 in.	1305	1585	----
135 in.	1230	1465	----
145 in.	1290	1550	----
155-1/2 in.	1365	1635	----
Average	1310	1575	1715
Coal Rate, lb/hr ^b	43.77	39.95	28.7
Feed Gas Rate, SCF/hr ^c	598.1	620.0	498.9
Steam Rate, lb/hr	31.95	29.92	75.00
Steam, mole % of hydrogen-steam mixture	52.9	50.3	51.3
Hydrogen/Coal Ratio, % of stoichiometric ^d	28.7	31.9	36.9
Hydrogen/Steam Ratio, mole/mole	0.886	0.984	0.947
Bed Pressure Differential, in. wc	----	----	360
Coal Space Velocity, lb/cu ft-hr	141.5	129.1	92.7
Feed Gas Residence Time, min ^e	0.306	0.263	0.302
Superficial Feed Gas Velocity, ft/sec ^f	0.190	0.222	0.193

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	971.5	1040.0	916.1
Net Btu Recovery, 1000 Btu/lb	0.970	1.624	2.783
Product Gas Yield, SCF/lb	22.20	25.88	31.95
Hydrocarbon Yield, SCF/lb	1.11	2.19	3.14
Gaseous Hydrocarbon Space-Time Yield, SCF/cu ft-hr ^g	157.0	283.4	291.5
Carbon Oxides Yield, SCF/lb	0.266	1.061	1.981
Net Reacted Hydrogen, SCF/lb	1.131	2.37	2.39
Residue, lb/lb coal ^h	0.840	0.814	0.808
Liquid Products, lb/lb coal ⁱ	0.747	0.703	0.751
Net MAF Coal Hydrogasified, wt % ^j	5.73	17.3	23.1
Carbon Gasified, wt %	6.52	13.1	20.9
Steam Decomposed, lb/hr ^k	Nil	1.83	3.46
Steam Decomposed, % of steam fed ^k	Nil	6.10	13.8
Steam Decomposed, % of total equivalent fed ^m	Nil	6.23	14.8
Overall Material Balance, %	95.8	98.1	99.5
Carbon Balance, %	87.9	90.4	98.5
Hydrogen Balance, %	102.3	102.7	100.5
Oxygen Balance, %	104.2	104.0	100.3

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	37.6	36.6	37.1
Carbon Monoxide	0.6	2.0	3.6
Carbon Dioxide	0.6	2.1	2.6
Hydrogen	56.1	50.7	46.8
Methane	4.5	8.6	9.9
Ethane	0.5	---	---
Propane	---	---	---
Butane	---	---	---
Benzene	0.1	---	---
Hydrogen Sulfide	---	---	---
Total	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	381	401	413
Specific Gravity (Air = 1.00)	0.430	0.490	0.523
Nitrogen Purge Rate, SCF/hr	358	378	339

- a. From start of coal feed.
- b. Operating conditions and results based on weight of dry feed.
- c. Hydrogen.
- d. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- e.
$$\frac{\text{Coal Bed Volume}}{\text{CF/min Feed Gas at Reactor Pressure and Temperature}}$$
- f.
$$\frac{\text{CF/sec Feed Gas at Reactor Pressure and Temperature}}{\text{Cross-sectional Area of Reactor}}$$
- g. Reactor volume of 0.309 cu ft.

- h. By ash balance.
- i. Includes condensed, undecomposed steam.
- j.
$$100 \left[\frac{\text{Wt of Product Gas} - \text{Wt Hydrogen in} - \text{Wt Decomposed Steam} - \text{Wt Nitrogen in}}{\text{Wt of Moisture-, Ash-Free Coal}} \right]$$
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char), and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30 in. Hg pressure. SCF - dry gas volume in SCF at 60°F, 30 in. Hg pressure.

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Table 2-A7, Part 2, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS:
PARTIALLY HYDROGASIFIED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL,
SYNTHESIS GAS + STEAM FEED GAS (Runs HT-201, and -207)

Coal	Partially Hydro- gasified Ireland Mine Bituminous Coal	Partially Hydro- gasified Ireland Mine Bituminous Coal
Source	Run HT-200	Run HT-200
Sieve Size, USS	10/80	10/80
Feed Gas	Synthesis Gas + Steam	Synthesis Gas + Steam
<u>Run No.</u>	<u>HT-201</u>	<u>HT-207</u>
Duration of Test, hr	4	5
Steady-State Operating Period, min ^a	107-235	99-298
OPERATING CONDITIONS		
Bed Height, ft	7.0	7.0
Reactor Pressure, psig	1005	1040
Reactor Temperature, °F ^b		
62-1/2 in.	1205	1535
67-3/4 in.	1505	1550
73 in.	1630	1680
78-1/4 in.	1600	1610
83-1/2 in.	1555	1660
89 in.	1580	1645
94-1/2 in.	1610	1580
100 in.	1625	1660
104 in.	1655	1675
114 in.	1645	1695
124-1/2 in.	1570	1670
135 in.	1600	1670
145 in.	1540	1595
Average	1565	1635
Coal Rate, lb/hr ^c	28.52	30.54
Feed Gas Rate, SCF/hr ^d	346.9	377.6
Steam Rate, lb/hr	20.00	18.73
Steam, mole % of hydrogen-steam mixture	54.8	51.0
Hydrogen/Coal Ratio, % of stoichiometric ^e	13.75	14.91
Hydrogen/Steam Ratio, mole/mole	0.409	0.535
Bed Pressure Differential, in. wc	----	----
Coal Space Velocity, lb/cu ft-hr	46.03	49.36
Feed Gas Residence Time, min ^f	0.862	0.855
Superficial Feed Gas Velocity, ft/sec ^g	0.136	0.136

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	837.9	792.5
Net Btu Recovery, 1000 Btu/lb	2.568	2.086
Product Gas Yield, SCF/lb	29.38	25.95
Hydrocarbon Yield, SCF/lb	2.97	2.60
Carbon Oxides Yield, SCF/lb	1.492	1.556
Net Reacted Hydrogen, SCF/lb	Nil	0.1657
Residue, lb/lb coal ^a	0.829	0.796
Liquid Products, lb/lb coal ⁱ	0.505	0.469
Net MAF Coal Hydrogasified, wt % ^j	27.9	27.0
Carbon Gasified, wt %	19.3	17.2
Steam Decomposed, lb/hr ^k	5.60	4.42
Steam Decomposed, % of steam fed	28.0	23.6
Steam Decomposed, % of total equivalent fed ^m	29.7	26.8
Overall Material Balance, %	101.4	99.6
Carbon Balance, %	100.6	94.0
Hydrogen Balance, %	103.7	104.0
Oxygen Balance, %	104.3	105.3

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product
Nitrogen	3.0	41.5	---	37.0
Carbon Monoxide	43.4	9.7	38.2	12.3
Carbon Dioxide	4.0	15.0	6.1	14.8
Hydrogen	49.6	23.6	55.7	25.9
Methane	---	9.9	---	10.0
Ethane	---	0.2	---	---
Propane	---	---	---	---
Butane	---	---	---	---
Benzene	---	---	---	---
Hydrogen Sulfide	---	0.1	---	---
Total	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	305	356	299	351
Specific Gravity (Air = 1.00)	0.545	0.801	0.501	0.778
Nitrogen Purge Rate, SCF/hr		337		203

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance.

- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 3. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRETREATED OHIO NO. 6 SEAM, BROKEN ARO MINE, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-130, -131, and -132)

Coal Source	Broken Aro Mine Bituminous Coal IGT Pretreater, Run FP-86	Broken Aro Mine Bituminous Coal IGT Pretreater, Run FP-87	Broken Aro Mine Bituminous Coal IGT Pretreater, Run FP-88
	10/80	10/80	10/80
Sieve Size, USS Feed Gas	Hydrogen + Steam		
Run No.	HT-130	HT-131	HT-132
Duration of Test, hr	4	4-1/4	3-3/4
Steady-State Operating Period, min ^a	135-245	120-200	140-221
OPERATING CONDITIONS			
Bed Height, ft	3.5	2.0	3.5
Reactor Pressure, psig	1046	1030	1075
Reactor Temperature, °F ^b		1585	1655
72-1/2 in.	1490	----	----
73 in.	1870	----	----
83 in.	----	1700	1670
84-1/2 in.	1750	----	----
94-1/2 in.	----	1720	1690
96-1/2 in.	1625	----	----
104 in.	1685	1670	1670
Average			
Coal Rate, lb/hr ^c	63.76	62.67	59.64
Feed Gas Rate, SCF/hr ^d	511.0	715.9	518.8
Steam Rate, lb/hr	26.07	15.50	26.12
Steam, mole % of hydrogen-steam mixture	51.7	31.3	51.4
Hydrogen/Coal Ratio, % of stoichiometric ^e	19.8	29.9	21.6
Hydrogen/Steam Ratio, mole/mole	0.933	2.198	0.945
Bed Pressure Differential, in. wc	124	94	126
Coal Space Velocity, lb/cu ft-hr	206.1	354.4	192.8
Feed Gas Residence Time, min ^{f,g}	0.306	0.176	0.314
Superficial Feed Gas Velocity, ft/sec ^h	0.191	0.189	0.186

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1005	1079	1007
Net Btu Recovery, 1000 Btu/lb	3.999	3.678	3.986
Product Gas Yield, SCF/lb	15.77	17.22	16.88
Hydrocarbon Yield, SCF/lb	4.21	4.43	4.39
Carbon Oxides Yield, SCF/lb	2.33	1.55	2.14
Net Reacted Hydrogen, SCF/lb	3.08	4.74	3.63
Residue, lb/lb coal ^l	0.647	0.591	0.678
Liquid Products, lb/lb coal ^j	0.366	0.299	0.408
Net MAF Coal Hydrogasified, wt % ^k	35.9	33.9	36.2
Carbon Gasified, wt %	29.7	27.2	29.6
Steam Decomposed, lb/hr ^m	3.73	Nil	2.85
Steam Decomposed, % of steam fed ^m	14.3	Nil	10.9
Steam Decomposed, % of total equivalent fed ⁿ	37.1	28.5	31.1
Overall Material Balance, %	99.5	97.6	101.2
Carbon Balance, %	103.5	98.0	109.7
Hydrogen Balance, %	96.1	93.1	94.6
Oxygen Balance, %	92.0	98.0	96.1

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	26.9	26.2	31.0
Carbon Monoxide	8.2	6.3	7.0
Carbon Dioxide	6.6	2.7	5.7
Hydrogen	31.3	38.8	30.0
Methane	25.8	24.6	25.1
Ethane	0.7	0.8	0.7
Propane	0.2	0.3	0.2
Butane	0.0	0.0	0.0
Benzene	0.3	0.3	0.3
Hydrogen Sulfide	0.0	0.0	0.0
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ^p	562	572	575
Specific Gravity (Air = 1.00)	0.625	0.541	0.635
Nitrogen Purge Rate, SCF/hr	270	283	312

- a. From start of coal feed.
- b. Tube wall temperatures in Run HT-130; internal coal bed temperatures in Runs HT-131 and HT-132.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. Reactor volume of 0.309 cu ft in Runs HT-130 and HT-132; 0.177 cu ft in Run HT-131.

- h. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- i. By ash balance for Runs HT-131 and HT-132. Based on moisture-, ash-free coal conversion to gas and liquids for Run HT-130.
- j. Includes condensed, undecomposed steam.
- k. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- m. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- n. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char), and the measured liquid water rate leaving the reactor.
- p. Gross, gas saturated at 60°F, 30 in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30 in. Hg pressure.

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Table 2-A7, Part 4. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRETREATED NO. 5 BLOCK SEAM, WEST VIRGINIA HIGH-VOLATILE CONTENT, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-146, -147, and -149)

Coal	West Virginia No. 5 Block Bituminous Coal IGT Pretreater, Runs FP-90 and FP-92 10/80	West Virginia No. 5 Block Bituminous Coal IGT Pretreater, Runs FP-92 and FP-93a 10/80	West Virginia No. 5 Block Bituminous Coal IGT Pretreater, Runs FP-93a and FP-94 10/80
Source			
Steve Size, USS			
Feed Gas		Hydrogen + Steam	
<u>Run No.</u>	<u>HT-146</u>	<u>HT-147</u>	<u>HT-149</u>
Duration of Test, hr	6	5	5
Steady-State Operating Period, min ^a	195-348	187-279	188-276
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1019	984	1016
Reactor Temperature, °F ^b			
67-3/4 in.	1550	1530	1510
73 in.	1460	1670	1605
78-1/4 in.	1560	1710	1655
83-1/2 in.	1565	1710	1640
89 in.	1595	1755	1675
94-1/2 in.	1635	1730	1685
100 in.	1605	1755	1705
104 in.	1610	1755	1725
Average	1570	1700	1650
Coal Rate, lb/hr ^c	43.40	67.21	61.85
Feed Gas Rate, SCF/hr ^d	509.2	700.3	497.1
Steam Rate, lb/hr	25.65	15.36	25.20
Steam, mole % of hydrogen-steam mixture	51.4	31.5	51.6
Hydrogen/Coal Ratio, % of stoichiometric ^e	29.0	20.2	19.2
Hydrogen/Steam Ratio, mole/mole	0.945	2.170	0.939
Bed Pressure Differential, in. wc	92	108	128
Coal Space Velocity, lb/cu ft-hr	140.3	217.2	199.9
Feed Gas Residence Time, min ^f	0.318	0.296	0.306
Superficial Feed Gas Velocity, ft/sec ^g	0.184	0.197	0.190

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1033	1269	1080
Net Btu Recovery, 1000 Btu/lb	3.979	4.562	4.067
Product Gas Yield, SCF/lb	23.80	19.22	17.46
Hydrocarbon Yield, SCF/lb	4.31	4.94	4.00
Carbon Oxides Yield, SCF/lb	1.737	2.17	2.36
Net Reacted Hydrogen, SCF/lb	3.41	3.93	2.59
Residue, lb/lb coal ^h	0.610	0.587	0.636
Liquid Products, lb/lb coal ⁱ	0.635	0.227	0.395
Net MAF Coal Hydrogasified, wt % ^j	37.2	39.5	35.7
Carbon Gasified, wt %	27.4	31.5	28.5
Steam Decomposed, lb/hr ^k	Nil	2.02	3.79
Steam Decomposed, % of steam fed	Nil	13.2	15.0
Steam Decomposed, % of total equivalent fed ^m	14.3	42.9	36.0
Overall Material Balance, %	99.6	98.0	99.1
Carbon Balance, %	97.5	102.0	104.3
Hydrogen Balance, %	101.1	98.5	96.2
Oxygen Balance, %	103.1	94.6	92.9

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	39.4	29.0	32.1
Carbon Monoxide	4.6	8.4	8.5
Carbon Dioxide	2.7	2.9	5.0
Hydrogen	35.0	33.8	31.2
Methane	17.3	24.8	21.9
Ethane	0.6	0.7	0.7
Propane	0.2	0.2	0.3
Butane	0.0	0.0	0.0
Benzene	0.2	0.2	0.3
Hydrogen Sulfide	0.0	0.0	0.0
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	531	572	554
Specific Gravity (Air = 1.00)	0.604	0.584	0.634
Nitrogen Purge Rate, SCF/hr	406	375	347

- | | | | |
|----|---|----|--|
| a. | From start of coal feed. | h. | By ash balance. |
| b. | Tube wall temperatures. | i. | Includes condensed, undecomposed steam. |
| c. | Operating conditions and results based on weight of dry feed. | j. | 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal). |
| d. | Hydrogen. | k. | Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor. |
| e. | Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane. | m. | Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor. |
| f. | Coal bed volume/(CF/min feed gas at reactor pressure and temperature). | n. | Gross, gas saturated at 60°F, 30-in. -Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. -Hg pressure. |
| g. | (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor. | | |

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Table 2-A7, Part 5. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRETREATED NO. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-155, -156, and -157)

Coal Source	Illinois No. 6 Seam Bituminous Coal IGT Pretreater Run FP-105 10/80	Illinois No. 6 Seam Bituminous Coal IGT Pretreater Run FP-99 10/80	Illinois No. 6 Seam Bituminous Coal IGT Pretreater Runs FP-99 and FP-102d 10/80
Sieve Size, USS Feed Gas		Hydrogen - Steam	
<u>Run No.</u>	<u>HT-155</u>	<u>HT-156</u>	<u>HT-157</u>
Duration of Test, hr	5-1/4	5-1/2	5
Steady-State Operating Period, min ^a	132-316	153-336	137-306
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	991	998	988
Reactor Temperature, F ^b			
67-3/4 in.	1560	1545	1555
73 in.	1525	1545	1630
78-1/4 in.	1620	1615	1605
83-1/2 in.	1615	1630	1625
89 in.	1650	1675	1660
94-1/2 in.	1705	1725	1705
100 in.	1660	1710	1670
104 in.	1670	1720	1680
Average	1625	1660	1640
Coal Rate, lb/hr ^c	54.76	75.55	76.39
Feed Gas Rate, SCF/hr ^d	519.5	717.6	500.8
Steam Rate, lb/hr	26.06	16.12	27.28
Steam, mole % of hydrogen-steam mixture	51.3	32.2	53.4
Hydrogen/Coal Ratio, % of stoichiometric ^e	25.5	25.3	17.5
Hydrogen/Steam Ratio, mole/mole	0.949	2.110	0.874
Bed Pressure Differential, in. wc	122	88	80
Coal Space Velocity, lb/cu ft-hr	177.0	244.2	246.9
Feed Gas Residence Time, min ^f	0.296	0.296	0.291
Superficial Feed Gas Velocity, ft/sec ^g	0.197	0.197	0.200

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	857.3	1015	944.6
Net Btu Recovery, 1000 Btu/lb	4.211	3.904	3.801
Product Gas Yield, SCF/lb	15.66	13.44	12.37
Hydrocarbon Yield, SCF/lb	4.63	4.76	3.85
Carbon Oxides Yield, SCF/lb	2.44	1.96	2.35
Net Reacted Hydrogen, SCF/lb	3.60	4.71	2.17
Residue, lb/lb coal ^a	0.585	0.559	0.686
Liquid Products, lb/lb coal ⁱ	0.420	0.236	0.353
Net MAF Coal Hydrogasified, wt % ^j	40.6	40.8	40.7
Carbon Gasified, wt %	34.4	31.6	29.0
Steam Decomposed, lb/hr ^k	3.75	0.12	1.84
Steam Decomposed, % of steam fed	14.4	0.73	6.75
Steam Decomposed, % of total equivalent fed ^m	32.2	37.9	27.8
Overall Material Balance, %	96.5	95.0	103.4
Carbon Balance, %	99.9	95.4	108.7
Hydrogen Balance, %	98.8	94.6	97.7
Oxygen Balance, %	96.0	100.9	106.8

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	16.9	14.1	14.2
Carbon Monoxide	8.5	9.6	11.1
Carbon Dioxide	7.1	5.0	8.0
Hydrogen	37.6	35.6	35.5
Methane	28.7	34.6	30.1
Ethane	0.7	0.7	0.8
Propane	0.2	0.1	0.2
Butane	0.0	0.0	0.0
Benzene	0.2	0.2	0.1
Hydrogen Sulfide	0.1	0.1	0.0
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	551	595	549
Specific Gravity (Air= 1.00)	0.557	0.538	0.573
Nitrogen Purge Rate, SCF/hr	145	143	134

- a. From start of coal feed.
b. Tube wall temperatures.
c. Operating conditions and results based on weight of dry feed.
d. Hydrogen.
e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.

- h. By ash balance.
i. Includes condensed, undecomposed steam.
j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char), and the measured liquid water rate leaving the reactor.
n. Gross, gas saturated at 60°F, 30 in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30 in. Hg pressure.

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Table 2-A7, Part 6. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRETREATED SIXTH VEIN SEAM, MINNEHAHA MINE, INDIANA HIGH-VOLATILE CONTENT, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-158, -159, -160, and -161)

Coal Source	Indiana No. 6 Vein Bituminous Coal IGT Pretreater Run FP-106 10/80	Indiana No. 6 Vein Bituminous Coal IGT Pretreater Run FP-107 10/80	Indiana No. 6 Vein Bituminous Coal IGT Pretreater Run FP-107 10/80	Indiana No. 6 Vein Bituminous Coal IGT Pretreater Run FP-109 10/80
Sieve Size, USS Feed Gas	Hydrogen + Steam			
Run No.	HT-158	HT-159	HT-160	HT-161
Duration of Test, hr	5-1/2	2-3/4	5	5-1/4
Steady-State Operating Period, min ^a	136-334	191-199	179-315	177-304
OPERATING CONDITIONS				
Bed Height, ft	3.5	3.5	3.5	3.5
Reactor Pressure, psig	978	992	1014	996
Reactor Temperature, °F ^b				
67-3/4 in.	1395	1530	1600	1660
73 in.	1625	1535	1640	1680
78-1/4 in.	1555	1535	1670	1670
83-1/2 in.	1605	1535	1670	1615
89 in.	1670	1590	1700	1660
94-1/2 in.	1685	1695	1725	1680
100 in.	1685	1615	1725	1680
104 in.	1710	1590	1740	1670
Average	1615	1585	1685	1665
Coal Rate, lb/hr ^c	60.48	94.41	66.32	56.81
Feed Gas Rate, SCF/hr ^d	517.2	714.1	741.7	531.4
Steam Rate, lb/hr	25.75	14.94	14.65	24.93
Steam, mole % of hydrogen-steam mixture	51.1	30.5	29.3	49.6
Hydrogen/Coal Ratio, % of stoichiometric ^e	22.0	19.4	28.7	23.6
Hydrogen/Steam Ratio, mole/mole	0.956	2.276	2.409	1.014
Bed Pressure Differential, in. wc	70	---	---	72
Coal Space Velocity, lb/cu ft-hr	195.5	305.1	214.3	183.6
Feed Gas Residence Time, min ^f	0.302	0.314	0.299	0.296
Superficial Feed Gas Velocity, ft/sec ^g	0.193	0.186	0.195	0.197

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	865.4	1298	1243	1075
Net Btu Recovery, 1000 Btu/lb	4.018	2.951	3.570	4.360
Product Gas Yield, SCF/lb	14.31	13.74	18.74	18.93
Hydrocarbon Yield, SCF/lb	4.28	3.31	4.27	4.62
Carbon Oxides Yield, SCF/lb	2.26	1.35	1.69	2.27
Net Reacted Hydrogen, SCF/lb	3.09	2.89	4.55	3.32
Residue, lb/lb coal ^h	0.599	0.749	0.567	0.618
Liquid Products, lb/lb coal ⁱ	0.442	0.171	0.235	0.436
Net MAF Coal Hydrogasified, wt % ^j	42.5	27.9	34.8	42.6
Carbon Gasified, wt %	30.2	21.5	28.4	31.9
Steam Decomposed, lb/hr ^k	0.25	0.312	0.315	1.038
Steam Decomposed, % of steam fed	0.97	2.09	2.15	4.16
Steam Decomposed, % of total equivalent fed ^m	31.7	42.9	40.8	24.2
Overall Material Balance, %	99.6	99.6	93.5	100.6
Carbon Balance, %	97.0	104.3	93.1	101.0
Hydrogen Balance, %	101.4	88.7	94.9	102.5
Oxygen Balance, %	106.3	87.5	88.6	104.7

PRODUCT GAS PROPERTIES

Gas Composition, mole %				
Nitrogen	15.8	31.9	32.5	31.4
Carbon Monoxide	9.8	7.0	6.8	7.4
Carbon Dioxide	6.0	2.8	2.2	4.6
Hydrogen	38.2	34.0	35.4	31.9
Methane	29.0	23.2	22.2	23.9
Ethane	0.7	0.7	0.5	0.4
Propane	0.2	0.2	0.1	0.1
Butane	0.0	0.0	0.0	0.0
Benzene	0.2	0.2	0.3	0.3
Hydrogen Sulfide	0.1	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	556	568	560	560
Specific Gravity (Air = 1.00)	0.546	0.589	0.578	0.616
Nitrogen Purge Rate, SCF/hr	137	414	404	338

- a. From start of coal feed.
- b. Tube wall temperatures.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.

- h. Based on moisture-, ash-free coal conversion to gas and liquids for Run HT-159. By ash balance for Runs HT-158, HT-160 and HT-161.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross gas saturated at 60°F, 30-in. Hg pressure. SCF dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 7. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRETREATED SEWELL SEAM, LOCHGELLY NO. 2 MINE, WEST VIRGINIA LOW-VOLATILE CONTENT, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-170, 172, and -174)

Coal	West Virginia Sewell Seam, Lochgelly No. 2 Mine	West Virginia Sewell Seam, Lochgelly No. 2 Mine	West Virginia Sewell Seam, Lochgelly No. 2 Mine
Source	Bituminous Coal IGT Pretreater, Run FP-120	Bituminous Coal IGT Pretreater, Run FP-120	Bituminous Coal IGT Pretreater, Run FP-120
Sieve Size, USS	10/80	10/80	10/80
Feed Gas	Hydrogen + Steam		
Run No.	<u>HT-170</u>	<u>HT-172</u>	<u>HT-174</u>
Duration of Test, hr	5-1/4	4-1/2	4-3/4
Steady-State Operating Period, min ^a	170-313	148-272	164-346
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1019	1017	1002
Reactor Temperature, °F ^b			
62 in.	1475	1535	1565
67-3/4 in.	1515	1555	1545
73 in.	1560	1570	1520
78-1/4	1620	1665	1590
83-1/2 in.	1700	1685	1605
89 in.	1710	1720	1655
94-1/2 in.	1705	1680	1650
100 in.	1760	1740	1700
104 in.	1780	1735	1730
Average	1650	1655	1620
Coal Rate, lb/hr ^c	62.28	62.26	51.30
Feed Gas Rate, SCF/hr ^d	713.2	517.1	520.5
Steam Rate, lb/hr	15.63	25.62	25.39
Steam, mole % of hydrogen-steam mixture	31.5	51.0	50.6
Hydrogen/Coal Ratio, % of stoichiometric ^e	24.5	16.9	21.8
Hydrogen/Steam Ratio, mole/mole	2.171	0.961	0.976
Bed Pressure Differential, ft-hr	----	48	----
Coal Space Velocity, lb/cu ft-hr	201.3	201.2	165.8
Feed Gas Residence Time, min ^f	0.308	0.303	0.304
Superficial Feed Gas Velocity, ft/sec ^g	0.189	0.193	0.192

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1228	1150	1136
Net Btu Recovery, 1000 Btu/lb	4.014	4.002	4.717
Product Gas Yield, SCF/lb	19.72	18.47	22.14
Hydrocarbon Yield, SCF/lb	4.36	3.79	4.30
Carbon Oxides Yield, SCF/lb	2.86	2.59	2.75
Net Reacted Hydrogen, SCF/lb	4.09	1.90	1.36
Residue, lb/lb coal ^h	0.636	0.664	0.652
Liquid Products, lb/lb coal ⁱ	0.212	0.331	0.430
Net MAF Coal Hydrogasified, wt % ^j	38.2	30.5	29.3
Carbon Gasified, wt %	28.5	24.7	28.0
Steam Decomposed, lb/hr ^k	2.89	5.47	3.69
Steam Decomposed, % of steam fed	18.46	21.4	14.54
Steam Decomposed, % of total equivalent fed ^m	41.4	35.0	29.6
Overall Material Balance, %	100.3	98.0	100.4
Carbon Balance, %	99.5	96.8	99.1
Hydrogen Balance, %	92.2	100.6	103.5
Oxygen Balance, %	110.3	100.1	104.5

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	25.9	30.6	28.3
Carbon Monoxide	11.0	9.8	8.4
Carbon Dioxide	3.5	4.2	4.0
Hydrogen	37.3	34.7	39.7
Methane	21.7	20.2	19.2
Ethane	0.3	0.2	0.2
Propane	0.1	0.1	Trace
Butane	0.0	0.0	0.0
Benzene	0.2	0.2	0.2
Hydrogen Sulfide	0.0	0.0	0.0
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	520	514	497
Specific Gravity (Air = 1.00)	0.568	0.602	0.559
Nitrogen Purge Rate, SCF/hr	318	352	321

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.

- h. By ash balance.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 8. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: COLORADO SUBBITUMINOUS COAL, LARAMIE NO. 3 SEAM, EAGLE MINE, HYDROGEN + STEAM FEED GAS (Runs HT-178, -180, and -182)

Coal Source	Colorado Subbituminous Coal	Colorado Subbituminous Coal	Colorado Subbituminous Coal
	Laramie No. 3 Seam Eagle Mine	Laramie No. 3 Seam Eagle Mine	Laramie No. 3 Seam Eagle Mine
Sieve Size, USS	10/80	10/80	10/80
Feed Gas	Hydrogen + Steam		
<u>Run No.</u>	<u>HT-178</u>	<u>HT-180</u>	<u>HT-182</u>
Duration of Test, hr	2-3/4	2-1/2	2-3/4
Steady-State Operating Period, min ^a	102-160	133-154	129-165
OPERATING CONDITIONS			
Bed Height, ft	5.62 ^P	6.08 ^P	4.75
Reactor Pressure, psig	1032	991	1050
Reactor Temperature, °F ^b			
31-1/2 in.	----	1450	----
42 in.	----	----	900
47 in.	----	1190	1155
52 in.	----	1300	1290
62-1/2 in.	1450	1430	1355
67-3/4 in.	1405	1560	1470
73 in.	1355	1655	1645
78-1/4 in.	1425	1710	1575
83-1/2 in.	1560	1715	1580
89 in.	1630	1710	1655
94-1/2 in.	1615	1650	1610
100 in.	1685	1715	1670
104 in.	1695	1715	1685
114 in.	1690	----	1685
124-1/2 in.	1545	----	1535
135 in.	1585	----	1605
145 in.	1505	----	1600
155-1/2 in.	1520	----	----
166 in.	1485	----	----
176 in.	1505	----	----
187-1/2 in.	1350	----	----
Average	1530	1565	1505
Coal Rate, lb/hr ^c	29.43	49.93	54.59
Feed Gas Rate, SCF/hr ^d	520.0	721.8	580.7
Steam Rate, lb/hr	24.88	15.09	15.31
Steam, mole % of hydrogen-steam mixture	50.1	30.5	35.7
Hydrogen/Coal Ratio, % of stoichiometric ^e	48.1	38.8	28.2
Hydrogen/Steam Ratio, mole/mole	0.995	2.277	1.805
Bed Pressure Differential, in. wc	----	----	----
Coal Space Velocity, lb/cu ft-hr	63.66	185.7	130.0
Feed Gas Residence Time, min ^f	0.494	0.274	0.533
Superficial Feed Gas Velocity, ft/sec ^g	0.177	0.186	0.148

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1064	1239	1063
Net Btu Recovery, 1000 Btu/lb	5.998	4.713	4.805
Product Gas Yield, SCF/lb	36.14	24.82	19.47
Hydrocarbon Yield, SCF/lb	5.71	5.04	5.24
Carbon Oxides Yield, SCF/lb	3.14	2.61	2.73
Net Reacted Hydrogen, SCF/lb	2.71	4.55	4.68
Residue, lb/lb coal ^h	0.488	0.530	0.483
Liquid Products, lb/lb coal ⁱ	0.811	0.374	0.372
Net MAF Coal Hydrogasified, wt % ^j	52.7	48.5	50.4
Carbon Gasified, wt %	42.5	37.0	39.7
Steam Decomposed, lb/hr ^k	1.934	Nil	Nil
Steam Decomposed, % of steam fed	7.77	Nil	Nil
Steam Decomposed, % of total equivalent fed ^m	26.8	27.1	40.4
Overall Material Balance, %	100.4	101.2	100.6
Carbon Balance, %	102.2	102.0	101.8
Hydrogen Balance, %	99.1	98.5	111.2
Oxygen Balance, %	96.5	102.9	99.0

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	33.9	29.0	28.2
Carbon Monoxide	4.1	6.2	7.8
Carbon Dioxide	4.6	4.3	6.2
Hydrogen	41.4	39.9	30.6
Methane	14.7	19.0	25.3
Ethane	1.0	1.0	1.2
Propane	0.1	0.3	0.4
Butane	0.0	0.0	0.0
Benzene	0.2	0.3	0.3
Hydrogen Sulfide	0.0	0.0	0.0
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	483	525	581
Specific Gravity (Air = 1.00)	0.567	0.564	0.633
Nitrogen Purge Rate, SCF/hr	361	359	300

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in. for Runs HT-178 and HT-180 and at 31 in. for Run HT-182.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance for Runs HT-178 and HT-180. Based on moisture-, ash-free coal conversion to gas and liquids for Run HT-182.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF dry gas volume in SCF at 60°F, 30-in. Hg pressure.
- p. Average bed height for steady-state operating period.

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Table 2-A7, Part 9. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRETREATED COLORADO SUBBITUMINOUS COAL, LARAMIE NO. 3 SEAM, EAGLE MINE, HYDROGEN + STEAM FEED GAS (Runs HT-184, -185, and -187)

Coal	Colorado	Colorado	Colorado
	Subbituminous Coal Laramie No. 3 Seam Eagle Mine Pretreatment Run FP-122 10/80	Subbituminous Coal Laramie No. 3 Seam Eagle Mine Pretreatment Run FP-122 10/80	Subbituminous Coal Laramie No. 3 Seam Eagle Mine Pretreatment Run FP-124 10/80
Source	Hydrogen + Steam		
Sieve Size, USS			
Feed Gas			
Run No.	HT-184	HT-185	HT-187
Duration of Test, hr	5-1/2	4	5-3/4
Steady-State Operating Period, min ^a	210-325	130-241	232-375
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1014	1017	1045
Reactor Temperature, °F ^b			
42 in.	1155	----	----
47 in.	1375	----	----
52 in.	1490	----	----
57-1/4 in.	1495	----	----
62-1/2 in.	1500	1175	1455
67-3/4 in.	1600	1370	1375
73 in.	1670	1530	1615
78-1/4 in.	1685	1485	1555
83-1/2 in.	----	1575	1585
89 in.	----	1640	1650
94-1/2 in.	----	1645	1640
100 in.	----	1725	1690
104 in.	----	1740	1700
Average	1495	1545	1585
Coal Rate, lb/hr ^c	63.73	77.50	70.27
Feed Gas Rate, SCF/hr ^d	516.9	716.9	513.9
Steam Rate, lb/hr	25.40	15.50	25.55
Steam, mole % of hydrogen-steam mixture	50.8	31.2	51.1
Hydrogen/Coal Ratio, % of stoichiometric ^e	21.3	24.3	18.9
Hydrogen/Steam Ratio, mole/mole	0.969	2.201	0.957
Bed Pressure Differential, in. wc	74.0	72.0	76.0
Coal Space Velocity, lb/cu ft-hr	206.0	250.5	227.1
Feed Gas Residence Time, min ^f	0.328	0.323	0.323
Superficial Feed Gas Velocity, ft/sec ^g	0.178	0.180	0.181

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1217	1379	1359
Net Btu Recovery, 1000 Btu/lb	5.061	5.424	5.263
Product Gas Yield, SCF/lb	19.09	17.79	19.34
Hydrocarbon Yield, SCF/lb	4.75	5.41	4.64
Carbon Oxides Yield, SCF/lb	3.30	2.90	3.44
Net Reacted Hydrogen, SCF/lb	2.27	2.84	1.55
Residue, lb/lb coal ^a	0.521	0.474	0.611
Liquid Products, lb/lb coal ⁱ	0.337	0.206	0.271
Net MAF Coal Hydrogasified, wt % ^j	47.6	50.0	45.9
Carbon Gasified, wt % ^k	37.6	39.8	37.9
Steam Decomposed, lb/hr ^k	5.18	2.26	7.75
Steam Decomposed, % of steam fed	20.4	14.6	30.3
Steam Decomposed, % of total equivalent fed ^m	45.7	54.9	51.2
Overall Material Balance, %	99.4	98.6	102.6
Carbon Balance, %	101.8	98.6	110.1
Hydrogen Balance, %	98.1	102.5	98.2
Oxygen Balance, %	94.4	97.7	97.5

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	26.9	22.4	28.0
Carbon Monoxide	8.5	10.3	9.7
Carbon Dioxide	8.8	6.0	8.1
Hydrogen	30.6	30.4	29.8
Methane	23.6	28.0	23.2
Ethane	1.0	1.1	0.5
Propane	0.3	0.4	0.3
Butane	----	----	----
Benzene	0.3	0.5	0.4
Hydrogen Sulfide	----	----	----
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	542	601	539
Specific Gravity (Air = 1.00)	0.653	0.622	0.660
Nitrogen Purge Rate, SCF/hr	327	309	380

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 31 in. in Run HT-184; 62 in. in Runs HT-185 and HT-187.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60 °F, 30-in. -Hg pressure. SCF: dry gas volume in SCF at 60 °F, 30-in. -Hg pressure.

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Table 2-A7, Part 10. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: NORTH DAKOTA LIGNITE, GLENHAROLD MINE, HYDROGEN + STEAM FEED GAS (Runs HT-139, -143, -144, -145, and -239)

Coal	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80
Source	Hydrogen + Steam				
Sieve Size, USS					
Feed Gas					
Run No.	HT-139	HT-143	HT-144	HT-145	HT-239
Duration of Test, hr	5-1/4	2-1/2	5-1/2	5	5-1/4
Steady-State Operating Period, min ^a	102-311	145-154	175-331	189-305	165-307
OPERATING CONDITIONS					
Bed Height, ft	3.5	3.5	3.5	3.5	3.5
Reactor Pressure, psig	1035	1048	1002	1048	478
Reactor Temperature, °F ^b					
62-1/2 in.	----	----	----	----	1310
67-3/4 in.	1525	1460	1560	1625	1480
73 in.	1625	1440	1585	1710	1500
78-1/4 in.	1590	1350	1560	1645	1515
83-1/2 in.	1540	1470	1595	1625	1620
89 in.	1630	1470	1605	1680	1550
94-1/2 in.	1585	1595	1615	1700	1520
100 in.	1600	1480	1590	1690	1680
104 in.	1625	1580	1600	1715	1630
Average	1590	1480	1590	1675	1535
Coal Rate, lb/hr ^c	64.7	68.03	75.91	85.76	32.07
Feed Gas Rate, SCF/hr ^d	504.9	603.7	503.6	710.3	368.8
Steam Rate, lb/hr	25.36	15.20	26.09	15.35	8.69
Steam, mole % of hydrogen-steam mixture	51.3	34.6	52.1	31.2	33.1
Hydrogen/Coal Ratio, % of stoichiometric ^e	23.8	26.6	19.8	24.7	34.2
Hydrogen/Steam Ratio, mole/mole	0.948	1.890	0.919	2.202	2.020
Bed Pressure Differential, in. wc	112	108	110	90	----
Coal Space Velocity, lb/cu ft-hr	209.5	219.9	245.4	277.2	103.7
Feed Gas Residence Time, min ^f	0.323	0.390	0.309	0.316	0.294
Superficial Feed Gas Velocity, ft/sec ^g	0.181	0.150	0.189	0.185	0.199

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OPERATING RESULTS

Product Gas Rate, SCF/hr	1272	1242	1247	1415	694.8
Net Btu Recovery, 1000 Btu/lb	5.571	4.308	5.104	4.726	4.579
Product Gas Yield, SCF/lb	19.63	18.26	16.42	16.50	21.67
Hydrocarbon Yield, SCF/lb	5.14	4.69	4.48	5.06	4.33
Carbon Oxides Yield, SCF/lb	3.83	2.25	3.50	3.22	3.68
Net Reacted Hydrogen, SCF/lb	1.88	3.30	1.132	3.84	3.33
Residue, lb/lb coal ^h	0.474	0.476	0.454	0.511	0.439
Liquid Products, lb/lb coal ⁱ	0.425	0.246	0.381	0.264	0.261
Net MAF Coal Hydrogasified, wt % ^j	64.8	49.3	64.6	58.1	54.2
Carbon Gasified, wt %	46.5	34.9	41.0	42.1	41.4
Steam Decomposed, lb/hr ^k	1.31	Nil	2.41	Nil	1.49
Steam Decomposed, % of steam fed	5.17	Nil	9.25	Nil	17.16
Steam Decomposed, % of total equivalent fed ^m	44.7	50.9	49.3	75.9	56.9
Overall Material Balance, %	103.5	94.1	99.2	105.2	97.3
Carbon Balance, %	109.0	93.7	103.1	109.7	97.5
Hydrogen Balance, %	102.2	94.5	99.4	98.5	92.0
Oxygen Balance, %	100.9	81.5	95.8	106.5	94.5

PRODUCT GAS PROPERTIES

Gas Composition, mole %

Nitrogen	24.0	31.4	17.7	23.0	24.8
Carbon Monoxide	8.1	6.5	9.1	8.6	9.4
Carbon Dioxide	11.4	5.8	12.2	10.9	7.6
Hydrogen	30.1	30.5	33.5	26.9	37.7
Methane	24.6	24.8	25.3	28.6	18.7
Ethane	1.2	0.6	1.5	1.2	0.9
Propane	0.4	0.3	0.5	0.6	0.4
Butane	0.0	0.0	0.0	0.0	---
Benzene	0.2	0.1	0.2	0.2	0.4
Hydrogen Sulfide	0.0	0.0	0.0	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	534	564	527	574	501
Specific Gravity (Air = 1.00)	0.667	0.629	0.639	0.678	0.606
Nitrogen Purge Rate, SCF/hr	305	348	221	325	172

- a. From start of coal feed.
b. Tube wall temperature.
c. Operating conditions and results based on weight of dry feed.
d. Hydrogen.
e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.

- h. By ash balance.
i. Includes condensed, undecomposed steam.
j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
n. Gross, gas saturated at 60°F, 30-in-Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in-Hg pressure.

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Table 2-A7, Part 10, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: NORTH DAKOTA LIGNITE, GLENHAROLD MINE, SYNTHESIS GAS + STEAM FEED GAS (Runs HT-192, -195, -196, -197, and -241)

Coal Source Sieve Size, USS Feed Gas	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80	North Dakota Lignite Glenharold Mine 10/80
	Synthesis Gas + Steam				
Run No.	HT-192	HT-195	HT-196	HT-197	HT-241
Duration of Test, hr	4	4-3/4	4-1/4	4-1/4	5
Steady-State Operating Period, min ^a	122-233	158-278	124-262	108-256	139-304
OPERATING CONDITIONS					
Bed Height, ft	3.5	3.5	3.5	3.5	3.5
Reactor Pressure, psig	1009	1031	1069	999	498
Reactor Temperature, °F ^b					
62-1/2 in.	1360	1645	1690	1680	1465
67-3/4 in.	1430	1655	1680	1680	1510
73 in.	1500	1700	1675	1715	1640
78-1/4 in.	1330	1615	1585	1595	1590
83-1/2 in.	1365	1540	1545	1560	1655
89 in.	1420	1550	1555	1560	1660
94-1/2 in.	1470	1560	1565	1550	1510
100 in.	1470	1600	1600	1590	1665
104 in.	1500	1630	1630	1605	1595
Average	1430	1610	1615	1615	1590
Coal Rate, lb/hr ^c	36.88	36.64	33.17	47.03	23.92
Feed Gas Rate, SCF/hr ^d	503.0	401.5	513.7	404.4	276.7
Steam Rate, lb/hr	22.44	18.88	25.60	19.02	13.08
Steam, mole % of hydrogen-steam mixture	48.4	49.7	51.1	49.7	49.8
Hydrogen/Coal Ratio, % of stoichiometric ^e	21.0	17.5	24.4	12.4	16.9
Hydrogen/Steam Ratio, mole/mole	0.532	0.535	0.482	0.526	0.529
Bed Pressure Differential, in. wc	56.0	-----	-----	-----	-----
Coal Space Velocity, lb/cu ft-hr	119.2	118.4	107.2	152.0	77.3
Feed Gas Residence Time, min ^f	0.362	0.409	0.321	0.393	0.297
Superficial Feed Gas Velocity, ft/sec ^g	0.161	0.143	0.182	0.149	0.196

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OPERATING RESULTS

Product Gas Rate, SCF/hr	920.0	1022.0	1053.9	1046.6	786.5
Net Btu Recovery, 1000 Btu/lb	3.642	4.831	5.271	4.808	4.775
Product Gas Yield, SCF/lb	24.95	27.89	31.77	22.25	32.88
Hydrocarbon Yield, SCF/lb	5.56	4.46	4.54	4.16	3.62
Carbon Oxides Yield, SCF/lb	0.756	3.28	4.35	1.22	3.59
Net Reacted Hydrogen, SCF/lb	3.31	Nil	Nil	Nil	3.52
Residue, lb/lb coal ^h	0.525	0.436	0.456	0.390	0.531
Liquid Products, lb/lb coal ⁱ	0.591	0.428	0.587	0.362	0.393
Net MAF Coal Hydrogasified, wt % ^j	49.9	58.8	62.2	65.2	51.6
Carbon Gasified, wt %	33.9	40.8	47.3	43.8	36.0
Steam Decomposed, lb/hr ^k	2.07	5.20	8.18	5.01	4.22
Steam Decomposed, % of steam fed	9.23	27.6	32.0	26.4	32.3
Steam Decomposed, % of total equivalent fed ^m	47.9	52.3	49.7	56.8	86.0
Overall Material Balance, %	100.1	99.3	101.7	103.4	99.5
Carbon Balance, %	102.2	100.2	107.3	102.5	100.1
Hydrogen Balance, %	100.8	99.6	97.6	96.2	97.0
Oxygen Balance, %	98.9	98.2	99.3	103.1	98.6

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product	Feed	Product	Feed	Product	Feed	Product
Nitrogen	2.6	34.7	----	30.2	9.6	20.9	8.2	23.9	----	36.2
Carbon Monoxide	42.8	6.3	41.8	11.2	35.6	12.0	35.3	13.1	43.0	14.2
Carbon Dioxide	4.7	22.7	5.4	19.1	4.4	21.2	4.5	21.2	4.5	13.6
Hydrogen	49.9	14.0	52.8	23.5	50.4	31.6	52.0	23.1	52.5	24.8
Methane	----	20.8	----	14.5	----	13.0	----	17.1	----	10.2
Ethane	----	1.0	----	0.9	----	0.8	----	1.0	----	0.5
Propane	----	0.3	----	0.4	----	0.4	----	0.5	----	0.3
Butane	----	0.0	----	----	----	----	----	----	----	----
Benzene	----	0.2	----	0.2	----	0.1	----	0.1	----	0.2
Hydrogen Sulfide	----	0.0	----	----	----	----	----	----	----	----
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	303	467	301	413	302	324	303	420	304	390
Specific Gravity (Air = 1.00)	0.546	0.801	0.524	0.811	0.540	0.755	0.526	0.815	0.521	0.786
Nitrogen Purge Rate, SCF/hr		306		309		171		217		285

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/sec feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance for Runs HT-192, HT-196 and HT-241. By weight of residue recovered for Run HT-197 and based on moisture-, ash-free coal conversion to gas and liquids for Run HT-241.

- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. -Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

2A-113

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Table 2-A7, Part 11. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: MONTANA SUBBITUMINOUS COAL, COLSTRIP MINE, HYDROGEN + STEAM FEED GAS (Runs HT-211, -212, -213, -216, -244, and -247)

Coal	Montana Subbituminous Coal Colstrip Mine 10/80	Montana Subbituminous Coal Colstrip Mine 10/80	Montana Subbituminous Coal Colstrip Mine 10/80	Montana Subbituminous Coal Colstrip Mine 10/80	Montana Subbituminous Coal Colstrip Mine 10/80	Montana Subbituminous Coal Colstrip Mine 10/80
Source						
Sieve Size, USS						
Feed Gas			Hydrogen + Steam			
<u>Run No.</u>	<u>HT-211</u>	<u>HT-212</u>	<u>HT-213</u>	<u>HT-216</u>	<u>HT-244</u>	<u>HT-247</u>
Duration of Test	2	5	4-3/4	4	1-1/4	2-1/4
Steady-State Operating Period, min ^a	87-118	136-305	156-285	100-239	60-75	123-141
OPERATING CONDITIONS						
Bed Height, ft	3.5	3.5	3.5	3.5	3.5	3.5
Reactor Pressure, psig	993	1082	1068	1052	488	549
Reactor Temperature, °F ^b						
62-1/2 in.	865	1495	1475	1310	1020	1125
67-3/4 in.	1085	1600	1605	1535	1160	1340
73 in.	1100	1690	1695	1650	1325	1515
78-1/4 in.	1020	1600	1605	1630	1435	1405
83-1/2 in.	1070	1600	1610	1650	1495	1560
89 in.	1090	1600	1610	1665	1335	1425
94-1/2 in.	1230	1545	1555	1630	1420	1515
100 in.	1350	1640	1645	1755	1690	1615
104 in.	1340	1605	1625	1720	1570	1625
Average	1130	1595	1605	1615	1385	1460
Coal Rate, lb/hr ^c	39.24	42.82	69.11	53.74	69.45	54.60
Feed Gas Rate, SCF/hr ^d	510.2	626.4	489.2	461.3	343.8	377.9
Steam Rate, lb/hr	8.15	26.54	25.62	11.80	9.22	8.90
Steam, mole % of hydrogen-steam mixture	25.1	51.4	52.4	34.9	36.0	33.1
Hydrogen/Coal Rate, % of stoichiometric ^e	39.3	37.2	20.8	24.8	14.2	19.9
Hydrogen/Steam Ratio, mole/mole	2.980	0.944	0.909	1.861	1.775	2.021
Bed Pressure Differential, in. wc	-----	-----	-----	66.0	48.0	-----
Coal Space Velocity, lb/cu ft-hr	126.8	138.4	223.4	173.7	224.5	176.5
Feed Gas Residence Time, min ^f	0.610	0.322	0.334	0.474	0.332	0.341
Superficial Feed Gas Velocity, ft/s ^g	0.956	0.181	0.175	0.123	0.176	0.173

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(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	855.4	1062.7	1117.6	980.9	714.8	889.5
Net Btu Recovery, 1000 Btu/lb	1.742	5.434	4.475	4.653	2.497	3.132
Product Gas Yield, SCF/lb	21.80	24.82	16.17	18.42	10.29	16.29
Hydrocarbon Yield, SCF/lb	1.79	5.66	4.32	5.12	1.88	2.80
Carbon Oxides Yield, SCF/lb	1.02	3.52	3.09	3.37	2.72	2.22
Net Reacted Hydrogen, SCF/lb	1.427	4.203	2.728	4.790	1.153	1.708
Residue, lb/lb coal ^h	0.62 ^o	0.390	0.503	0.458	0.591	0.517
Liquid Products, lb/lb coal ⁱ	0.334	0.608	0.350	0.210	0.184	0.230
Net MAF Coal Hydrogasified, wt % ^j	19.0	58.0	46.3	56.3	34.7	36.2
Carbon Gasified, wt %	14.7	48.3	38.3	43.1	23.5	26.1
Steam Decomposed, lb/hr ^k	Nil	2.66	4.81	0.486	Nil	Nil
Steam Decomposed, % of steam fed	Nil	10.0	18.8	4.12	Nil	Nil
Steam Decomposed, % of total equivalent fed ^m	39.4	37.4	50.7	63.1	59.8	50.4
Overall Material Balance, %	94.5	97.3	97.2	96.0	94.1	94.0
Carbon Balance, %	96.5	100.4	103.3	101.6	97.3	92.6
Hydrogen Balance, %	93.2	97.1	98.6	68.4	82.6	88.7
Oxygen Balance, %	82.3	93.0	89.3	88.9	88.8	90.1

PRODUCT GAS PROPERTIES

Gas Composition, mole %						
Nitrogen	34.0	30.2	26.9	32.9	18.1	36.9
Carbon Monoxide	2.7	6.1	8.6	11.0	20.2	8.5
Carbon Dioxide	2.9	8.1	10.5	7.3	6.2	5.1
Hydrogen	53.1	32.6	26.9	20.6	36.9	32.0
Methane	7.3	21.2	24.9	26.2	16.7	15.9
Ethane	0.6	1.2	1.2	1.2	1.0	0.9
Propane	0.3	0.4	0.6	0.4	0.6	0.4
Butane	----	----	----	----	----	----
Benzene	----	0.2	0.4	0.4	0.3	0.3
Hydrogen Sulfide	----	----	----	----	----	----
Total	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	269	534	564	608	479	515
Specific Gravity (Air = 1.00)	0.475	0.641	0.695	0.727	0.612	0.653
Nitrogen Purge Rate, SCF/hr	291	321	301	326	129	328

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor.

- h. By ash balance.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char, and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 11, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS:
MONTANA SUBBITUMINOUS COAL, COLSTRIP, SYNTHESIS GAS + STEAM FEED GAS (Runs HT-214,
-243, and -248)

Coal	Montana	Montana	Montana
	Subbituminous Coal Colstrip Mine 10/80	Subbituminous Coal Colstrip Mine 10/80	Subbituminous Coal Colstrip Mine 10/80
Source	Synthesis Gas + Steam		
Sieve Size, USS			
Feed Gas			
Run No.	<u>HT-214</u>	<u>HT-243</u>	<u>HT-248</u>
Duration of Test, hr	3	3-3/4	2-3/4
Steady-State Operating Period, min ^a	155-202	210-227	127-168
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1111	489	594
Reactor Temperature, °F ^b			
62-1/2 in.	1375	1250	645
67-3/4 in.	1405	1435	940
73 in.	1545	1535	1330
78-1/4 in.	1545	1575	1310
83-1/2 in.	1580	1700	1490
89 in.	1575	1570	1360
94-1/4 in.	1535	1535	1415
100 in.	1680	1700	1555
104 in.	1625	1635	1595
Average	1540	1550	1295
Coal Rate, lb/hr ^c	58.64	16.66	28.96
Feed Gas Rate, SCF/hr ^d	608.1	249.2	249.2
Steam Rate, lb/hr	26.16	12.18	12.31
Steam, mole % of hydrogen-steam mixture	47.5	50.7	50.9
Hydrogen/Coal Ratio, % of stoichiometric ^e	17.7	24.9	15.6
Hydrogen/Steam Ratio, mole/mole	0.648	0.559	0.596
Bed Pressure Differential, in. wc	----	----	126.0
Coal Space Velocity, lb/cu ft-hr	189.5	53.85	93.61
Feed Gas Residence Time, min ^f	0.318	0.325	0.447
Superficial Feed Gas Velocity, ft/s ^g	0.183	0.180	0.130

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1125.0	596.7	598.5
Net Btu Recovery, 1000 Btu/lb	3,974	3,145	2,964
Product Gas Yield, SCF/lb	19.18	35.82	20.66
Hydrocarbon Yield, SCF/lb	4.53	3.33	3.00
Carbon Oxides Yield, SCF/lb	1.156	2.47	2.01
Net Reacted Hydrogen, SCF/lb	1.396	nil	0.24
Residue, lb/lb coal ^h	0.554	0.537	0.671
Liquid Products, lb/lb coal ⁱ	0.375	0.560	0.356
Net MAF Coal Hydrogasified, wt % ^j	35.2	36.0	33.7
Carbon Gasified, wt %	29.6	30.0	27.4
Steam Decomposed, lb/hr ^k	6.50	3.80	2.89
Steam Decomposed, % of steam fed	24.8	31.2	23.4
Steam Decomposed, % of total equivalent fed ^m	50.6	49.1	49.8
Overall Material Balance, %	94.8	96.4	99.5
Carbon Balance, %	100.2	100.2	106.6
Hydrogen Balance, %	96.4	87.4	89.6
Oxygen Balance, %	86.6	90.8	92.7

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product	Feed	Product
Nitrogen	----	23.1	----	41.5	----	35.2
Carbon Monoxide	36.9	9.6	37.2	9.0	36.6	11.7
Carbon Dioxide	4.5	18.8	5.4	15.7	1.5	13.9
Hydrogen	58.6	24.4	57.4	24.4	61.9	24.6
Methane	----	22.0	----	8.5	----	13.7
Ethane	----	1.0	----	0.4	----	0.6
Propane	----	0.6	----	0.4	----	0.2
Butane	----	----	----	----	----	----
Benzene	----	0.2	----	0.1	----	0.1
Hydrogen Sulfide	----	0.3	----	----	----	----
Total	100.0	100.0	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	304	470	301	362	313	418
Specific Gravity (Air = 1.00)	0.468	0.772	0.482	0.808	0.420	0.773
Nitrogen Purge Rate, SCF/hr		260		248		211

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas.
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume / (CF/min feed gas at reactor pressure and temperature).
- g. (CF/s feed gas at reactor pressure and temperature) / cross-sectional area of reactor.
- h. By ash balance.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt feed gas in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 12. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: MONTANA LIGNITE, SAVAGE MINE, HYDROGEN + STEAM FEED GAS (Runs HT-217, -218, and -219)

Coal Source Sieve Size, USS Gas Feed	Montana Lignite Savage Mine 10/80	Montana Lignite Savage Mine 10/80 Hydrogen + Steam	Montana Lignite Savage Mine 10/80
<u>Run No.</u>	<u>HT-217</u>	<u>HT-218</u>	<u>HT-219</u>
Duration of Test, hr	4-1/4	5	4
Steady-State Operating Period, min ^a	144-298	135-290	108-247
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1020	1003	977
Reactor Temperature, °F ^b			
62-1/2 in.	1470	1420	1215
67-3/4 in.	1630	1660	1535
73 in.	1685	1700	1640
78-1/4 in.	1630	1650	1565
83-1/2 in.	1630	1690	1575
89 in.	1575	1615	1530
94-1/2 in.	1555	1590	1520
100 in.	1660	1735	1615
104 in.	1630	1695	1610
Average	1605	1640	1535
Coal Rate, lb/hr ^c	75.44	69.52	59.07
Feed Gas Rate, SCF/hr ^d	462.8	463.4	536.4
Steam Rate, lb/hr	25.75	11.87	26.62
Steam, mole % of hydrogen-steam mixture	53.9	35.0	51.0
Hydrogen/Coal Ratio, % of stoichiometric ^e	19.1	20.2	28.1
Hydrogen/Steam Ratio, mole/mole	0.855	1.858	0.959
Bed Pressure Differential, in. wc	78.0	52.0	92.0
Coal Space Velocity, lb/cu ft-hr	243.8	224.7	190.9
Feed Gas Residence Time, min ^f	0.326	0.445	0.297
Superficial Feed Gas Velocity, ft/s ^g	0.179	0.131	0.196

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1200.3	1095.9	1124.6
Net Btu Recovery, 1000 Btu/lb	4.758	4.355	4.356
Product Gas Yield, SCF/lb	15.91	15.76	19.04
Hydrocarbon Yield, SCF/lb	4.23	4.92	4.25
Carbon Oxides Yield, SCF/lb	3.64	2.85	3.50
Net Reacted Hydrogen, SCF/lb	1.647	2.930	2.780
Residue, lb/lb coal ⁿ	0.416	0.431	0.449
Liquid Products, lb/lb coal ⁱ	0.387	0.254	0.420
Net MAF Coal Hydrogasified, wt % ^j	60.1	51.3	48.6
Carbon Gasified, wt %	42.7	38.5	42.1
Steam Decomposed, lb/hr ^k	1.59	nil	5.88
Steam Decomposed, % of steam fed	6.16	nil	22.1
Steam Decomposed, % of total equivalent fed ^m	45.5	52.9	50.7
Overall Material Balance, %	100.0	96.3	97.8
Carbon Balance, %	102.9	94.4	105.6
Hydrogen Balance, %	100.1	99.4	93.7
Oxygen Balance, %	102.8	95.1	89.5

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	21.9	30.1	25.9
Carbon Monoxide	9.8	8.6	7.0
Carbon Dioxide	13.1	9.5	11.4
Hydrogen	28.2	23.7	33.1
Methane	25.0	26.2	20.6
Ethane	1.1	1.0	1.1
Propane	0.5	0.4	0.5
Butane	----	----	----
Benzene	0.4	0.4	0.3
Hydrogen Sulfide	----	0.1	0.1
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	534	581	455
Specific Gravity (Air = 1.00)	0.696	0.711	0.659
Nitrogen Purge Rate, SCF/hr	263	330	290

- a. From start of lignite feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Hydrogen gas
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance for Runs HT-218, and HT-219 Based on weight of residue recovered for Run HT-217.
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 12, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS:
MONTANA LIGNITE, SAVAGE MINE, SYNTHESIS GAS + STEAM FEED GAS (Run HT-220)

Coal Source	Montana Lignite Savage Mine
Sieve Size, USS	10/80
Gas Feed	Synthesis Gas + Steam
<u>Run No.</u>	<u>HT-220</u>
Duration of Test, hr	4-3/4
Steady-State Operating Period, min ^a	140-298
OPERATING CONDITIONS	
Bed Height, ft	3.5
Reactor Pressure, psig	986
Reactor Temperature, °F ^b	
62-1/2 in.	1375
67-3/4 in.	1620
73 in.	1640
78-1/4 in.	1610
83-1/2 in.	1615
89 in.	1585
94-1/2 in.	1515
100 in.	1645
104 in.	1605
Average	1580
Coal Rate, lb/hr ^c	66.22
Feed Gas Rate, SCF/hr ^d	547.4
Steam Rate, lb/hr	27.06
Steam, mole % of hydrogen-steam mixture	50.9
Hydrogen/Coal Ratio, % of stoichiometric ^e	13.9
Hydrogen/Steam Ratio, mole/mole	0.551
Bed Pressure Differential, in. wc	108
Coal Spave Velocity, lb/cu ft-hr	214.0
Feed Gas Residence Time, min ^f	0.288
Superficial Feed Gas Velocity, ft/s ^g	0.202

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	1257.2
Net Btu Recovery, 1000 Btu/lb	3.606
Product Gas Yield, SCF/lb	19.02
Hydrocarbon Yield, SCF/lb	3.38
Carbon Oxides Yield, SCF/lb	2.81
Net Reacted Hydrogen, SCF/lb	0.316
Residue, lb/lb coal ^a	0.510
Liquid Products, lb/lb coal ^b	0.361
Net MAF Coal Hydrogasified, wt % ^c	49.2
Carbon Gasified, wt %	13.3
Steam Decomposed, lb/hr ^k	1.36
Steam Decomposed, % of steam fed	19.8
Steam Decomposed, % of total equivalent fed ^m	12.6
Overall Material Balance, %	19.5
Carbon Balance, %	19.4
Hydrogen Balance, %	15.4
Oxygen Balance, %	15.1

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product
Nitrogen	----	25.2
Carbon Monoxide	38.1	13.2
Carbon Dioxide	4.7	20.2
Hydrogen	57.2	23.2
Methane	----	16.5
Ethane	----	0.8
Propane	----	0.5
Butane	----	----
Benzene	----	0.3
Hydrogen Sulfide	----	0.1
Total	100.0	100.0
Heating Value, N ₂ -free Btu/SCF ⁿ	301	425
Specific Gravity (Air = 1.00)	0.484	0.814
Nitrogen Purge Rate, SCF/hr		317

- a. From start of liquid feed.
- b. Tube wall temperatures. Bottom of coal bed at 60 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By ash balance

- i. Includes condensed, undecomposed steam.
- j. 100 (wt-% product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in-wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 13. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: FMC PROJECT COED CHAR, NO. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Run HT-221)

Coal Source Sieve Size, USS Feed Gas	Illinois Bituminous Coal Char FMC Project COED 10/80 Hydrogen + Steam
<u>Run No.</u>	<u>HT-221</u>
Duration of Test, hr	4-1/2
Steady-State Operating Period, min ^a	85-275
OPERATING CONDITIONS	
Bed Height, ft	3.5
Reactor Pressure, psig	965
Reactor Temperature, °F ^b	
62-1/2 in.	1100
67-3/4 in.	1500
73 in.	1620
78-1/4 in.	1585
83-1/2 in.	1645
89 in.	1605
94-1/2 in.	1550
100 in.	1695
104 in.	1660
Average	1550
Coal Rate, lb/hr ^c	42.78
Feed Gas Rate, SCF/hr ^d	579.6
Steam Rate, lb/hr	26.00
Steam, mole % of hydrogen-steam mixture	48.5
Hydrogen/Coal Ratio, % of stoichiometric ^e	28.4
Hydrogen/Steam Ratio, mole/mole	1.061
Bed Pressure Differential, in. wc	62.0
Coal Space Velocity, lb/cu ft-hr	138.3
Feed Gas Residence Time, min ^f	0.283
Superficial Feed Gas Velocity, ft/s ^g	0.206

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	837.5
Net Btu Recovery, 1000 Btu/lb	1.720
Product Gas Yield, SCF/lb	19.58
Hydrocarbon Yield, SCF/lb	2.84
Carbon Oxides Yield, SCF/lb	1.33
Net Reacted Hydrogen, SCF/lb	4.405
Residue, lb/lb coal ^h	0.800
Liquid Products, lb/lb coal ⁱ	0.511
Net MAF Coal Hydrogasified, wt % ^j	16.6
Carbon Gasified, wt %	17.4
Steam Decomposed, lb/hr ^k	4.15
Steam Decomposed, % of steam fed	16.0
Steam Decomposed, % of total equivalent fed ^m	17.1
Overall Material Balance, %	96.8
Carbon Balance, %	95.9
Hydrogen Balance, %	95.1
Oxygen Balance, %	100.6

PRODUCT GAS PROPERTIES

Gas Composition, mole %	
Nitrogen	31.9
Carbon Monoxide	2.9
Carbon Dioxide	3.9
Hydrogen	46.7
Methane	14.4
Ethane	0.1
Propane	----
Butane	----
Benzene	0.1
Hydrogen Sulfide	----
Total	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	451
Specific Gravity (Air = 1.00)	0.514
Nitrogen Purge Rate, SCF/hr	267

- | | |
|--|--|
| a. From start of coal feed. | i. Includes condensed, undecomposed steam. |
| b. Tube wall temperatures. Bottom of coal bed at 62 in. | j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal). |
| c. Operating conditions and results based on weight of dry feed. | k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor. |
| d. Hydrogen gas | m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor. |
| e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane. | n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure. |
| f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature). | |
| g. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor. | |
| h. By ash balance | |

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Table 2-A7, Part 13, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: FMC PROJECT COED CHAR, No. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL SYNTHESIS GAS + STEAM FEED GAS (Runs HT-222, and -223)

Coal Source Sieve Size, USS Feed Gas	Illinois Bituminous Coal Char FMC Project COED 10/80	Illinois Bituminous Coal Char FMC Project COED 10/80
	Synthesis Gas + Steam	
Run No.	HT-222	HT-223
Duration of Test, hr	2-1/2	4
Steady-State Operating Period, min ^a	98-155	119-240
OPERATING CONDITIONS		
Bed Height, ft	3.5	3.5
Reactor Pressure, psig	999	1010
Reactor Temperature, °F ^b		
62-1/2 in.	1215	1340
67-3/4 in.	1500	1555
73 in.	1580	1675
78-1/4 in.	1485	1585
83-1/2 in.	1480	1650
89 in.	1445	1575
94-1/2 in.	1380	1565
100 in.	1510	1690
104 in.	1495	1655
Average	1455	1590
Coal Rate, lb/hr ^c	27.47	31.46
Feed Gas Rate, SCF/hr ^d	554.7	501.5
Steam Rate, lb/hr	26.56	25.29
Steam, mole % of hydrogen-steam mixture	50.1	51.4
Hydrogen/Coal Ratio, % of stoichiometric ^e	23.8	18.3
Hydrogen/Steam Ratio, mole/mole	0.551	0.510
Bed Pressure Differential, in. wc	----	74.0
Coal Space Velocity, lb/cu ft-hr	88.8	101.7
Feed Gas Residence Time, min ^f	0.312	0.317
Superficial Feed Gas Velocity, ft/s ^g	0.187	0.184

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	856.8	909.4
Net Btu Recovery, 1000 Btu/lb	1.426	1.850
Product Gas Yield, SCF/lb	31.19	28.90
Hydrocarbon Yield, SCF/lb	1.47	2.46
Carbon Oxides Yield, SCF/lb	nil	0.482
Net Reacted Hydrogen, SCF/lb	nil	0.283
Residue, lb/lb coal ⁿ	0.901	0.862
Liquid Products, lb/lb coal ⁱ	0.751	0.656
Net MAF Coal Hydrogasified, wt % ^j	11.7	15.6
Carbon Gasified, wt %	12.3	14.5
Steam Decomposed, lb/hr ^k	5.91	4.65
Steam Decomposed, % of steam fed	22.3	18.4
Steam Decomposed, % of total equivalent fed ^m	24.4	20.9
Overall Material Balance, %	96.6	98.4
Carbon Balance, %	93.0	95.1
Hydrogen Balance, %	96.0	103.7
Oxygen Balance, %	96.3	100.0

PRODUCT AND FEED GAS PROPERTIES

Gas Composition, mole %	Feed	Product	Feed	Product
Nitrogen	----	31.2	----	39.0
Carbon Monoxide	39.9	8.8	41.0	7.4
Carbon Dioxide	4.7	17.5	5.0	16.3
Hydrogen	55.4	37.8	54.0	28.8
Methane	----	4.7	----	8.5
Ethane	----	----	----	----
Propane	----	----	----	----
Butane	----	----	----	----
Benzene	----	----	----	----
Hydrogen Sulfide	----	----	----	----
Total	100.0	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ⁿ	303	283	302	327
Specific Gravity (Air = 1.00)	0.496	0.708	0.512	0.767
Nitrogen Purge Rate, SCF/hr		267		355

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Synthesis gas
- e. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- f. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- g. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- h. By weight of residue recovered
- i. Includes condensed, undecomposed steam.
- j. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- k. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- m. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- n. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 14. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: PRE-TREATED SEWELL SEAM, SEWELL NO. 1 MINE, WEST VIRGINIA MEDIUM-VOLATILE CONTENT, BITUMINOUS COAL, HYDROGEN + STEAM FEED GAS (Runs HT-230, -231, and -233)

Coal	Sewell No. 1	Sewell No. 1	Sewell No. 1
	Mine, Medium-Volatile Content W. Va. Bit. Coal IGT Pretreater, FP-140 10/80	Mine, Medium-Volatile Content W. Va. Bit. Coal IGT Pretreater FP-140 10/80	Mine, Medium-Volatile Content W. Va. Bit. Coal IGT Pretreater, FP-140 10/80
Source	Hydrogen + Steam		
Sieve Size, USS			
Feed Gas			
Run No.	HT-230	HT-231	HT-233
Duration of Test, hr	4-1/2	4-1/4	4-1/4
Steady-State Operating Period, min ^a	128-264	84-262	95-259
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	996	1045	1016
Reactor Temperature, °F ^b			
62-1/2 in.	840	880	1000
67-3/4 in.	980	975	1380
73 in.	1270	1215	1480
78-1/4	1310	1290	1480
83-1/2 in.	1450	1365	1605
89 in.	1455	1420	1555
94-1/2 in.	1440	1475	1510
100 in.	1665	1670	1705
104 in.	1680	1690	1720
Average	1345	1330	1490
Coal Rates, lb/hr ^c	40.97	56.58	46.21
Hydrogen Rate, SCF/hr	596.3	506.0	485.5
Steam Rate, lb/hr	15.94	27.33	25.36
Steam, mole % of hydrogen-steam mixture	36.0	53.2	52.3
Hydrogen/Coal Ratio, % of stoichiometric ^d	33.5	20.5	23.7
Hydrogen/Steam Ratio, mole/mole	1.781	0.881	0.911
Bed Pressure Differential, in. wc	70.0	94.0	64.0
Coal Space Velocity, lb/cu ft-hr	132.4	182.9	149.4
Feed Gas Residence Time, min ^e	0.394	0.359	0.340
Superficial Feed Gas Velocity, ft/s ^f	0.148	0.163	0.172

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(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	999.6	1054.9	939.6
Net Btu Recovery, 1000 Btu/lb	4.487	4.160	4.163
Product Gas Yield, SCF/lb	24.40	18.64	20.33
Hydrocarbon Yield, SCF/lb	4.88	4.05	4.39
Carbon Oxides Yield, SCF/lb	2.68	2.27	2.05
Net Reacted Hydrogen, SCF/lb	4.16	2.14	2.94
Residue, lb/lb coal ^g	0.577	0.614	0.667
Liquid Products, lb/lb coal ^h	0.351	0.451	0.500
Net MAF Coal Hydrogasified, wt % ⁱ	41.9	35.2	32.8
Carbon Gasified, wt %	31.7	26.7	26.7
Steam Decomposed, lb/hr ^j	2.13	2.59	2.65
Steam Decomposed, % of steam fed	13.4	9.48	10.47
Steam Decomposed, % of total equivalent fed ^k	35.4	28.6	26.0
Overall Material Balance, %	98.7	97.3	98.6
Carbon Balance, %	98.5	97.8	100.8
Hydrogen Balance, %	96.8	99.9	99.3
Oxygen Balance, %	96.2	98.6	95.5

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	26.2	39.2	20.9
Carbon Monoxide	7.8	7.8	6.6
Carbon Dioxide	3.2	4.4	3.5
Hydrogen	42.6	36.5	37.2
Methane	19.6	21.3	21.2
Ethane	9.3	0.3	0.3
Propane	0.1	0.1	0.1
Butane	----	----	----
Benzene	0.2	0.3	0.2
Hydrogen Sulfide	----	0.1	0.1
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ^m	503	525	529
Specific Gravity (Air= 1.00)	0.538	0.584	0.571
Nitrogen Purge Rate, SCF/hr	262	308	289

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Percent of the stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- e. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- f. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- g. By ash balance.

- h. Includes condensed, undecomposed steam.
- i. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- j. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- k. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- m. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

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Table 2-A7, Part 15. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: NEW MEXICO SUBBITUMINOUS COAL, SEAM A, NAVAHO INDIAN LEASE, FARMINGTON, HYDROGEN + STEAM FEED GAS (Runs HT-249, -251, and -252B)

Coal Source	New Mexico Subbituminous Farmington Pit A 10/80	New Mexico Subbituminous Farmington Pit B 10/80	New Mexico Subbituminous Farmington Pit B 10/80
Sieve Size, USS			
Feed Gas	Hydrogen + Steam		
<u>Run No.</u>	<u>HT-249</u>	<u>HT-251</u>	<u>HT-252B</u>
Duration of Test, hr	2	2-1/4	6-3/4
Steady-State Operating Period, min ^a	165-182	126-137	310-405
OPERATING CONDITIONS			
Bed Height, ft	3.5	3.5	3.5
Reactor Pressure, psig	1010	1004	1009
Reactor Temperature, °F ^b			
62-1/2 in.	1105	1300	1085
67-3/4 in.	1220	1220	1235
73 in.	1365	1470	1455
78-1/4 in.	1280	1545	1400
83-1/2 in.	1420	1795	1620
89 in.	1300	1635	1500
94-1/4 in.	1430	1640	1570
100 in.	1555	1770	1730
104 in.	1440	1665	1770
Average	1345	1560	1485
Coal Rate, lb/hr ^c	63.00	30.38	33.85
Hydrogen Rate, SCF/hr	447.6	459.0	454.4
Steam Rate, lb/hr	30.00	8.33	9.89
Steam, mole % of hydrogen-steam mixture ^d	58.5	27.6	31.4
Hydrogen/Coal Ratio, % of stoichiometric	23.1	47.9	42.2
Hydrogen/Steam Ratio, mole/mole	0.710	2.622	2.187
Bed Pressure Differential, in. wc	----	----	----
Coal Space Velocity, lb/cu ft-hr	203.6	98.2	109.4
Feed Gas Residence Time, min ^e	0.328	0.674	0.521
Superficial Feed Gas Velocity, ft/s ^f	0.178	0.0865	0.112

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	832.3	892.0	937.3
Net Btu Recovery, 1000 Btu/lb	3.346	5.467	6.142
Product Gas Yield, SCF/lb	13.21	29.36	27.69
Hydrocarbon Yield, SCF/lb	3.59	7.40	7.06
Carbon Oxides Yield, SCF/lb	2.03	1.35	2.85
Net Reacted Hydrogen, SCF/lb	3.19	8.77	6.86
Residue, lb/lb coal ^g	0.578	0.543	0.415
Liquid Products, lb/lb coal ^h	0.445	0.276	0.347
Net MAF Coal Hydrogasified, wt % ⁱ	31.8	45.5	64.5
Carbon Gasified, wt %	31.8	46.2	53.5
Steam Decomposed, lb/hr ^j	5.75	0.846	Nil
Steam Decomposed, % of steam fed	19.2	10.2	Nil
Steam Decomposed, % of total equivalent fed ^k	41.2	46.3	34.2
Overall Material Balance, %	93.4	98.3	99.4
Carbon Balance, %	101.0	104.3	97.6
Hydrogen Balance, %	83.7	97.4	99.7
Oxygen Balance, %	83.3	78.4	106.2

PRODUCT GAS PROPERTIES

Gas Composition, mole %			
Nitrogen	27.4	48.5	40.2
Carbon Monoxide	7.6	3.3	7.6
Carbon Dioxide	7.8	1.3	2.7
Hydrogen	29.6	21.6	23.7
Methane	24.9	23.7	24.1
Ethane	1.9	1.3	1.3
Propane	0.4	0.2	0.1
Butane	---	---	---
Benzene	0.4	0.1	0.2
Hydrogen Sulfide	---	---	0.1
Total	100.0	100.0	100.0
Heating Value, N ₂ -free, Btu/SCF ^m	585	674	624
Specific Gravity (Air = 1.00)	0.655	0.689	0.677
Nitrogen Purge Rate, SCF/hr	228	433	377

- a. From start of coal feed.
- b. Tube wall temperatures. Bottom of coal bed at 62 in.
- c. Operating conditions and results based on weight of dry feed.
- d. Percent of stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane.
- e. Coal bed volume/(CF/min feed gas at reactor pressure and temperature).
- f. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor.
- g. By ash balance.
- h. Includes condensed, undecomposed steam.
- i. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal).
- j. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor.
- k. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor.
- m. Gross, gas saturated at 60°F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60°F, 30-in. Hg pressure.

Table 2-A7, Part 15, Cont. FLUIDIZED-BED HYDROGASIFICATION TEST OPERATING RESULTS: NEW MEXICO SUBBITUMINOUS COAL, SEAM A, NAVAHO INDIAN LEASE, FARMINGTON, HYDROGEN FEED GAS (Run HT-252A)

Coal	New Mexico
Source	Subbituminous
Sieve Size, USS	Farmington
Feed Gas	Pit B
	10/80
	Hydrogen
<u>Run No.</u>	<u>HT-252A</u>
Duration of Test, hr	6-3/4
Steady-State Operating Period, min ^a	129-285
OPERATING CONDITIONS	
Bed Height, ft	3.5
Reactor Pressure, psig	1016
Reactor Temperature, °F ^b	
62-1/2 in.	1315
67-3/4 in.	1415
73 in.	1740
78-1/4 in.	1680
83-1/2 in.	1850
89 in.	1695
94-1/4 in.	1690
100 in.	1870
104 in.	1845
Average	1675
Coal Rate, lb/hr ^c	33.76
Hydrogen Rate, SCF/hr	460.4
Steam Rate, lb/hr	----
Steam, mole % of hydrogen-steam mixture ^d	----
Hydrogen/Coal Ratio, % of stoichiometric ^d	42.9
Hydrogen/Steam Ratio, mole/mole	----
Bed Pressure Differential, in. wc	24.0
Coal Space Velocity, lb/cu ft-hr	109.1
Feed Gas Residence Time, min ^e	0.686
Superficial Feed Gas Velocity, ft/s ^f	0.0851

(Continued)

OPERATING RESULTS

Product Gas Rate, SCF/hr	846.5
Net Btu Recovery, 1000 Btu/lb	5.028
Product Gas Yield, SCF/lb	25.07
Hydrocarbon Yield, SCF/lb	6.67
Carbon Oxides Yield, SCF/lb	1.25
Net Reacted Hydrogen, SCF/lb	7.77
Residue, lb/lb coal ^g	0.509
Liquid Products, lb/lb coal ^h	0.153
Net MAF Coal Hydrogasified, wt % ⁱ	44.9
Carbon Gasified, wt %	43.2
Steam Decomposed, lb/hr ^j	----
Steam Decomposed, % of steam fed	----
Steam Decomposed, % of total equivalent fed ^k	34.3
Overall Material Balance, %	100.8
Carbon Balance, %	101.5
Hydrogen Balance, %	101.3
Oxygen Balance, %	108.7

PRODUCT GAS PROPERTIES

Gas Composition, mole %	
Nitrogen	44.8
Carbon Monoxide	3.8
Carbon Dioxide	1.2
Hydrogen	23.4
Methane	25.2
Ethane	1.3
Propane	0.1
Butane	----
Benzene	0.2
Hydrogen Sulfide	----
Total	100.0
Heating Value, N ₂ -free, Btu/SCF ^m	672
Specific Gravity (Air = 1.00)	0.667
Nitrogen Purge Rate, SCF/hr	379

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|--|--|
| a. From start of coal feed. | h. Includes condensed, undecomposed steam. |
| b. Tube wall temperatures. Bottom of coal bed at 62 in. | i. 100 (wt of product gas-wt hydrogen in-wt decomposed steam-wt nitrogen in/wt of moisture-, ash-free coal). |
| c. Operating conditions and results based on weight of dry feed. | j. Computed as difference between steam feed rate and the measured liquid water rate leaving the reactor. |
| d. Percent of stoichiometric hydrogen/char ratio - the net feed hydrogen/char ratio required to convert all the carbon to methane. | k. Computed as difference between the total equivalent steam feed rate (includes moisture content of feed char and bound water corresponding to oxygen content of feed char) and the measured liquid water rate leaving the reactor. |
| e. Coal bed volume/(CF/min feed gas at reactor pressure and temperature). | m. Gross, gas saturated at 60 °F, 30-in. Hg pressure. SCF: dry gas volume in SCF at 60 °F, 30-in. Hg pressure. |
| f. (CF/s feed gas at reactor pressure and temperature)/cross-sectional area of reactor. | |
| g. By ash balance. | |

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Table 2-A8, Part 1. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-95, -96, -104, -105, -106, and -109)

Run No. Sample	HT-95		HT-96		HT-104		HT-105		HT-106		HT-109	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %												
Moisture	1.3	0.4	1.3	0.5	1.4	0.8	0.9	0.3	0.9	0.3	1.3	1.0
Volatile Matter	15.8	3.0	22.0	3.9	23.2	4.0	23.6	3.1	23.9	2.9	24.0	3.4
Fixed Carbon	68.6	75.6	63.7	74.6	63.3	77.1	63.1	80.2	60.3	77.7	64.0	78.5
Ash	14.3	21.0	13.0	21.0	12.1	18.1	12.4	16.4	14.9	19.1	10.7	17.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %												
Carbon	74.2	75.9	73.1	74.7	71.7	78.3	73.3	81.9	70.4	77.8	73.7	78.7
Hydrogen	2.59	1.28	3.22	1.30	3.55	1.47	3.82	1.52	3.89	1.05	4.06	1.59
Nitrogen	1.06	0.69	1.20	0.79	1.25	0.61	1.24	---	1.27	0.77	1.29	0.86
Oxygen	4.97	0.00	6.16	0.00	8.05	0.00	5.72	---	5.85	0.00	6.79	0.00
Sulfur	2.70	2.04	3.04	2.17	3.14	1.85	3.40	---	3.56	1.86	3.33	1.89
Ash	14.48	21.07	13.28	21.10	12.31	18.40	12.52	16.44	15.03	19.19	10.83	17.31
Total	100.00	100.98	100.00	100.06	100.00	100.63	100.00	99.86	100.00	100.67	100.00	100.35
Screen Analysis, USS, wt %												
+ 20	11.4	4.9	14.7	7.7	12.1	11.3	11.3	12.2	8.9	18.0	22.3	14.9
+ 30	12.7	17.1	20.2	14.4	20.1	18.9	19.1	25.1	17.5	22.4	24.0	15.5
+ 40	23.2	34.3	21.7	23.5	22.8	23.1	22.9	22.2	22.7	21.4	19.9	13.4
+ 60	26.5	31.4	22.3	28.5	23.3	24.7	24.3	19.1	26.7	20.5	17.4	13.5
+ 80	11.6	7.9	9.6	12.5	9.5	10.0	9.9	7.6	10.5	7.7	6.3	6.2
+ 100	5.2	2.3	4.3	5.5	5.6	5.1	5.4	4.4	5.7	3.8	3.5	3.6
+ 200	6.6	1.9	5.2	6.6	5.3	5.5	6.1	6.9	7.0	5.1	4.9	8.7
+ 325	1.7	0.1	1.2	0.9	0.9	0.8	0.8	2.0	0.9	0.9	1.0	5.5
- 325	1.1	0.1	0.8	0.4	0.4	0.6	0.2	0.5	0.1	0.2	0.7	18.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-132

B7506 1542

Table 2-A8, Part 1, Cont. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-113, -115, -116, -118, -119, and -121)

Run No. Sample	HT-113		HT-115		HT-116		HT-118		HT-119		HT-121	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %												
Moisture	1.0	0.4	1.4	1.4	1.7	0.7	1.4	0.6	1.8	0.5	1.8	1.6
Volatile Matter	24.1	2.5	24.6	3.1	25.1	2.4	24.5	2.4	23.0	2.5	25.5	2.9
Fixed Carbon	64.0	73.5	61.7	69.9	61.9	74.8	61.3	73.5	64.7	74.6	62.8	79.1
Ash	10.9	23.6	12.3	25.6	11.3	22.1	12.8	23.5	10.5	22.4	9.9	16.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %												
Carbon	72.3	74.8	71.2	72.5	71.9	76.3	70.9	74.0	73.0	75.1	72.6	79.6
Hydrogen	3.90	0.87	3.98	0.80	4.02	0.92	3.98	0.80	3.97	0.86	4.06	1.21
Nitrogen	1.29	0.43	1.23	0.38	1.26	0.40	1.31	0.40	1.46	0.51	1.39	0.46
Oxygen	7.84	0.00	7.13	0.00	7.51	0.00	6.75	0.00	6.93	0.00	8.06	0.66
Sulfur	3.64	1.59	3.94	1.92	3.83	1.75	4.08	1.92	3.94	2.32	3.86	1.42
Ash	11.03	23.70	12.52	25.96	11.48	22.22	12.98	23.62	10.70	22.50	10.03	16.65
Total	100.00	101.39	100.00	101.56	100.00	101.59	100.00	100.74	100.00	101.29	100.00	100.00
Screen Analysis, USS, wt %												
+20	11.5	7.7	11.0	4.1	8.3	6.4	3.3	10.2	17.0	6.8	18.4	18.5
+30	17.5	17.8	17.9	11.5	12.1	13.4	18.4	17.7	22.8	19.1	21.1	24.0
+40	24.2	24.5	20.1	23.5	23.3	27.2	27.6	24.6	22.5	24.9	21.9	24.8
+60	24.0	24.9	24.0	28.3	27.5	25.7	30.3	26.6	21.5	28.1	23.2	20.4
+80	10.6	7.3	10.2	10.7	10.8	7.5	11.8	9.8	6.4	7.9	8.5	4.2
+100	5.6	9.2	6.2	7.3	7.1	7.0	5.8	5.6	6.4	7.7	4.5	4.6
+200	0.1	0.2	8.3	2.9	0.2	0.1	0.5	0.3	0.2	0.0	0.3	1.9
+325	6.4	7.7	1.7	9.1	10.0	10.2	2.1	4.6	2.9	5.2	1.9	0.8
-325	0.1	0.7	0.6	2.6	0.7	2.5	0.2	0.6	0.3	0.3	0.2	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-133

B7506 1542A

Table 2-A8, Part 1, Cont. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-125, -126, -128, -129, -138, and -154)

Run No. Sample	HT-125		HT-126		HT-128		HT-129		HT-138		HT-154	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %												
Moisture	1.7	0.6	2.2	1.4	1.6	0.4	1.8	1.5	2.4	1.0	3.0	0.6
Volatile Matter	21.7	2.7	24.4	3.5	23.9	3.1	24.0	2.3	23.4	2.2	24.1	2.5
Fixed Carbon	65.6	75.0	63.8	75.8	63.1	73.7	63.7	77.9	63.5	81.6	63.4	78.9
Ash	11.0	21.7	9.6	19.3	11.4	22.8	10.5	18.3	10.7	15.2	9.5	18.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %												
Carbon	72.7	76.1	73.3	76.6	70.0	74.8	70.5	79.1	71.3	80.9	70.9	79.3
Hydrogen	3.41	0.76	3.79	1.01	3.33	0.66	3.35	1.07	3.39	0.91	3.20	1.52
Nitrogen	1.03	0.52	1.19	0.43	1.28	0.35	1.29	0.35	1.23	0.47	1.21	0.36
Oxygen	7.92	0.00	8.34	0.56	10.30	0.00	10.74	0.00	9.75	0.79	10.83	0.00
Sulfur	3.64	1.65	3.60	1.86	3.49	1.71	3.46	1.36	3.41	1.61	4.02	1.81
Ash	11.30	21.84	9.78	19.54	11.60	22.86	10.66	18.34	10.92	15.32	9.84	18.11
Total	100.00	100.87	100.00	100.00	100.00	100.38	100.00	100.22	100.00	100.00	100.00	101.10
Screen Analysis, USS, wt %												
+20	14.1	8.9	20.8	10.5	11.6	11.4	14.2	13.6	24.3	14.0	15.8	9.9
+30	19.8	18.1	22.5	21.1	21.7	19.3	23.7	26.9	24.1	23.4	15.5	13.5
+40	22.8	25.0	21.3	25.1	21.0	25.3	22.4	21.8	20.6	24.5	24.5	28.2
+60	23.0	26.1	19.4	25.2	25.1	25.9	22.1	21.1	18.8	25.4	25.7	28.4
+80	7.0	6.5	6.1	5.3	11.1	9.4	10.6	9.5	6.5	7.5	10.2	9.2
+100	6.3	8.2	4.6	8.0	3.7	3.0	3.6	3.7	2.2	2.3	4.0	4.3
+200	2.2	3.4	2.4	3.2	4.5	2.7	2.7	3.0	2.7	1.9	3.2	4.4
+325	3.9	3.0	2.2	1.4	1.0	2.1	0.4	0.2	0.4	0.5	0.6	0.9
-325	0.9	0.8	0.7	0.2	0.3	0.9	0.3	0.2	0.4	0.5	0.5	1.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-134

B7506 1542B

Table 2-A8, Part 1, Cont. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-168, -169, -171, -173, -193, and -194)

Run No. Sample	HT-168			HT-169		HT-171		HT-173		HT-193		HT-194	
	Feed	Residue A ^a	Residue B ^b	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %													
Moisture	2.9	0.7	0.9	1.9	0.6	2.4	0.6	2.2	0.3	0.5	0.2	1.4	0.1
Volatile Matter	22.9	1.7	1.6	23.9	3.1	23.1	1.5	23.3	0.7	22.9	2.1	24.2	1.0
Fixed Carbon	64.0	80.7	79.5	63.7	78.9	63.1	79.8	65.2	79.5	64.3	78.8	63.1	81.7
Ash	10.2	16.9	18.0	10.5	17.4	11.4	18.1	9.3	19.5	12.3	18.9	11.3	17.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (Dry), wt %													
Carbon	70.9	79.3	78.2	70.7	79.0	71.5	78.3	72.5	78.1	69.7	77.4	69.9	80.8
Hydrogen	3.40	1.38	1.14	4.07	0.89	3.44	0.87	3.69	1.01	3.19	1.09	3.09	0.92
Nitrogen	0.87	0.74	0.73	1.33	0.53	1.17	0.60	1.24	0.40	1.18	0.29	1.46	0.60
Oxygen	10.67	0.00	0.00	9.17	0.13	8.43	0.45	9.08	0.00	9.96	0.39	10.78	0.00
Sulfur	3.61	1.94	2.08	4.05	1.95	3.94	1.56	4.00	1.92	3.59	1.89	3.33	1.95
Ash	10.55	17.06	18.19	10.68	17.50	11.52	18.22	9.49	19.60	12.38	18.94	11.44	17.28
Total	100.00	100.42	100.34	100.00	100.00	100.00	100.00	100.00	101.03	100.00	100.00	100.00	101.47
Screen Analysis, USS, wt %													
+20	17.8	11.3	10.4	18.6	15.2	20.5	15.3	12.2	9.4	9.2	6.5	12.9	5.9
+30	18.9	17.1	15.1	14.2	16.4	14.4	16.9	13.7	9.8	19.0	4.7	17.6	18.1
+40	23.7	24.5	26.8	23.6	25.1	23.5	25.0	23.7	30.2	22.6	23.5	25.1	25.8
+60	21.4	25.1	26.6	24.7	24.0	23.2	23.5	26.5	27.0	22.3	27.9	22.7	25.1
+80	10.8	12.4	12.1	12.3	11.0	10.4	11.0	12.8	11.9	13.0	15.3	11.3	11.6
+100	3.3	4.1	3.8	3.0	3.4	3.6	3.8	4.5	4.2	4.6	5.6	3.7	4.6
+200	2.6	3.9	3.5	2.2	3.1	2.8	3.1	3.4	3.3	8.5	12.8	5.6	7.3
+325	0.8	0.8	1.0	0.6	0.9	1.0	0.9	1.4	1.8	0.7	2.3	0.8	0.8
-325	0.7	0.8	0.7	0.8	0.9	0.6	0.5	1.8	2.4	0.1	1.4	0.3	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

- a. 3.5-ft coal bed.
b. 7.0-ft coal bed.

2A-135

B7506 1542C

Table 2-A8, Part 1, Cont. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURTH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-200, -202, -203, -204, -205, and -206)

Run No. Sample	HT-200		HT-202		HT-203		HT-204		HT-205		HT-206	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %												
Moisture	0.7	0.6	1.1	1.4	1.6	1.2	1.0	2.4	1.6	2.7	2.2	1.0
Volatile Matter	22.0	3.0	21.9	0.0	22.4	4.6	25.4	2.0	22.3	2.0	23.1	2.8
Fixed Carbon	63.5	75.6	63.6	79.6	63.2	73.0	60.1	73.5	62.6	76.0	62.7	77.3
Ash	13.8	20.8	13.4	19.0	12.8	21.2	13.5	22.1	13.5	19.3	12.0	18.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %												
Carbon	68.2	75.0	67.8	76.8	68.9	73.0	69.1	73.2	68.2	76.1	69.4	76.6
Hydrogen	3.27	1.40	2.51	1.25	3.38	1.49	3.43	1.22	3.51	1.09	3.42	1.17
Nitrogen	1.30	0.79	1.33	0.77	1.33	0.69	1.35	0.67	1.11	0.73	1.11	0.67
Oxygen	10.08	0.00	11.55	0.00	10.59	1.60	9.77	0.32	10.95	0.88	11.32	1.13
Sulfur	3.28	2.13	3.26	2.10	2.78	1.72	2.67	1.93	2.55	1.33	2.49	1.37
Ash	13.87	20.92	13.55	19.22	13.02	21.50	13.68	22.66	13.68	19.87	12.26	19.06
Total	100.00	100.24	100.00	100.14	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %												
+20	9.5	6.8	9.2	5.7	9.4	3.9	10.6	3.6	8.6	6.0	10.9	5.4
+30	7.9	14.9	12.1	12.7	15.7	10.2	15.3	9.1	9.3	14.6	18.0	17.9
+40	23.9	24.0	19.1	21.7	22.5	25.1	26.5	23.3	22.7	25.1	23.6	29.2
+60	24.4	24.5	20.2	24.1	21.1	26.1	23.1	26.4	24.4	25.6	27.0	27.2
+80	13.0	12.6	12.1	13.3	11.2	13.3	10.4	13.9	12.7	12.0	14.6	12.1
+100	4.7	4.1	5.0	4.8	3.8	5.0	3.2	4.9	4.3	4.0	4.2	3.9
+200	13.1	11.9	16.3	13.3	13.0	13.1	8.6	14.3	14.5	10.3	1.5	3.9
+325	2.8	0.5	4.6	3.3	2.9	2.3	1.8	3.4	3.0	1.7	0.0	0.2
-325	0.7	0.7	1.4	1.1	0.4	1.0	0.5	1.1	0.5	0.7	0.2	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-136

B7506 1542D

Table 2-A8, Part 1, Cont. CHEMICAL AND SCREEN ANALYSIS OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-208, -209, -210, -224, -225, and -242)

Run No. Sample	HT-208		HT-209		HT-210		HT-224		HT-225		HT-242	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %												
Moisture	2.2	1.1	2.2	1.1	2.0	0.6	1.5	0.5	2.2	1.6	0.8	0.5
Volatile Matter	23.1	2.8	22.7	3.2	22.4	4.6	22.3	2.8	22.4	8.9	22.5	3.9
Fixed Carbon	63.9	78.1	63.4	75.6	64.7	75.4	62.9	74.9	63.4	69.9	62.1	73.7
Ash	10.8	18.0	11.7	20.1	10.9	19.4	13.3	21.8	12.0	19.6	14.6	21.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %												
Carbon	70.5	77.9	69.5	75.8	70.1	75.0	67.80	74.20	69.70	73.80	67.4	73.6
Hydrogen	3.49	1.01	3.20	1.16	3.41	1.39	3.04	0.82	3.16	1.68	3.11	1.49
Nitrogen	1.14	0.50	1.17	0.59	1.38	0.96	1.29	0.52	1.30	1.09	1.03	0.78
Oxygen	12.38	1.33	11.54	0.71	10.98	0.97	11.36	0.42	10.54	1.05	10.26	0.59
Sulfur	2.41	1.09	1.54	1.40	2.98	2.15	2.98	2.08	2.99	2.44	3.23	1.57
Ash	10.08	18.17	12.05	20.34	11.15	19.53	13.53	21.96	12.31	19.94	14.70	21.97
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %												
+20	6.7	5.7	9.4	5.6	13.7	4.9	13.8	14.3	26.9	23.8	24.3	24.5
+30	14.0	16.1	13.2	17.0	15.9	13.0	18.2	12.8	17.7	19.5	15.3	19.7
+40	22.4	25.1	22.9	25.8	19.8	24.2	22.6	22.6	20.0	23.1	15.5	17.5
+60	27.2	25.6	26.6	24.8	24.3	28.9	25.2	26.6	20.5	20.3	22.7	21.7
+80	15.7	13.3	15.5	13.4	14.8	15.0	11.7	12.2	8.6	6.9	12.8	9.2
+100	4.5	4.8	4.5	4.5	4.6	4.9	3.2	4.3	2.3	1.9	4.0	2.7
+200	7.5	7.5	6.4	7.8	5.4	6.9	4.1	5.2	2.6	2.7	4.8	4.0
+325	1.5	1.4	1.2	0.7	1.1	1.4	1.0	1.1	0.7	0.9	0.4	0.5
-325	0.5	0.5	0.3	0.4	0.4	0.8	0.2	0.9	0.7	0.9	0.2	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-137

B7506 1542E

Table 2-A8, Part 2. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PARTIALLY HYDROGASIFIED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-99, -100A, -111A, -201, and -207)

Run No. Sample	HT-99		HT-100A		HT-111A		HT-201		HT-207	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %										
Moisture	0.5	0.2	0.1	0.0	1.0	0.6	0.9	1.0	2.2	0.9
Volatile Matter	3.1	2.6	2.1	2.6	3.1	2.3	4.2	1.6	2.9	3.0
Fixed Carbon	78.9	76.3	78.9	74.1	76.9	73.5	74.9	73.3	75.4	71.3
Ash	17.5	20.9	18.9	23.3	19.0	23.6	20.0	24.1	19.5	24.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %										
Carbon	78.8	76.4	78.9	75.0	77.9	74.8	74.3	73.3	76.5	72.5
Hydrogen	1.21	0.97	0.61	0.61	1.10	0.89	1.58	0.80	1.08	0.94
Nitrogen	0.70	0.55	0.46	0.43	0.72	0.37	0.83	0.48	0.63	0.44
Oxygen	0.00	0.00	0.00	0.00	0.00	0.00	0.75	0.00	0.43	0.00
Sulfur	1.78	1.68	1.56	1.41	1.78	0.69	2.33	1.77	1.42	1.26
Ash	17.58	20.94	18.95	23.29	19.19	23.74	20.21	24.39	19.94	25.07
Total	100.07	100.54	100.48	100.74	100.69	100.49	100.00	100.74	100.00	100.00
Screen Analysis, USS, wt %										
+ 20	10.1	6.6	5.5	1.3	11.7	5.0	5.7	3.4	4.3	2.7
+ 30	20.0	13.3	16.8	10.3	20.0	18.0	12.4	10.0	17.8	14.8
+ 40	24.0	25.1	22.8	23.2	21.4	26.3	2.9	26.2	29.0	25.7
+ 60	25.4	28.5	26.8	34.2	21.8	28.0	28.8	28.4	28.7	30.0
+ 80	10.2	11.9	10.9	14.2	8.6	10.3	14.3	13.7	14.5	16.9
+ 100	3.9	5.5	6.0	7.6	4.9	5.0	18.8	4.5	3.9	5.8
+ 200	5.3	6.9	8.2	7.9	7.4	5.1	12.6	10.3	1.6	3.5
+ 325	0.6	1.2	1.8	1.1	2.3	1.5	3.3	2.4	0.0	0.0
-325	0.5	1.0	1.2	0.2	1.9	0.8	1.2	1.1	0.2	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-138

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Table 2-A8, Part 3. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED OHIO NO. 6 SEAM, BROKEN ARO MINE, BITUMINOUS COAL (Runs HT-130, -131, and -132)

Run No. Sample	HT-130		HT-131		HT-132	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	1.1	1.2	1.4	0.7	1.1	0.5
Volatile Matter	25.5	3.1	26.8	2.1	25.2	3.1
Fixed Carbon	67.9	82.8	65.8	86.4	67.3	86.8
Ash	5.5	12.9	6.0	10.8	6.4	9.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %						
Carbon	74.9	83.3	75.0	86.2	75.4	86.9
Hydrogen	3.57	1.16	4.18	0.98	3.84	1.08
Nitrogen	1.55	0.65	1.30	0.51	1.39	0.58
Oxygen	12.16	0.22	10.80	0.87	10.39	0.77
Sulfur	2.25	1.57	2.31	0.60	2.46	1.05
Ash	5.57	13.10	6.41	10.84	6.52	9.62
Total	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %						
+ 20	7.3	11.2	10.1	23.3	13.0	13.3
+ 30	18.5	26.9	17.2	23.3	22.0	22.2
+ 40	20.8	24.7	25.9	20.6	24.0	22.8
+ 60	24.0	18.7	25.7	17.2	25.0	23.0
+ 80	14.2	8.5	12.1	8.8	12.2	9.7
+ 100	5.3	2.9	3.1	2.8	2.5	3.8
+ 200	8.7	5.9	4.5	3.0	0.9	3.6
+ 325	1.0	0.9	0.8	0.6	0.2	0.8
-325	0.2	0.3	0.6	0.4	0.2	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-139

17506 1542G

Table 2-A8, Part 4. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED NO. 5 BLOCK SEAM, WEST VIRGINIA HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-146, -147, and -149)

Run No. Sample	HT-146		HT-147		HT-149	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	0.6	0.4	1.0	0.4	2.9	0.5
Volatile Matter	23.2	3.2	24.1	1.5	22.9	2.3
Fixed Carbon	68.6	83.8	66.5	83.7	66.3	84.5
Ash	7.6	12.6	8.4	14.4	7.9	12.7
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %						
Carbon	76.1	83.4	76.0	87.1	76.8	85.0
Hydrogen	3.97	1.40	3.79	0.91	3.43	0.89
Nitrogen	1.51	0.86	1.29	0.51	1.60	0.69
Oxygen	9.96	1.47	9.64	0.00	9.19	0.35
Sulfur	0.77	0.27	0.82	0.10	0.84	0.27
Ash	7.69	12.60	8.46	14.42	8.14	12.80
Total	100.00	100.00	100.00	103.04	100.00	100.00
Screen Analysis, USS, wt %						
+ 20	14.4	18.5	17.7	22.8	15.0	13.2
+ 30	9.8	14.0	13.0	10.3	10.8	9.4
+ 40	29.3	31.7	27.5	28.2	28.9	30.6
+ 60	27.1	23.1	25.5	24.5	27.8	29.7
+ 80	8.7	4.8	8.1	6.4	8.2	8.3
+ 100	3.5	1.8	3.1	2.4	3.2	3.0
+ 200	4.8	3.0	3.4	2.6	4.2	3.8
+ 325	1.3	0.8	1.0	0.6	1.1	0.3
-325	1.1	2.3	0.7	2.2	0.8	1.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-140

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Table 2-A8, Part 5. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED NO. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-155, -156, and -157)

Run No. Sample	HT-155		HT-156		HT-157	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	1.1	1.0	1.4	0.5	1.1	3.0
Volatile Matter	23.0	2.8	22.7	0.9	23.2	1.5
Fixed Carbon	63.0	74.1	64.6	78.2	62.8	77.0
Ash	<u>12.9</u>	<u>22.1</u>	<u>11.3</u>	<u>20.4</u>	<u>12.9</u>	<u>18.5</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %						
Carbon	68.6	75.1	70.3	77.0	70.3	79.3
Hydrogen	3.25	1.25	3.58	0.61	3.70	0.98
Nitrogen	1.34	0.41	1.20	0.41	1.11	0.44
Oxygen	10.10	0.00	10.11	0.11	8.24	0.00
Sulfur	3.63	1.37	3.33	1.34	3.60	0.94
Ash	<u>13.08</u>	<u>22.34</u>	<u>11.48</u>	<u>20.53</u>	<u>13.05</u>	<u>19.03</u>
Total	100.00	100.47	100.00	100.00	100.00	100.69
Screen Analysis, USS, wt %						
+ 20	14.6	4.8	11.8	4.2	14.5	7.4
+ 30	18.4	12.1	18.6	13.6	24.7	23.1
+ 40	24.0	25.7	22.8	25.3	27.2	29.0
+ 60	24.2	29.8	24.7	30.4	21.1	23.6
+ 80	9.9	12.5	12.0	13.6	7.6	9.1
+ 100	4.2	6.9	5.4	6.5	2.5	3.9
+ 200	3.3	6.1	3.8	5.5	1.4	2.8
+ 325	0.6	0.7	0.4	0.4	0.4	0.5
- 325	<u>0.8</u>	<u>1.4</u>	<u>0.5</u>	<u>0.5</u>	<u>0.6</u>	<u>0.6</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-141

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Table 2-A8, Part 6. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED SIXTH VEIN SEAM, MINNEHAHA MINE, INDIANA HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-158, -159, -160, and -161)

Run No. Sample	HT-158		HT-159		HT-160		HT-161	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %								
Moisture	0.7	0.7	0.6	0.9	1.3	0.3	0.5	0.3
Volatile Matter	23.7	1.9	24.3	1.5	24.8	1.5	22.7	1.9
Fixed Carbon	65.5	80.5	65.3	80.7	64.1	80.8	67.0	81.9
Ash	10.1	16.9	9.8	16.9	9.8	17.4	9.8	15.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (Dry), wt %								
Carbon	72.1	77.5	73.3	80.9	71.8	79.2	73.0	79.5
Hydrogen	3.48	1.06	3.86	0.85	3.35	0.99	3.43	1.00
Nitrogen	1.40	0.57	1.56	0.88	1.29	0.42	1.55	0.54
Oxygen	10.78	2.80	9.49	0.00	11.65	1.16	10.11	2.00
Sulfur	2.04	1.05	1.96	1.05	2.00	0.76	2.03	0.97
Ash	10.20	17.02	9.83	17.03	9.91	17.47	9.88	15.99
Total	100.00	100.00	100.00	100.71	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %								
+20	8.7	8.5	10.3	8.7	10.0	10.9	14.9	11.2
+30	16.3	16.1	17.2	16.4	12.1	18.1	17.3	15.8
+40	25.1	27.6	26.8	27.2	27.6	26.1	23.8	29.0
+60	26.9	27.2	24.7	26.3	27.2	24.0	24.7	23.6
+80	12.4	10.6	11.2	10.5	11.2	9.9	12.1	10.2
+100	5.3	4.9	4.7	4.6	5.1	4.9	3.0	3.3
+200	2.3	2.3	2.1	2.6	4.5	4.6	2.3	3.0
+325	2.6	2.1	2.4	3.0	1.0	0.6	0.9	0.9
-325	0.4	0.7	0.6	0.7	1.3	0.9	1.0	3.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-142

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Table 2-A8, Part 7. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED SEWELL SEAM, LOCHGELLY NO. 2 MINE, WEST VIRGINIA LOW-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-170, -172, and -174)

Run No. Sample	HT-170		HT-172		HT-174	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	1.0	0.5	1.0	0.4	0.8	0.3
Volatile Matter	16.2	0.8	16.3	0.9	15.9	0.8
Fixed Carbon	80.2	94.5	80.0	94.6	80.5	94.6
Ash	2.6	4.2	2.7	4.1	2.8	4.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (Dry), wt %						
Carbon	84.1	92.9	85.8	92.1	83.3	89.8
Hydrogen	3.32	0.59	2.69	1.05	3.22	0.95
Nitrogen	1.49	0.62	1.43	0.71	1.39	0.57
Oxygen	7.84	1.64	6.76	1.95	8.68	4.34
Sulfur	0.58	0.05	0.57	0.05	0.62	0.06
Ash	2.67	4.20	2.75	4.14	2.79	4.28
Total	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %						
+20	4.6	4.9	5.0	5.9	3.4	3.3
+30	12.6	12.3	13.2	16.8	7.6	8.3
+40	22.0	27.4	22.3	27.4	23.6	27.1
+60	29.0	30.4	28.7	27.4	32.3	32.0
+80	17.9	15.2	19.0	12.8	19.9	17.1
+100	6.3	4.9	6.5	5.0	6.5	6.0
+200	6.2	3.5	3.5	4.0	5.3	4.5
+325	0.9	0.7	1.0	0.4	0.7	0.9
-325	0.5	0.7	0.8	0.3	0.7	0.8
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-143

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Table 2-A8, Part 8. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: COLORADO SUBBITUMINOUS COAL, LARAMIE NO. 3 SEAM, EAGLE MINE (Runs HT-178, -180, and -182)

Run No. Sample	HT-178		HT-180		HT-182	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	3.7	0.6	4.0	1.0	4.2	1.0
Volatile Matter	34.6	3.2	34.7	4.2	35.8	6.0
Fixed Carbon	57.1	86.5	56.8	86.0	55.4	85.0
Ash	4.6	9.7	4.5	8.8	4.6	8.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %						
Carbon	72.5	84.8	72.8	86.6	69.5	82.9
Hydrogen	4.77	1.20	4.60	1.88	3.22	1.85
Nitrogen	1.47	0.67	1.37	0.83	1.28	0.94
Oxygen	16.11	3.47	16.16	1.64	20.81	5.97
Sulfur	0.39	0.11	0.36	0.16	0.34	0.22
Ash	4.76	9.75	4.71	8.89	4.85	8.12
Total	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %						
+20	2.5	24.8	3.2	9.1	2.8	5.6
+30	15.6	17.3	16.9	13.8	23.1	17.0
+40	29.0	24.8	30.4	36.6	32.3	31.4
+60	27.5	17.7	26.1	28.1	24.7	26.3
+80	14.3	7.0	12.8	8.2	10.5	10.7
+100	5.2	3.0	5.1	2.0	3.5	3.5
+200	4.5	3.0	4.7	1.8	2.6	4.6
+325	0.8	1.2	0.4	0.2	0.4	0.5
-325	0.6	1.2	0.4	0.2	0.1	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-144

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Table 2-A8, Part 9. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED COLORADO SUBBITUMINOUS COAL, LARAMIE NO. 3 SEAM, EAGLE MINE (Runs HT-184, -185, and -187)

Run No. Sample	HT-184		HT-185		HT-187	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	0.3	0.7	0.3	0.8	0.8	0.6
Volatile Matter	31.1	2.5	31.1	3.6	28.2	3.3
Fixed Carbon	63.3	86.6	63.3	84.4	63.9	84.5
Ash	5.3	10.2	5.3	11.2	7.1	11.6
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %						
Carbon	73.1	86.3	73.1	84.6	73.3	84.3
Hydrogen	4.27	1.42	4.27	1.37	4.04	1.12
Nitrogen	1.40	0.59	1.40	0.64	1.55	0.49
Oxygen	15.62	1.44	15.62	1.97	13.10	2.09
Sulfur	0.27	0.01	0.27	0.15	0.89	0.34
Ash	5.34	10.24	5.34	11.27	7.12	11.66
Total	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %						
+20	3.1	1.0	3.1	2.2	3.0	5.7
+30	14.8	6.3	14.8	8.4	6.4	7.3
+40	33.9	37.2	33.9	34.9	32.5	36.8
+60	29.6	33.7	29.6	30.3	31.2	30.8
+80	12.9	13.3	12.9	13.9	15.8	11.0
+100	3.5	4.0	3.5	5.0	5.4	3.9
+200	1.9	3.4	1.9	4.5	4.8	3.4
+325	0.2	0.7	0.2	0.4	0.7	0.7
-325	0.1	0.4	0.1	0.4	0.2	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-145

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Table 2-A8, Part 10. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: NORTH DAKOTA LIGNITE, GLENHAROLD MINE (Runs HT-139, -143, -144, -145, and -192)

Run No. Sample	HT-139		HT-143		HT-144		HT-145		HT-192	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %										
Moisture	5.3	1.1	5.0	0.7	5.4	0.7	4.4	0.3	2.1	0.1
Volatile Matter	42.3	9.2	40.8	6.3	41.2	7.2	39.9	7.1	41.1	8.4
Fixed Carbon	44.3	71.9	46.5	76.2	45.9	74.8	47.5	75.8	49.3	76.9
Ash	8.1	17.8	7.7	16.8	7.5	17.3	8.2	16.8	7.5	14.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (Dry), wt %										
Carbon	65.5	77.2	66.0	79.6	66.4	77.7	66.6	79.5	65.2	79.3
Hydrogen	4.38	0.87	4.37	1.25	4.48	1.03	4.47	0.99	4.60	1.71
Nitrogen	0.92	0.37	0.56	0.45	0.78	0.37	0.90	0.37	0.94	0.70
Oxygen	19.87	3.23	20.00	0.92	19.63	3.18	18.47	1.79	21.07	3.51
Sulfur	0.78	0.30	0.99	0.81	0.79	0.27	0.94	0.48	0.53	0.20
Ash	8.55	18.03	8.08	16.97	7.92	17.45	8.62	16.87	7.66	14.58
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %										
+ 20	2.3	6.0	2.8	12.5	1.7	11.2	1.8	5.4	0.2	2.4
+ 30	21.0	11.1	25.4	17.3	19.2	14.3	21.6	11.5	15.8	11.1
+ 40	29.5	33.6	31.6	22.6	28.9	28.5	26.1	22.8	31.4	34.2
+ 60	27.8	37.7	25.3	23.9	28.9	29.6	25.8	28.9	28.2	32.1
+ 80	9.9	6.4	7.8	9.1	10.4	8.7	11.2	12.4	13.4	11.6
+ 100	4.6	2.1	3.7	4.6	4.9	3.4	5.8	6.2	4.3	3.1
+ 200	4.5	2.5	3.2	8.2	5.4	3.7	7.2	11.4	6.4	5.1
+ 325	0.3	0.3	0.1	1.1	0.3	0.3	0.4	0.9	0.2	0.2
-325	0.1	0.3	0.1	0.7	0.3	0.3	0.1	0.5	0.1	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-146

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Table 2-A8, Part 10, Cont. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: NORTH DAKOTA LIGNITE, GLENHAROLD MINE (Runs HT-195, -196, -197, -239, and -241)

Run No. Sample	HT-195		HT-196		HT-197		HT-239		HT-241	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %										
Moisture	3.7	0.5	3.6	0.6	5.4	0.7	2.1	1.0	2.6	0.9
Volatile Matter	40.2	6.0	41.7	7.7	41.0	5.4	38.3	5.6	34.1	5.9
Fixed Carbon	47.9	74.1	46.1	72.2	45.1	77.5	51.8	75.1	55.0	77.3
Ash	8.2	19.4	8.6	19.5	8.5	16.4	7.8	18.3	8.3	15.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %										
Carbon	65.2	77.5	64.1	76.3	64.7	80.0	65.7	76.9	68.9	79.6
Hydrogen	4.30	0.78	4.45	0.92	4.38	0.74	4.12	0.86	3.94	0.98
Nitrogen	1.06	0.27	0.97	0.30	1.09	0.29	1.10	0.39	1.19	0.57
Oxygen	20.35	1.78	20.83	2.65	20.18	2.29	20.26	2.74	16.71	2.48
Sulfur	0.59	0.19	0.72	0.25	0.69	0.14	0.81	0.65	0.72	0.29
Ash	8.50	19.48	8.93	19.58	8.96	16.54	8.01	18.46	8.54	16.08
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %										
+ 20	1.3	0.6	0.4	2.4	1.2	0.8	22.0	13.4	36.0	24.4
+ 30	0.7	2.7	15.6	6.2	13.1	5.6	14.7	22.8	20.6	22.6
+ 40	33.8	30.0	21.0	37.3	33.2	34.4	21.9	26.5	16.1	21.5
+ 60	28.6	34.3	27.8	23.7	25.7	32.8	23.7	22.5	16.0	20.0
+ 80	14.2	14.3	13.9	12.0	11.0	14.0	10.3	6.9	7.3	6.7
+ 100	5.0	4.8	5.5	4.3	4.0	4.0	3.4	2.2	2.3	1.9
+ 200	12.3	9.4	12.5	11.1	8.9	4.7	3.0	4.1	1.5	2.5
+ 325	2.7	2.4	2.5	1.8	2.0	1.6	0.5	1.1	0.1	0.2
-325	1.4	1.5	0.8	1.2	0.9	1.6	0.5	0.5	0.1	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-147

B7506 15420

Table 2-A8, Part 11. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: MONTANA SUBBITUMINOUS COAL, COLSTRIP MINE (Runs HT-211, -212, -213, -214, and -216)

Run No. Sample	HT-211		HT-212		HT-213		HT-214		HT-216	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %										
Moisture	3.2	1.1	3.5	0.9	3.1	1.0	3.0	1.7	3.3	0.8
Volatile Matter	38.1	10.0	36.9	4.0	36.5	5.1	36.6	6.2	38.5	4.8
Mixed Carbon	51.4	77.0	52.1	75.5	52.9	78.7	52.7	78.4	51.0	78.2
Ash	7.3	11.9	7.5	19.6	7.5	15.2	7.7	13.7	7.2	16.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %										
Carbon	66.4	79.6	65.5	76.8	67.7	79.5	67.9	80.7	68.5	79.3
Hydrogen	4.67	2.48	4.40	1.28	4.61	1.66	4.52	1.68	4.56	1.31
Nitrogen	0.57	0.67	0.86	0.33	0.85	0.44	1.01	0.56	0.90	0.43
Oxygen	19.88	4.79	20.87	1.64	18.46	2.84	17.86	2.80	17.76	2.18
Sulfur	0.92	0.44	0.64	0.12	0.66	0.22	0.81	0.35	0.80	0.46
Ash	7.56	12.02	7.73	19.83	7.72	15.34	7.90	13.91	7.48	16.32
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %										
+20	1.1	4.1	1.4	2.2	2.6	4.5	2.0	15.4	2.5	13.0
+30	3.8	18.4	16.3	10.6	21.8	10.3	18.2	11.5	19.2	10.6
+40	38.5	33.1	28.6	38.0	31.1	29.2	29.9	30.4	31.5	28.9
+60	35.5	27.8	31.1	31.8	28.8	30.6	30.6	26.5	29.2	28.2
+80	15.2	10.6	15.9	10.8	11.3	13.6	13.2	9.0	11.7	10.7
+100	3.0	2.9	4.2	2.7	2.4	4.5	3.3	2.5	2.9	3.4
+200	2.6	2.7	2.3	3.5	1.5	6.1	2.4	3.6	2.4	4.2
+325	0.2	0.2	0.1	0.2	0.2	0.5	0.2	0.3	0.3	0.3
-325	0.1	0.2	0.1	0.2	0.3	0.7	0.2	0.8	0.3	0.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-148

B7506 1542P

Table 2-A8, Part 11, Cont. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: MONTANA SUBBITUMINOUS COAL, COLSTRIP MINE (Runs HT-243, -244, -247, and -248)

Run No. Sample	HT-243		HT-244		HT-247		HT-248	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %								
Moisture	4.8	1.9	3.7	1.0	1.6	0.9	2.1	1.7
Volatile Matter	37.0	6.9	36.5	6.9	37.1	3.1	36.8	9.9
Fixed Carbon	51.2	77.8	51.8	78.1	53.2	80.2	52.9	76.2
Ash	7.0	13.4	8.0	14.0	8.1	15.8	8.2	12.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %								
Carbon	68.3	80.3	67.7	79.6	68.0	80.4	67.3	78.9
Hydrogen	4.54	1.92	4.22	1.88	4.34	1.08	4.43	2.19
Nitrogen	0.96	0.82	0.93	0.75	1.01	0.50	1.00	1.00
Oxygen	18.13	2.84	17.80	3.12	17.55	1.39	17.89	4.89
Sulfur	0.74	0.48	1.01	0.53	0.84	0.64	1.03	0.57
Ash	7.33	13.64	8.34	14.12	8.26	15.99	8.35	12.45
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %								
+20	3.0	1.2	3.3	8.2	3.0	11.3	1.6	10.0
+30	27.3	10.6	22.4	16.2	23.5	13.3	18.0	12.3
+40	25.1	27.5	24.5	22.5	26.5	24.3	26.0	23.2
+60	26.9	38.7	33.0	29.2	30.0	31.7	33.0	34.6
+80	11.8	13.9	11.8	13.1	11.6	11.9	13.8	12.3
+100	3.3	3.9	2.9	4.5	2.6	3.4	3.6	3.4
+200	2.2	3.5	1.7	5.1	2.5	3.5	3.3	3.5
+325	0.3	0.4	0.2	0.6	0.2	0.4	0.6	0.4
-325	0.1	0.3	0.2	0.6	0.1	0.2	0.1	0.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-149

B7506 15426

Table 2-A8, Part 12. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: MONTANA LIGNITE, SAVAGE MINE (Runs HT-217, -218, and -220)

Run No. Sample	HT-217		HT-218		HT-219		HT-220	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %								
Moisture	3.1	0.6	4.3	0.0	0.8	0.6	3.3	0.6
Volatile Matter	40.2	7.1	39.3	6.6	41.0	7.0	38.7	8.1
Fixed Carbon	46.2	73.2	48.6	74.4	50.7	75.6	50.9	77.1
Ash	10.5	19.1	7.8	19.0	7.5	16.8	7.1	14.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %								
Carbon	63.9	76.5	64.8	76.2	64.0	77.5	65.6	79.4
Hydrogen	4.37	1.28	4.17	1.20	4.30	1.58	3.97	1.48
Nitrogen	1.04	0.43	0.95	0.58	0.96	0.53	0.94	0.57
Oxygen	19.03	2.24	21.22	2.31	22.52	3.24	22.04	3.86
Sulfur	0.83	0.36	0.68	0.71	0.63	0.23	0.69	0.38
Ash	10.83	19.19	8.18	19.00	7.59	16.92	7.30	14.31
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %								
+20	0.8	1.2	4.7	1.4	10.3	5.3	12.7	6.9
+30	10.4	4.7	13.9	7.4	14.5	6.0	17.7	13.9
+40	27.4	26.3	28.1	25.3	26.5	23.9	21.9	24.3
+60	34.1	37.8	31.0	38.3	31.6	33.6	24.9	28.5
+80	17.5	16.1	14.5	15.7	15.0	15.2	12.2	12.7
+100	4.9	5.4	3.8	4.8	0.9	5.1	4.1	4.2
+200	3.5	7.5	3.1	6.0	0.7	8.2	5.0	7.6
+325	0.5	0.7	0.3	0.7	0.3	1.4	1.0	1.3
-325	0.9	0.3	0.6	0.4	0.2	1.3	0.5	0.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-150

B7506 1542R

Table 2-A8, Part 13. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: FMC PROJECT COED CHAR, NO. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-221, -222, and -223)

Run No. Sample	HT-221		HT-222		HT-223	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	0.8	0.7	0.7	0.6	0.9	0.5
Volatile Matter	4.0	3.0	3.5	2.6	3.3	2.6
Fixed Carbon	78.7	75.7	79.5	76.7	79.5	76.7
Ash	16.5	20.6	16.3	20.1	16.3	20.1
Total	100.0	100.0	100.0	100.0	100.0	99.9
Ultimate Analysis (dry), wt %						
Carbon	78.5	77.0	77.3	75.2	77.4	76.1
Hydrogen	0.97	0.86	0.93	0.92	0.95	0.89
Nitrogen	1.21	0.65	1.13	0.92	1.16	0.65
Oxygen	0.00	0.00	1.78	1.10	1.49	1.01
Sulfur	2.80	1.23	2.40	1.63	2.50	1.04
Ash	16.63	20.78	16.46	20.23	16.50	20.31
Total	100.11	100.52	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %						
+20	17.4	22.4	17.9	15.3	21.1	14.8
+30	10.1	10.5	8.0	10.5	11.3	16.0
+40	23.5	22.8	17.8	21.9	23.1	24.5
+60	28.5	21.9	27.1	26.9	23.6	23.8
+80	11.3	8.1	15.4	12.8	9.4	9.2
+100	2.4	3.0	5.0	4.1	2.7	2.5
+200	3.7	6.8	5.8	5.6	4.9	2.5
+325	1.6	1.8	1.7	1.8	2.2	5.2
-325	1.5	2.7	1.3	1.1	1.7	1.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-151

B7506 1542S

Table 2-A8, Part 14. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED SEWELL SEAM, SEWELL NO. 1 MINE, WEST VIRGINIA MEDIUM-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-230, -231, and -233)

Run No. Sample	HT-230		HT-231		HT-233	
	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %						
Moisture	1.8	2.1	1.8	1.2	1.8	0.9
Volatile Matter	20.1	2.2	19.0	3.2	19.4	3.4
Fixed Carbon	74.2	88.9	75.2	89.0	74.0	88.5
Ash	3.9	6.8	4.0	6.6	4.8	7.2
Total	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %						
Carbon	79.9	90.5	80.2	88.0	80.8	88.6
Hydrogen	3.65	0.98	3.65	1.54	3.54	1.52
Nitrogen	1.62	1.59	1.59	0.94	1.60	0.95
Oxygen	10.14	0.00	9.85	2.75	8.63	1.51
Sulfur	0.67	0.00	0.59	0.06	0.56	0.12
Ash	4.02	6.93	4.12	6.71	4.87	7.30
Total	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %						
+20	17.3	21.9	22.4	20.9	10.9	15.3
+30	13.1	18.6	14.4	16.3	15.4	20.0
+40	17.8	20.4	18.8	19.8	21.2	25.5
+60	26.3	22.0	23.1	22.8	31.3	26.8
+80	13.6	8.7	10.8	10.2	16.1	8.4
+100	4.2	2.4	3.3	3.2	4.0	2.2
+200	6.5	4.8	5.7	5.4	1.1	1.4
+325	1.0	0.9	1.2	0.8	0.0	0.2
-325	0.2	0.3	0.3	0.6	0.0	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0

2A-152

B7506 1542T

Table 2-A8, Part 15. CHEMICAL AND SCREEN ANALYSES OF FEED AND RESIDUES IN FLUIDIZED-BED HYDROGASIFICATION TESTS: NEW MEXICO SUBBITUMINOUS COAL, SEAM A, NAVAHO INDIAN LEASE, FARMINGTON (Runs HT-249, -251, -252A, and 252B)

Run No. Sample	HT-249		HT-251		HT-252A		HT-252B	
	Feed	Residue	Feed	Residue	Feed	Residue	Feed	Residue
Proximate Analysis, wt %								
Moisture	2.1	4.9	2.5	3.0	2.2	0.8	2.2	0.8
Volatile Matter	35.7	5.4	38.0	11.0	37.3	2.2	37.3	2.4
Fixed Carbon	45.8	62.2	44.8	59.0	44.6	65.4	44.6	58.0
Ash	16.4	27.5	14.7	27.0	15.9	31.6	15.9	38.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Ultimate Analysis (dry), wt %								
Carbon	62.8	56.6	64.3	64.7	63.2	66.1	63.2	59.1
Hydrogen	4.66	1.36	4.78	2.23	4.82	0.84	4.82	0.94
Nitrogen	1.25	0.65	1.15	0.83	1.17	0.33	1.17	0.31
Oxygen	13.95	2.33	14.11	4.00	13.91	0.54	13.91	0.40
Sulfur	0.58	0.17	0.57	0.44	0.68	0.28	0.68	0.14
Ash	16.74	28.97	15.09	27.80	16.22	31.85	16.22	39.11
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Screen Analysis, USS, wt %								
+20	28.6	26.4	24.8	31.8	33.6	24.2	33.6	27.2
+30	20.2	21.2	19.8	24.2	22.2	24.7	22.2	25.2
+40	15.9	17.7	17.9	17.6	15.3	20.0	15.3	19.2
+60	19.1	18.0	22.3	16.7	18.8	29.8	18.8	19.0
+80	9.0	7.5	11.3	6.1	8.3	7.1	8.3	6.5
+100	3.5	2.8	2.0	1.3	1.6	1.8	1.6	1.8
+200	3.4	4.5	1.8	1.8	0.2	1.0	0.2	0.7
+325	0.2	0.5	0.1	0.3	0.0	0.2	0.0	0.2
-325	0.1	0.5	0.0	0.2	0.0	0.2	0.0	0.2
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

2A-153

B7506 1542U

Table 2-A9, Part 1. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-95, -96, -104, -105, -106, and -109)

<u>Run No.</u> Sample	<u>HT-95</u> Condenser	<u>HT-96</u> Condenser	<u>HT-104</u> Condenser	<u>HT-105</u> Condenser	<u>HT-106</u> Condenser	<u>HT-109</u> Condenser
Liquid Products, ^a lb/lb coal	0.213	0.820	0.510	0.407	0.408	0.452
Composition of Liquid Products, wt %						
Water	94.4	94.4	94.7	95.5	94.9	94.6
Oil	<u>5.6</u>	<u>5.6</u>	<u>5.3</u>	<u>4.5</u>	<u>5.1</u>	<u>5.4</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %						
Carbon	83.7	82.5	86.9	86.9	85.5	86.8
Hydrogen	<u>6.18</u>	<u>6.55</u>	<u>6.22</u>	<u>6.22</u>	<u>6.06</u>	<u>6.03</u>
Total	89.88	89.05	93.12	93.12	91.56	92.83
Carbon in Oil Fraction, lb/lb coal	0.00997	0.0379	0.0233	0.0162	0.0178	0.0211
wt % of carbon in coal	1.34	5.18	3.25	2.21	2.52	2.86

a. Includes condensed, undecomposed steam.

2A-154

B7506 1543

Table 2-A9, Part 1, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-113, -115, -116, -118, -119, and -121)

<u>Run No.</u>	<u>HT-113</u>	<u>HT-115</u>	<u>HT-116</u>	<u>HT-118</u>	<u>HT-119</u>	<u>HT-121</u>
Sample	Condenser	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.583	0.479	0.474	0.470	0.174	0.513
Composition of Liquid Products, wt %						
Water	96.2	97.9	98.2	95.6	95.7	96.0
Oil	<u>3.8</u>	<u>2.1</u>	<u>1.8</u>	<u>4.4</u>	<u>4.3</u>	<u>4.0</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %						
Carbon	84.3	85.3	86.2	84.7	84.7	84.9
Hydrogen	<u>5.59</u>	<u>6.35</u>	<u>6.25</u>	<u>6.03</u>	<u>6.48</u>	<u>6.34</u>
	89.89	91.65	92.45	90.73	91.18	91.24
Carbon in Oil Fraction, lb/lb coal	0.0187	0.00878	0.00735	0.0177	0.00629	0.0175
wt % of carbon in coal	2.58	1.23	1.02	2.49	0.86	2.40

a. Includes condensed, undecomposed steam.

2A-155

B7506 1543A

Table 2-A9, Part 1, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-125, -126, -128, -129, -138, and -154)

<u>Run No.</u>	<u>HT-125</u>	<u>HT-126</u>	<u>HT-128</u>	<u>HT-129</u>	<u>HT-138</u>	<u>HT-154</u>
Sample	Condenser	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.522	0.574	0.226	0.550	0.624	0.562
Composition of Liquid Products, wt %						
Water	95.6	96.0	91.6	98.2	98.0	99.0
Oil	<u>4.4</u>	<u>4.0</u>	<u>8.4</u>	<u>1.8</u>	<u>2.0</u>	<u>1.0</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %						
Carbon	85.1	86.0	86.4	87.7	83.4	84.9
Hydrogen	6.03	5.80	6.18	6.22	6.16	6.06
Nitrogen	----	----	----	----	0.65	----
Sulfur	----	----	----	----	<u>1.59</u>	----
Total	91.13	91.80	92.58	93.92	91.80	90.96
Properties of Oil Fraction						
Specific Gravity, 60°/60°F	----	----	----	----	1.11	----
Pour Point, °F	----	----	----	----	15	----
Viscosity, Saybolt seconds universal	----	----	----	----	51	----
Carbon in Oil Fraction, lb/lb coal	0.0198	0.0197	0.0184	0.00863	0.0102	0.00477
wt % of carbon in coal	2.72	2.68	2.62	1.23	1.44	0.672

a. Includes condensed, undecomposed steam.

2A-156

B7506 1543B

Table 2-A9, Part 1, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-168, -169, -171, -173, -193, and -194)

Run No. Sample	HT-168		HT-169	HT-171	HT-173	HT-193	HT-194
	Condenser A ^b	Condenser B ^c	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.480	0.480	0.506	0.996	0.542	0.436	0.267 ^d
Composition of Liquid Products, wt %							
Water	97.2	97.1	96.1	97.6	96.5	98.2	97.0
Oil	<u>2.8</u>	<u>2.9</u>	<u>3.9</u>	<u>2.4</u>	<u>3.5</u>	<u>1.8</u>	<u>3.0</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %							
Carbon	88.2	84.5	83.9	91.1	88.1	84.7	85.2
Hydrogen	<u>5.75</u>	<u>6.06</u>	<u>5.97</u>	<u>5.73</u>	<u>5.89</u>	<u>6.08</u>	<u>6.01</u>
Total	93.95	90.56	89.87	96.83	93.99	90.78	91.21
Carbon in Oil Fraction, lb/lb coal	0.0120	0.0116	0.0166	0.0221	0.0166	0.00672	0.00687
wt % of carbon in coal	1.69	1.63	2.35	3.10	2.29	0.964	0.983

- a. Includes condensed, undecomposed steam.
- b. 3.5-ft coal bed.
- c. 7.0-ft coal bed.
- d. Includes ammonium carbonate crystals estimated to be 5% of reported weight.

2A-157

B7506 1543C

Table 2-A9, Part 1, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL
(Runs HT-200, -202, -203, -204, -205, and -206)

<u>Run No.</u>	<u>HT-200</u>	<u>HT-202</u>	<u>HT-203</u>	<u>HT-204</u>	<u>HT-205</u>	<u>HT-206</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.398	0.164	0.432	0.205	0.219	0.265
Composition of Liquid Product, wt %						
Water	94.3	96.7	96.2	91.7	94.0	95.6
Oil	<u>5.7</u>	<u>3.3</u>	<u>3.8</u>	<u>8.3</u>	<u>6.0</u>	<u>4.4</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %						
Carbon	83.7	82.5	83.2	82.8	82.2	82.8
Hydrogen	<u>6.20</u>	<u>6.68</u>	<u>6.21</u>	<u>6.47</u>	<u>6.62</u>	<u>6.32</u>
Total	89.90	89.18	89.41	89.27	88.82	89.12
Carbon in Oil Fraction, lb/lb coal	0.0189	0.00449	0.0138	0.01413	0.01084	0.00956
wt % of carbon in coal	2.77	0.663	2.00	2.05	1.59	1.38

a. Includes condensed, undecomposed steam.

Table 2-A9, Part 1, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-208, -209, -210, -224, -225, and -242)

<u>Run No.</u>	<u>HT-208</u>	<u>HT-209</u>	<u>HT-210</u>	<u>HT-224</u>	<u>HT-225</u>	<u>HT-242</u>
Sample	Condenser	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.630	0.602	1.350	0.224	0.436	0.638
Composition of Liquid Product, wt %						
Water	97.0	97.3	98.9	95.6	97.7	97.2
Oil	<u>3.0</u>	<u>2.7</u>	<u>1.1</u>	<u>4.4</u>	<u>2.3</u>	<u>2.8</u>
Total	100.0	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %						
Carbon	84.3	85.9	87.0	84.30	85.50	85.00
Hydrogen	<u>5.84</u>	<u>5.96</u>	<u>5.84</u>	<u>6.21</u>	<u>6.31</u>	<u>6.09</u>
Total	90.14	91.86	92.84	90.51	91.81	91.09
Carbon in Oil Fraction, lb/lb coal	0.01567	0.01380	0.01256	0.00827	0.00853	0.01546
wt % of carbon in coal	2.22	1.99	1.792	1.22	1.22	2.29

a. Includes condensed, undecomposed steam.

2A-159

B7506 1543E

Table 2-A9, Part 2. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PARTIALLY HYDROGASIFIED PITTSBURGH NO. 8 SEAM, IRELAND MINE, BITUMINOUS COAL (Runs HT-99, -100A, -111A, -201, and -207)

<u>Run No.</u>	<u>HT-99</u>	<u>HT-100A</u>	<u>HT-111A</u>	<u>HT-201</u>	<u>HT-207</u>
Sample	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.747	0.703	0.751	0.505	0.469
Composition of Liquid Products, wt %					
Water	100.0	100.0	100.0	100.0	100.0
Oil	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	100.0	100.0	100.0	100.0	100.0

a. Includes condensed, undecomposed steam.

2A-160

B7506 1543F

Table 2-A9, Part 3. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED OHIO NO. 6 SEAM, BROKEN ARO MINE, BITUMINOUS COAL (Runs HT -130, -131, and -132)

<u>Run No.</u>	<u>HT-130</u>	<u>HT-131</u>	<u>HT-132</u>
Sample	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.366	0.299	0.408
Composition of Liquid Products, wt %			
Water	95.7	91.7	95.6
Oil	<u>4.3</u>	<u>8.3</u>	<u>4.4</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	85.8	85.3	84.2
Hydrogen	<u>6.33</u>	<u>6.10</u>	<u>6.22</u>
Total	92.13	91.40	90.42
Carbon in Oil Fraction, lb/lb coal	0.0135	0.0212	0.0153
wt % of carbon in coal	1.81	2.81	2.03

a. Includes condensed, undecomposed steam.

2A-161

B7506 1543G

Table 2-A9, Part 4. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED NO. 5 BLOCK SEAM, WEST VIRGINIA HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-146, -147, and -149)

<u>Run No.</u>	<u>HT-146</u>	<u>HT-147</u>	<u>HT-149</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.635	0.227	0.395
Composition of Liquid Products, wt %			
Water	95.7	87.6	87.7
Oil	<u>4.3</u>	<u>12.4</u>	<u>12.3</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	88.3	88.3	86.0
Hydrogen	<u>6.79</u>	<u>6.68</u>	<u>6.56</u>
Total	95.09	94.98	92.56
Properties of Oil Fraction			
Specific Gravity, 60°/60°F	1.066	1.024	----
Carbon in Oil Fraction, lb/lb coal	0.0243	0.0248	0.0416
wt % of carbon in coal	3.20	3.27	5.42

a. Includes condensed, undecomposed steam.

2A-162

B7506 1543E

Table 2-A9, Part 5. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED NO. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-155, -156, and -157)

<u>Run No.</u>	<u>HT-155</u>	<u>HT-156</u>	<u>HT-157</u>
Sample	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.420	0.236	0.353
Composition of Liquid Products, wt %			
Water	97.1	90.3	94.4
Oil	<u>2.9</u>	<u>9.7</u>	<u>5.6</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	80.0	78.8	81.7
Hydrogen	<u>5.61</u>	<u>6.00</u>	<u>5.84</u>
Total	85.61	84.80	87.54
Carbon in Oil Fraction, lb/lb coal	0.00970	0.0180	0.0161
wt % of carbon in coal	1.41	2.56	2.29

a. Includes condensed, undecomposed steam.

2A-163

B7506 1543I

Table 2-A9, Part 6. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED SIXTH VEIN SEAM, MINNEHAHA MINE, INDIANA HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-158, -159, -160, and -161)

<u>Run No.</u>	<u>HT-158</u>	<u>HT-159</u>	<u>HT-160</u>	<u>HT-161</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.442	0.171	0.235	0.436
Composition of Liquid Products, wt %				
Water	95.4	86.2	91.9	96.4
Oil	<u>4.6</u>	<u>13.8</u>	<u>8.1</u>	<u>3.6</u>
Total	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %				
Carbon	83.9	84.4	80.8	83.2
Hydrogen	<u>4.60</u>	<u>5.73</u>	<u>5.58</u>	<u>6.07</u>
Total	88.50	90.13	86.38	89.27
Carbon in Oil Fraction, lb/lb coal	0.0169	0.0209	0.0155	0.0132
wt % of carbon in coal	2.34	2.85	2.15	1.806

a. Includes condensed, undecomposed steam.

2A-164

B7506 1543J

Table 2-A9, Part 7. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED SEWELL SEAM, LOCHGELLY NO. 2 MINE, WEST VIRGINIA LOW-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-170, -172, and -174)

<u>Run No.</u>	<u>HT-170</u>	<u>HT-172</u>	<u>HT-174</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.212	0.331	0.430
Composition of Liquid Products, wt %			
Water	96.5	97.6	98.3
Oil	<u>3.5</u>	<u>2.4</u>	<u>1.7</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	85.6	91.8	88.2
Hydrogen	<u>5.34</u>	<u>5.64</u>	<u>5.92</u>
Total	90.94	97.44	94.12
Carbon in Oil Fraction, lb/lb coal	0.00641	0.00715	0.00661
wt % of carbon in coal	0.762	0.833	0.793

a. Includes condensed, undecomposed steam.

ZA-165

B7506 1543K

Table 2-A9, Part 8. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: COLORADO SUBBITUMINOUS COAL, LARAMIE NO. 3 SEAM, EAGLE MINE (Runs HT-178, -180, and -182)

<u>Run No.</u>	<u>HT-178</u>	<u>HT-180</u>	<u>HT-182</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.811	0.374	0.372
Composition of Liquid Products, wt %			
Water	96.2	95.1	89.6
Oil	<u>3.8</u>	<u>4.9</u>	<u>10.4</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	72.9	79.6	79.5
Hydrogen	<u>4.37</u>	<u>5.43</u>	<u>6.21</u>
Total	77.27	85.03	85.71
Carbon in Oil Fraction, lb/lb coal	0.0226	0.0145	0.0306
wt % of carbon in coal	2.51	1.99	4.41

a. Includes condensed, undecomposed steam.

Table 2-A9, Part 9. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED COLORADO SUBBITUMINOUS COAL, LARAMIE NO. 3 SEAM, EAGLE MINE (Runs HT-184, -185, and -187)

<u>Run No.</u>	<u>HT-184</u>	<u>HT-185</u>	<u>HT-187</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.337	0.206	0.271
Composition of Liquid Products, wt %			
Water	93.0	83.0	93.6
Oil	<u>7.0</u>	<u>17.0</u>	<u>6.4</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	81.9	81.6	83.7
Hydrogen	<u>6.63</u>	<u>6.69</u>	<u>6.42</u>
Total	88.53	88.29	90.12
Carbon in Oil Fraction lb/lb coal	0.01937	0.02857	0.01455
wt % of carbon in coal	2.65	3.91	1.98

a. Includes condensed, undecomposed steam.

2A-167

B7506 1543M

Table 2-A9, Part 10. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: NORTH DAKOTA LIGNITE, GLENHAROLD MINE (Runs HT-139, -143, -144, -145, and -192)

<u>Run No.</u>	<u>HT-139</u>	<u>HT-143</u>	<u>HT-144</u>	<u>HT-145</u>	<u>HT-192</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.425	0.246	0.381	0.264	0.591
Composition of Liquid Products, wt %					
Water	87.3	96.1	81.8	78.2	93.4
Oil	<u>12.7</u>	<u>3.9</u>	<u>18.2</u>	<u>21.8</u>	<u>6.6</u>
Total	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %					
Carbon	80.1	88.9	85.7	85.5	86.3
Hydrogen	6.98	5.65	7.13	7.99	7.36
Nitrogen	0.62	----	----	----	----
Sulfur	<u>0.33</u>	----	----	----	----
Total	88.03	94.55	92.83	93.49	93.66
Properties of Oil Fraction					
Specific Gravity, 60°/60°F	1.029	1.055	1.013	1.006	----
Viscosity, Saybolt seconds universal	39.6	----	----	----	----
Carbon in Oil Fraction, lb/lb coal	0.0431	0.00858	0.0593	0.0492	0.0335
wt % of carbon in coal	6.58	1.30	8.93	7.39	5.14

a. Includes condensed, undecomposed steam.

Table 2-A9, Part 10, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: NORTH DAKOTA LIGNITE, GLENHAROLD MINE (Runs HT-195, -196, -197, -239, and -241)

<u>Run No.</u>	<u>HT-195</u>	<u>HT-196</u>	<u>HT-197</u>	<u>HT-239</u>	<u>HT-241</u>
Sample	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.428	0.587	0.362	0.2609	0.393
Composition of Liquid Products, wt %					
Water	87.1	89.5	82.4	86.0	94.3
Oil	12.9	10.5	17.6	14.0	5.7
Total	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %					
Carbon	83.2	82.60	81.60	85.7	83.70
Hydrogen	7.00	7.55	6.44	7.49	7.19
Total	90.20	90.15	88.04	93.19	90.89
Carbon in Oil Fraction, lb/lb coal	0.0459	0.0509	0.0522	0.0312	0.01876
wt % of carbon in coal	7.06	7.94	8.06	4.75	2.72

a. Includes condensed, undecomposed steam.

2A-169

B7506 1543C

Table 2-A9, Part 11. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: MONTANA SUBBITUMINOUS COAL, COLSTRIP MINE (Runs HT-211, -212, -213, -214, and -216)

<u>Run No.</u>	<u>HT-211</u>	<u>HT-212</u>	<u>HT-213</u>	<u>HT-214</u>	<u>HT-216</u>
Sample	Condenser	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	1.350	0.608	0.350	0.375	0.210
Composition of Liquid Products, wt %					
Water	84.5	91.7	86.0	89.4	79.6
Oil	<u>15.5</u>	<u>8.3</u>	<u>14.0</u>	<u>10.6</u>	<u>20.4</u>
Total	100.0	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %					
Carbon	81.9	81.9	80.7	82.7	86.70
Hydrogen	<u>7.53</u>	<u>6.65</u>	<u>7.15</u>	<u>7.64</u>	<u>7.25</u>
Total	89.43	88.55	87.85	90.34	93.95
Carbon in Oil Fraction, lb/lb coal	0.0424	0.0413	0.0396	0.0329	0.0373
wt % of carbon in coal	6.39	6.31	5.85	4.85	5.44

a. Includes condensed, undecomposed steam

Table 2-A9, Part 11, Cont. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: MONTANA SUBBITUMINOUS COAL, COLSTRIP MINE (Runs HT-243, -244, -247, and -248)

<u>Run No.</u>	<u>HT-243</u>	<u>HT-244</u>	<u>HT-247</u>	<u>HT-248</u>
Sample	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.560	0.1840	0.230	0.356
Composition of Liquid Products, wt %				
Water	89.8	81.3	81.3	91.5
Oil	10.2	18.7	18.7	8.5
Total	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %				
Carbon	84.60	85.30	85.90	85.10
Hydrogen	7.98	7.76	7.79	8.46
Total	92.58	93.06	93.69	93.56
Carbon in Oil Fraction lb/lb coal	0.0483	0.0293	0.0369	0.0258
wt % of carbon in coal	7.07	4.33	5.43	3.83

a. Includes condensed, undecomposed steam.

2A-171

E7506 1543C

Table 2-A9, Part 12. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: MONTANA LIGNITE, SAVAGE MINE (Runs HT-217, -219, and -220)

<u>Run No.</u>	<u>HT-217</u>	<u>HT-218</u>	<u>HT-219</u>	<u>HT-220</u>
<u>Sample</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>	<u>Condenser</u>
Liquid Products, ^a lb/lb coal	0.387	0.254	0.420	0.361
Composition of Liquid Products, wt %				
Water	82.8	84.3	83.6	90.8
Oil	<u>17.2</u>	<u>15.7</u>	<u>16.4</u>	<u>9.2</u>
Total	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %				
Carbon	84.9	85.4	85.2	85.1
Hydrogen	<u>7.79</u>	<u>7.71</u>	<u>7.75</u>	<u>7.65</u>
Total	92.69	93.11	92.95	92.75
Carbon in Oil Fraction, lb/lb coal	0.0564	0.0341	0.0589	0.0283
wt % of carbon in coal	8.82	5.27	9.20	4.31

a. Includes condensed, undecomposed steam.

2A-172

B7506 1543R

Table 2-A9, Part 13. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: FMC PROJECT COED CHAR, NO. 6 SEAM, CROWN MINE, ILLINOIS HIGH-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-221, -222, and -223)

<u>Run No.</u>	<u>HT-221</u>	<u>HT-222</u>	<u>HT-223</u>
Sample	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.511	0.751	0.656
Composition of Liquid Products, wt %			
Water	100.0	100.0	100.0
Oil	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>
Total	100.0	100.0	100.0

a. Includes condensed, undecomposed steam.

Table 2-A9, Part 14. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: PRETREATED SEWELL SEAM, SEWELL NO. 1 MINE, WEST VIRGINIA MEDIUM-VOLATILE CONTENT, BITUMINOUS COAL (Runs HT-230, -231, and -233)

<u>Run No.</u>	<u>HT-230</u>	<u>HT-231</u>	<u>HT-233</u>
Sample	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.351	0.451	0.500
Composition of Liquid Products, wt %			
Water	96.1	96.9	98.2
Oil	<u>3.9</u>	<u>3.1</u>	<u>1.8</u>
Total	100.0	100.0	100.0
Composition of Oil Fraction, wt %			
Carbon	87.80	89.40	89.00
Hydrogen	<u>6.88</u>	<u>6.36</u>	<u>6.10</u>
Total	94.58	95.76	95.10
Carbon in Oil Fraction, lb/lb coal	0.01196	0.01259	0.00779
wt % of carbon in coal	1.50	1.57	0.96

a. Includes condensed, undecomposed steam.

2A-174

B7506 1543T

Table 2-A9. Part 15. COMPOSITIONS OF LIQUID PRODUCTS IN FLUIDIZED-BED HYDROGASIFICATION TESTS: NEW MEXICO SUBBITUMINOUS COAL, SEAM A, NAVAHO INDIAN LEASE, FARMINGTON (Runs HT-249, -251, -252A, and 252B)

<u>Run No.</u>	<u>HT-249</u>	<u>HT-251</u>	<u>HT-252A</u>	<u>HT-252B</u>
Sample	Condenser	Condenser	Condenser	Condenser
Liquid Products, ^a lb/lb coal	0.445	0.276	0.153	0.347
Composition of Liquid Products, wt %				
Water	86.5	89.4	76.8	89.3
Oil	<u>13.5</u>	<u>10.6</u>	<u>23.2</u>	<u>10.7</u>
Total	100.0	100.0	100.0	100.0
Composition of Oil Fraction, wt %				
Carbon	82.80	86.80	89.15	89.53
Hydrogen	<u>8.60</u>	<u>7.55</u>	<u>6.84</u>	<u>6.63</u>
Total	90.86	94.35	95.99	96.16
Carbon in Oil Fraction, lb/lb coal	0.0497	0.0254	0.0317	0.0333
wt % of carbon in coal	7.92	3.91	5.01	5.27

a. Includes condensed, undecomposed steam.

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