During the period that the temporary superheater (fig. 20) was being installed, a series of runs was made using steam at line temperatures - approximately 240°F. Steam from the main plant supply was put through a reducing valve and then through a steam-jacketed section of line to insure that it would be dry. Immediately before the connection to the generator, the line was trapped and a bleed connection used so that the line could be thoroughly warmed before starting.

The test procedure for these runs was as follows:

1. The generator was brought up to approximately 2,200°F. using the regular heat-up burner.
2. With the heat-up burner on, the steam flow was adjusted to the desired amount and the generator vent valve closed.
3. Using the steam and products of combustion from the generator and CO_2 added at the Aerotec hoppers, the dust-removal train was purged.
4. On completion of purging the generator burner was shut off and the coal-oxygen feed started at the desired rates.
5. The usual tests were made and readings taken as outlined for runs 1-14.
6. These runs were of approximately 3- to 6-hour duration.

Tests Made Using Steam at 1,600°-2,000°F. (runs 26-31)

After the temporary steam superheater (figs. 20 and 21) was completed, trial steam runs were made, and then gasifying runs made on Sewickley and Wyoming coals.

The test procedures for these runs were as follows:

1. The generator was heated to approximately 2,200°F. using the heat-up burner and the hot products of combustion from the superheater.

2. The steam was turned on about 3 hours before the start of the run and so adjusted that, when mixed with the products of combustion from the superheater, the desired superheated steam temperature was obtained. This procedure was followed so that the superheater would be at steady operating conditions before the coal-oxygen feed was started. With steam from the superheater at 2,000°F. the generator temperature at this stage was approximately 2,100°F. or about 300°F. lower than the temperature reached near the end of the runs.

3. Using the combined steam and POC from the generator and CO_2 added at the Aerotec hoppers, the dust train was purged. The generator heat-up burner was shut off after purging.

4. When the unit was purged, the coal-oxygen feed was started at the predetermined rate.

5. The small increase in generator pressure caused by gasification made necessary some slight readjustments in the flows of gas and steam to the superheater.

6. During the test the usual samples were taken and temperatures and flows recorded as in the other runs.

7. The POC from the superheater was sampled every half hour and complete analyses made. Since there had been some variations in the composition of the natural gas supplied to this area, a sample of this gas was also taken once during the run for complete analysis. For control purposes, Orsat samples were run on the POC from the superheater every 20 to 30 minutes.

RESULTS

In general, the pilot plant performed very well. Continuous operation was possible, the runs being terminated voluntarily when the residue containers became full. The performance data that follow indicate that this process could furnish low-cost synthesis gas on a commerical scale. The percentage gasification of the coal was very high and the oxygen requirement lower than any other oxygen process known.

Calculated Results of Gasification Runs

The calculated results of the gasification runs are presented in tables 1,2 and 3, the first table being for the high-temperature steam runs, the second for the low-temperature steam runs, and the third for the intermediate-temperature steam runs. Before the results of a run were calculated, the data collected during the run were averaged with respect to time, and temperature and pressure corrections made where necessary. Gas samples were analyzed for CO_2, O_2, illuminants, H_2, CO, and CH_4. Residue samples were analyzed for moisture, volatile matter, fixed carbon, ash, and particle-size distribution. Columns 1 to 7 give the conditions used in the experiments and columns 8 to 23 present the average results of the experiments. Columns 24 to 32 show the results in terms of calculated ratios.

Material balances on carbon, hydrogen, and oxygen are given in columns 33 to 59. Since synthesis-gas measurements for the first eight runs were inaccurate, results for these eight runs are based on residue data. Results beginning with run 9, when the Roots-Connersville gas meter was installed, are based on the carbon determined by the synthesis-gas measurement. Since the measurements of moisture in the synthesis gas leaving the generator were of doubtful accuracy (discussed later), the undecomposed steam in the synthesis gas was calculated as the average of the determinations from the hydrogen and oxygen balances.

TABLE 1. - Calculated results on pilot-plant runs, using high-temperature steam (runs 1 - 14)

Run No.	Conditions: Duration, hr.	Raw-coal rate, lb./hr.	Process-steam rate, lb./hr.	Process-oxygen rate, S.C.F./hr.	Steam-inlet temp., °F.	Input ratios: Steam/lb. raw coal, lb.	Oxygen/lb. raw coal, lb.	Synthesis-gas analysis, percent: CO_2	H_2	CO	CH_4 + Ill.	N_2	Outlet temp., °F.	Gross heating value, B.t.u./S.C.F.	Syn. gas, thousands of S.C.F./hr.	$(CO + H_2)$, thousands of S.C.F./hr.	H_2:CO ratio
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	9.47	211.5	483	1,180	2,960	2.28	0.47	21.1	51.4	28.8	2.6	-4.3	1,893	296.0	7.59	6.09	1.78
2A	2.80	200.0	593	1,116	3,048	2.97	.47	24.4	46.2	21.1	2.7	4.3	1,920	254.1	8.35	5.69	2.19
2B	8.13	257.7	609	1,469	3,022	2.36	.48	19.3	49.2	27.3	3.0	- .6	1,934	247.2	10.45	7.99	1.80
3	7.83	293.7	737	1,634	2,816	2.51	.47	17.7	43.8	27.9	2.3	6.6	2,081	263.6	11.57	8.30	1.57
4A	.75	309.0	674	1,664	2,772	2.18	.46	16.8	44.6	26.9	2.0	7.5	2,134	269.3	12.99	9.29	1.66
4B	.57	314.0	820	1,692	2,385	2.61	.46	19.6	46.6	25.5	2.5	5.4	2,120	269.3	12.61	9.09	1.63
4C	2.33	354.0	666	1,887	2,850	2.45	.45	16.7	43.5	27.4	2.1	7.7	2,139	269.3	14.71	10.43	1.59
5	7.73	299.0	752	1,765	2,889	2.52	.51	20.6	46.3	28.3	1.6	1.6	2,096	263.5	11.83	8.82	1.64
6A	.63	186.0	581	1,170	2,630	3.12	.53	19.1	49.4	26.8	1.5	2.9	2,123	267.6	8.40	6.40	1.84
6B	2.25	232.0	667	1,460	2,638	2.88	.53	19.5	47.8	27.5	1.1	3.8	2,105	258.1	10.09	7.60	1.74
7	5.43	236.0	815	1,740	2,783	3.42	.62	22.2	55.9	27.1	2.0	-8.3	2,035	298.5	9.75	8.09	2.06
8	8.00	200.4	498	1,220	3,195	2.49	.52	18.1	50.3	27.6	2.3	- .1	1,808	283.5	8.16	6.36	1.82
9A	2.87	207.0	507	1,066	3,096	2.45	.44	19.0	41.2	26.3	1.5	11.6	1,915	238.1	10.14	6.84	1.57
9B	3.00	193.3	508	954	3,043	2.63	.42	17.3	43.0	25.9	2.5	10.3	1,960	259.1	10.03	6.91	1.66
9C	3.00	187.0	507	869	3,050	2.71	.39	16.4	48.7	25.6	2.1	6.7	1,960	269.4	9.67	7.18	1.90
10	9.50	198.5	502	850	3,058	2.53	.36	17.8	51.2	25.8	2.6	2.1	1,790	282.6	8.18	6.30	1.98
11	6.10	245.0	510	853	3,055	2.08	.29	17.4	52.7	28.5	3.1	-2.0	1,935	301.2	8.83	7.17	1.85
12	5.52	247.0	507	853	3,303	2.05	.29	16.9	49.0	26.5	3.0	3.9	1,905	281.8	8.68	6.55	1.85
13	5.00	311.6	505	1,150	2,777	1.62	.31	15.2	49.1	30.5	2.9	1.8	1,915	294.6	8.94	7.12	1.61
14	5.00	305.4	500	1,153	2,706	1.64	.32	16.5	53.1	30.6	3.2	-3.9	1,910	307.8	9.00	7.54	1.74
Ave.	4.80	249.5	607	1,268	2,904	2.48	.44	18.6	48.2	27.1	2.3	2.8	1,984	273.7	10.00	7.48	1.78

Run No.	Generator temp., °F.: 4.5 ft. above floor of generator	11.5 ft. above floor of generator	16.5 ft. above floor of generator	In horizontal outlet	Residue (dry basis): Lb./hr.	Carbon, percent	Ratios/1,000 S.C.F.(CO+H_2): Coal, lb.	Oxygen, S.C.F.	Steam introduced, lb.	Steam decomposed, lb.	Ration/lb. raw coal: Process oxygen, S.C.F.	Steam introduced, lb.	Steam decomposed, lb.	Synthesis gas, S.C.F.	CO + H_2, S.C.F.
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	2,291	1,897	1,893	1,550	38.9	64.5	34.7	193.8	79.3	15.5	5.58	2.28	0.45	35.9	28.8
2A	2,170	1,904	1,920	1,452	24.2	63.7	35.6	198.6	105.6	19.8	5.58	2.97	.56	41.7	28.1
2B	2,341	2,097	1,930	(1)	30.9	63.7	32.2	183.8	76.2	17.7	5.70	2.36	.55	40.5	31.0
3	2,360	2,097	2,092	1,968	39.8	70.0	35.4	197.0	88.8	16.4	5.56	2.51	.46	39.4	28.2
4A	2,322	2,045	2,134	1,874	46.8	69.9	33.3	179.2	72.6	18.4	5.39	2.18	.55	42.0	30.1
4B	2,320	1,936	2,120	2,002	47.5	69.9	34.5	186.2	90.2	20.2	5.39	2.61	.59	40.1	28.9
4C	2,396	2,022	2,139	2,018	53.6	69.9	33.9	180.9	83.0	18.0	5.33	2.45	.53	41.6	29.5
5	2,400	2,220	2,096	2,028	31.0	85.2	33.9	202.3	85.2	17.2	5.97	2.52	.51	39.6	29.5
6A	2,275	2,372	2,183	1,968	12.7	61.0	29.1	182.8	90.8	9.5	6.29	3.12	.53	45.2	34.4
6B	2,330	2,380	2,105	1,987	24.0	61.0	30.5	192.1	87.8	13.1	6.29	2.88	.43	43.5	32.8
7	2,412	2,095	2,035	1,912	24.1	46.8	29.4	215.1	100.7	15.8	7.31	3.42	.54	41.0	34.0
8	2,262	1,870	1,808	1,644	30.9	62.9	31.5	191.9	78.4	16.8	6.09	2.49	.53	40.7	31.7
9A	2,265	1,977	1,915	1,822	28.1	63.4	30.3	155.8	74.2	22.2	5.15	2.45	.73	48.9	33.0
9B	2,312	1,991	1,960	1,870	35.1	63.3	28.0	138.0	73.5	23.6	4.94	2.63	.82	51.8	35.7
9C	2,296	2,008	1,960	1,863	44.9	66.4	26.1	121.0	70.6	22.7	4.65	2.71	.87	53.7	38.4
10	2,272	1,865	1,790	1,675	61.3	69.1	31.5	135.0	79.7	21.6	4.28	2.53	.69	41.2	31.7
11	2,272	1,905	1,935	1,813	54.6	70.9	34.2	119.0	70.0	21.2	3.48	2.08	.62	36.0	29.3
12	2,150	1,905	1,905	1,795	52.5	75.0	37.7	130.2	77.4	20.3	3.45	2.05	.54	35.2	26.6
13	2,192	1,906	1,915	1,807	116.6	72.0	43.7	161.5	71.0	15.3	3.69	1.62	.35	28.7	22.9
14	2,165	1,935	1,910	1,842	126.8	71.7	40.5	153.0	66.3	16.9	3.78	1.64	.42	29.5	24.7
Ave.	2,281	2,019	1,984	1,837	46.7	67.0	33.3	170.9	81.1	18.1	5.20	2.48	0.55	40.7	30.5

(1) T.C. not working.

TABLE 1. - Calculated results on pilot plant runs, using high temperature steam (runs 1 - 14) - Cont.

Run No.	Carbon balance: Total carbon in coal, lb/hr.	Carbon balance: Fixed carbon in coal, lb./hr.	Carbon balance: Based on measurement of gas volume: Total carbon in P.O.C. entering gen., lb./hr.	Carbon balance: Based on measurement of gas volume: Carbon in syn. gas, lb./hr.	Carbon balance: Based on measurement of gas volume: Unga sified carbon, lb./hr.	Carbon balance: Based on measurement of gas volume: Total carbon gasified, %	Carbon balance: Based on measurement of residue: Fixed carbon gasified, %	Hydrogen balance: Total carbon gasified, %	Hydrogen balance: Fixed carbon gasified, %	Hydrogen balance: H_2 in coal, lb./hr.	Hydrogen balance: H_2 in P.O.C. entering gen., lb./hr.	Hydrogen balance: H_2 in steam, lb./hr.	Hydrogen balance: Total to gen., lb./hr.	Steam balance: In dry syn. gas, lb./hr.	Steam balance: In undecomposed steam, lb./hr.
	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
1	155.3	116.6	5.5	130.2	25.1	-----	-----	83.9	77.4	10.8	1.6	53.7	66.1	22.8	43.3
2A	146.8	104.8	5.8	131.4	15.4	-----	-----	89.5	85.3	10.2	1.5	65.9	77.7	22.8	54.9
2B	189.1	135.0	4.8	169.4	19.7	-----	-----	89.6	85.4	13.1	1.4	67.7	82.2	30.5	51.7
3	215.6	153.9	3.1	180.7	34.9	-----	-----	83.9	77.4	15.0	1.8	82.9	98.2	29.6	68.6
4A	226.9	161.9	1.1	194.2	32.7	-----	-----	85.6	79.8	15.8	.1	74.9	91.1	33.4	57.7
4B	230.5	164.5	1/	197.3	33.2	-----	-----	85.6	79.8	16.0	.1	91.1	107.2	34.4	72.8
4C	259.8	185.5	1.8	222.3	37.5	-----	-----	85.6	79.8	18.1	.6	96.2	114.9	37.1	77.8
5	219.6	156.7	4.6	193.2	26.4	-----	-----	88.0	83.2	15.2	1.3	83.6	100.1	30.9	69.2
6A	136.6	97.5	15.4	128.8	7.7	-----	-----	94.4	92.1	9.5	4.8	64.6	78.9	23.3	55.6
6B	170.3	121.6	11.4	150.7	14.6	-----	-----	91.4	88.6	11.8	3.6	74.1	89.5	26.7	62.8
7	174.7	124.7	14.0	163.4	11.3	-----	-----	93.5	90.9	12.1	1.6	90.6	104.3	30.9	73.4
8	147.1	105.0	8.4	127.7	19.4	-----	-----	86.8	81.5	10.2	.1	59.3	69.6	23.7	41.9
9A	149.7	106.8	3.5	158.9	-3.2	102.1	103.0	88.2	83.5	10.6	.3	56.4	67.3	23.8	43.5
9B	139.8	100.9	3.5	150.9	-11.1	108.0	111.1	84.1	78.0	9.9	.3	56.4	66.6	25.5	41.1
9C	135.2	97.6	3.2	139.1	-3.9	102.9	104.0	78.0	69.5	9.6	.3	56.3	66.2	27.1	39.1
10	138.4	81.4	3.8	129.8	15.6	88.7	80.8	69.3	47.6	9.6	.3	55.8	65.7	24.4	41.3
11	170.8	120.1	3.1	140.4	30.4	82.2	74.7	73.2	61.9	11.9	.4	56.7	69.0	27.6	41.4
12	172.2	121.0	4.2	136.9	41.3	76.0	65.9	77.1	67.4	12.0	.4	56.4	68.8	25.4	43.4
13	217.2	152.7	4.7	141.3	75.9	65.1	50.3	61.3	45.0	15.1	.5	56.1	71.7	26.0	45.7
14	212.9	149.6	5.0	149.7	63.2	68.4	55.1	60.7	44.1	14.8	.5	55.6	70.9	28.4	42.5
Ave.	180.4	127.6	5.3	155.9	24.5	86.7	80.6	82.5	74.9	12.6	.1	67.5	81.1	27.7	53.4

1/ Added in as O.C.

Run No.	Oxygen balance: O_2 in coal, lb./hr.	Oxygen balance: O_2 in P.O.C. entering generator, lb./hr.	Oxygen balance: O_2 in steam, lb./hr.	Oxygen balance: Process oxygen, lb./hr.	Oxygen balance: Total in generator, lb./hr.	Steam balance: In dry synthesis gas, lb./hr.	Steam balance: In undecomposed steam, lb./hr.	Steam balance: Undecomposed steam from H_2 balance, lb./hr.	Steam balance: Undecomposed steam from O_2 balance, lb./hr.	Steam balance: Average undecomposed steam, lb./hr.	Steam balance: Total steam introduced, lb./hr.	Steam balance: Steam decomposed, lb./hr.	Computed equilibrium temperatures: Shift reaction, °F.	Computed equilibrium temperatures: C-CO_2 reaction, °F.
	48	49	50	51	52	53	54	55	56	57	58	59	60	61
1	13.4	30.7	429.4	99.5	572.0	228.1	344.9	389.7	386.0	388.8	483.0	94.2	1,904	1,130
2A	11.0	32.0	527.1	94.2	664.3	246.6	417.7	494.1	469.9	482.0	593.0	111.0	1,823	1,074
2B	16.3	26.9	543.3	124.0	708.5	290.9	417.6	465.3	469.8	467.5	609.0	141.4	1,866	1,137
3	18.5	18.8	655.2	138.0	830.5	310.5	520.0	617.4	585.0	601.2	737.0	135.8	2,207	1,148
4A	19.5	6.4	599.0	140.5	765.4	333.2	432.2	519.3	486.2	502.8	674.0	171.2	2,078	1,143
4B	19.8	3.2	739.0	142.7	894.7	345.8	548.9	655.2	617.5	636.4	820.0	183.6	2,137	1,122
4C	22.4	9.5	769.9	159.4	961.3	378.6	582.7	700.2	655.5	677.8	866.0	188.2	2,165	1,156
5	18.9	22.1	668.5	150.7	860.2	347.4	512.8	622.8	576.9	599.8	752.0	152.2	2,034	1,137
6A	11.8	63.5	516.5	98.9	710.7	231.1	479.6	500.4	539.6	520.0	581.0	61.0	2,287	1,127
6B	14.7	62.1	593.0	123.2	793.0	284.5	508.5	565.2	572.1	567.7	667.0	99.3	2,257	1,132
7	15.0	43.9	724.5	146.9	929.6	295.5	634.1	660.6	713.4	687.0	815.0	128.0	2,214	1,135
8	12.5	22.4	642.9	103.0	580.8	220.4	360.4	377.1	405.5	391.3	498.0	106.7	2,003	1,137
9A	13.4	12.2	459.9	89.9	568.4	287.0	281.4	392.0	317.0	355.0	507.0	152.0	2,100	1,136
9B	14.1	12.5	451.5	80.6-	558.7	274.0	284.7	370.0	321.0	345.0	508.0	163.0	2,120	1,139
9C	13.8	12.2	450.9	73.3	550.2	252.0	298.2	351.9	336.0	344.0	507.0	163.0	2,140	1,140
10	13.8	12.8	446.4	71.7	544.7	225.0	319.7	372.9	360.0	366.0	502.0	136.0	2,170	1,128
11	17.0	11.8	453.4	72.0	554.2	248.0	306.2	378.0	345.0	358.0	510.0	152.0	2,165	1,149
12	17.3	15.0	450.9	72.0	555.2	238.0	317.2	390.0	357.0	374.0	507.0	133.0	2,240	1,136
13	21.8	16.9	448.9	97.0	584.6	248.0	336.6	412.0	379.0	396.0	505.0	109.0	2,525	1,160
14	21.1	18.6	444.5	97.3	581.5	259.0	322.5	383.0	363.0	373.0	500.0	127.0	2,275	1,158
Ave.	16.4	23.6	539.7	108.7	688.5	277.2	411.3	480.5	462.9	472.7	607.0	135.4	2,126	1,136

TABLE 1. - Calculated results of pilot-plant runs, using high-temperature steam (runs 1 - 14) - Cont.

Run No.	Heat balance, millions of B.t.u. per hour: Net heat of combustion of coal	Sensible heat in steam	Sensible heat in 2.0.C. gases	Total heat in	Net heat of combustion of gas	Sensible heat in gas	Sensible heat in undecomposed steam	Sensible heat of residue	Net heat of combustion of unburned C	Total heat out	Heat loss measured by heat balance, B.t.u./hr.	Calculated heat loss from shell, 10^6 B.t.u./hr.	Calculated heat stored in bricks 10^6 B.t.u./hr.	Calculated heat loss, B.t.u./lb. coal
	62	63	64	65	66	67	68	69	70	71	72	73	74	75
1	2.556	0.801	0.094	3.553	2.050	0.381	0.372	0.021	0.362	3.186	0.367	0.095	0.276	1,754
2A	2.513	.990	.110	3.613	1.905	.422	.468	.014	.223	3.032	.581	.068	276	1,720
2B	3.238	1.008	.119	4.365	2.714	.501	.458	.017	.285	3.975	.390	1/	1/	1/
3	3.708	1.126	.056	4.890	2.770	.584	.638	.030	.503	4.525	.365	.095	.159	865
4A	3.901	1.004	.018	4.923	3.069	.628	.553	.029	.473	4.752	.171	1/	1/	1/
4B	3.931	1.011	.000	4.942	3.072	.581	.695	.029	.482	4.859	.083	1/	1/	1/
4C	4.469	1.331	.030	5.830	3.469	.721	.747	.033	.543	5.513	.317	.154	.435	1,664
5	3.775	1.173	.072	5.020	2.825	.608	.646	.019	.381	4.479	.541	.114	.163	926
6A	2.348	.868	.238	3.454	2.028	.866	.568	.008	.111	3.581	-.127	1/	1/	1/
6B	2.929	.982	.178	4.089	2.352	.729	.614	.015	.212	3.912	.177	.103	.315	1,802
7	3.005	1.213	.092	4.310	2.618	.511	.715	.015	.165	4.024	.286	.108	.314	1,773
8	2.530	.904	.081	3.515	2.091	.342	.354	.016	.282	3.085	.430	.113	.257	1,646
9A	2.594	.874	.041	3.509	2.197	.453	.320	.010	.000	2.980	.529	.130	.241	1,792
9B	2.422	.857	.041	3.320	2.348	.462	.320	.010	.000	3.140	.180	.137	.109	1.273
9C	2.343	.857	.040	3.240	2.352	.457	.321	.009	.000	3.139	.101	.137	.003	749
10	2.395	.851	.043	3.289	2.088	.347	.297	.024	.223	2.979	.310	.114	.156	1,360
11	2.956	.865	.039	3.860	2.397	.412	.318	.043	.432	3.602	.258	.117	.000	478
12	2.980	.952	.053	3.965	2.214	.405	.328	.053	.596	3.596	.389	.158	.082	976
13	3.759	.767	.050	4.576	2.388	.430	.350	.089	1.100	4.357	.219	.163	.041	655
14	3.685	.735	.054	4.474	2.501	.438	.341	.083	.980	4.343	.131	.151	-.168	-56
Ave.	3.107	.958	.072	4.138	2.472	.513	.471	.028	.368	3.853	.285	.122	.166	1,224

1/ Not counted in vertical averages.

Run No.	Thermal efficiencies: A	B	C	D
	76	77	78	79
1	77.1	57.7	75.4	82.5
2A	75.8	52.7	73.6	77.9
2B	83.8	62.2	80.6	85.2
3	74.7	56.6	78.0	85.2
4A	78.7	62.3	82.9	89.7
4B	78.1	62.2	84.3	91.1
4C	77.6	59.5	80.9	87.4
5	74.8	56.3	77.5	82.8
6A	86.4	58.7	82.3	84.6
6B	80.3	57.5	80.0	83.6
7	87.1	60.7	84.8	87.5
8	82.6	59.5	76.4	82.1
9A	84.7	62.6	81.3	81.3
9B	96.9	70.7	90.8	90.8
9C	100.4	72.6	92.9	92.9
10	87.2	63.5	80.1	84.9
11	81.1	62.1	78.4	86.2
12	74.3	55.6	71.4	81.8
13	63.5	52.2	68.3	85.1
14	67.9	55.9	70.5	85.9
Ave.	80.7	60.1	79.5	85.4

A. Net heat of combustion of gas (B.t.u.)/net heat of combustion of coal.

B. Net heat of combustion of gas (B.t.u.)/total heat in.

C. Net heat of combustion of gas plus ensible heat in undecomposed steam and in dry gas above 400°F./total heat in.

D. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F. plus 70% of the heat of combustion of ungasified carbon/total heat in.

TABLE 2. - Calculated results on pilot-plant runs, using low-temperature steam (runs 15A - 25B)

Run No.	Conditions: Duration, hr.	Raw-coal rate, lb./hr.	Process-steam rate, lb./hr.	Process oxygen rate, S.C.F./hr.	Input ratios: Steam-inlet temp., °F.	Steam/lb. raw coal, lb.	Oxygen/lb. raw coal, lb.	Synthesis gas: Synthesis-gas analysis, percent CO_2	H_2	CO	CH_4 + Ill.	N_2	Outlet temp., °F.	Gross heating value B.t.u./S.C.F.	Syn.gas, thousands of S.C.F./hr.	$(CO+H_2)$, thousands of S.C.F./hr.	H_2:CO ratio
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
15A	1.50	242.3	382	2,792	245	1.58	0.98	33.7	33.3	28.3	2.5	1.4	1,713	231.6	8.41	5.19	1.18
15B	2.00	242.3	318	2,723	245	1.31	.95	30.2	35.8	26.6	2.7	3.5	1,763	238.1	8.22	5.13	1.35
15C	3.50	242.3	245	2,644	245	1.01	.92	29.9	36.3	29.2	2.1	1.6	1,811	238.9	8.26	5.41	1.24
16A	2.33	264.0	243	2,654	235	.92	.85	24.6	36.3	35.6	1.8	.7	1,825	254.3	9.00	6.46	1.02
16B	1.19	264.0	297	2,659	237	1.13	.85	24.4	37.4	35.1	2.0	.5	1,870	258.6	9.59	6.95	1.07
16C	2.40	264.0	345	2,659	240	1.31	.85	27.0	36.4	31.8	1.2	3.1	1,948	236.6	9.50	6.48	1.15
17	6.00	245.6	146	2,550	233	.59	.88	13.7	36.4	45.8	1.8	1.5	2,040	288.4	8.64	7.10	.80
18	7.00	230.4	98	2,370	234	.43	.87	12.5	32.3	50.6	1.9	1.9	1,913	292.9	7.34	6.08	.64
19	6.50	245.7	60	2,171	230	.24	.75	8.4	27.4	64.7	1.9	1.9	2,030	322.5	7.36	6.79	.42
20	2.50	477.5	298	4,830	241	.62	.86	16.8	35.1	43.8	2.0	1.7	1,843	281.7	15.04	11.88	.80
21	4.50	406.9	315	3,968	242	.77	.83	18.0	37.6	40.9	1.9	.9	2,103	280.8	12.37	9.73	.93
22A	1.50	487.4	260	4,061	235	.53	.71	18.1	36.2	43.9	1.2	.3	1,867	275.6	12.51	10.02	.82
22B	2.00	487.4	278	4,069	237	.57	.71	15.8	37.0	44.0	1.7	.7	1,938	287.8	13.62	11.10	.83
23A	1.50	458.0	182	3,725	235	.40	.69	12.2	36.3	48.9	1.5	.8	1,955	294.5	12.35	10.52	.74
23B	2.50	458.0	172	3,526	235	.38	.65	10.5	35.1	50.6	2.2	1.1	1,975	306.3	12.19	10.45	.69
24A	1.00	477.0	91	3,322	235	.19	.59	6.5	34.3	54.4	2.9	.8	1,880	323.1	11.33	10.05	.63
24B	2.00	477.0	90	3,193	235	.19	.57	6.5	35.9	54.1	2.5	.7	1,895	323.9	11.39	10.25	.66
25A	1.25	446.0	178	3,785	245	.40	.72	12.4	35.5	50.6	.8	.3	1,950	291.6	12.55	10.81	.70
25B	3.75	446.0	176	4,420	245	.40	.84	11.2	32.5	51.8	1.5	2.1	2,060	294.4	13.58	11.45	.63
Ave.	2.89	361.2	220	3,270	238	.68	.79	17.2	35.1	43.7	1.9	1.3	1,935	280.1	10.70	8.52	.86

Run No.	Generator temp., °F.: 4.5 ft. above floor of generator	11.5 ft. above floor of generator	16.5 ft. above floor of generator	In horizontal outlet	Residue (dry basis): lb./hr.	Carbon, percent	Ratios/1,000 S.C.F. $(CO + H_2)$: Coal, lb.	Oxygen, S.C.F.	Steam introduced, lb.	Ratios/lb. raw coal: Steam decomposed, lb.	Process oxygen, S.C.F.	Steam introduced, lb.	Steam decomposed, lb.	Synthesis gas, S.C.F.	CO + H_2, S.C.F.
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
15A	2,162	1,780	1,713	1,620	56.3	56.3	56.8	538.0	74.0	16.2	11.5	1.58	.347	34.7	21.4
15B	2,180	1,858	1,763	1,700	57.6	56.5	47.3	531.0	69.0	14.1	11.2	1.31	.297	33.9	21.2
15C	2,195	1,920	1,811	1,765	56.6	55.9	44.8	489.0	45.3	14.3	10.9	1.01	.339	34.1	22.3
16A	2,119	1,870	1,825	1,758	13.0	66.3	40.8	411.0	37.6	12.9	10.1	.92	.314	34.1	24.5
16B	2,238	1,932	1,870	1,803	91.7	56.4	38.0	383.0	42.7	14.8	10.1	1.13	.390	36.4	26.4
16C	-----	2,040	1,948	1,881	29.9	54.0	40.0	410.0	53.2	15.0	10.1	1.31	.368	36.0	24.4
17	2,311	2,100	2,040	1,885	51.7	56.9	34.6	359.0	20.6	8.2	10.4	.59	.238	35.2	28.9
18	2,358	1,980	1,913	1,745	46.1	54.1	37.9	390.0	15.1	5.8	10.3	.43	.141	31.8	26.4
19	2,481	2,108	2,030	1,843	60.1	61.9	36.2	320.0	8.8	3.7	8.8	.24	.103	29.6	27.5
20	2,455	2,080	1,843	1,890	92.2	54.8	40.3	407.0	25.1	6.9	10.1	.62	.172	31.5	24.8
21	2,468	2,107	2,103	1,978	59.1	59.8	41.8	408.0	32.4	7.3	9.8	.77	.174	30.4	23.9
22A	2,182	-----	1,867	1,760	106.5	62.3	48.6	405.2	25.9	4.8	8.3	.53	.099	25.7	20.6
22B	2,291	-----	1,938	1,840	75.2	62.3	43.9	366.6	25.0	6.5	8.4	.57	.142	27.9	22.8
23A	2,230	2,030	1,955	1,820	107.4	62.7	43.5	354.0	17.3	4.6	8.1	.49	.106	27.0	23.0
23B	2,310	2,060	1,975	1,830	104.9	62.4	43.8	337.5	16.5	4.8	7.7	.38	.110	26.6	22.8
24A	-----	2,120	-----	1,735	84.0	66.1	47.5	330.5	9.1	2.6	7.0	.19	.055	23.8	21.1
24B	----	2,135	-----	1,750	123.8	66.5	46.5	311.5	8.8	3.1	6.7	.19	.066	23.9	21.5
25A	2,347	2,028	1,950	-----	91.4	58.7	41.3	390.1	16.5	5.0	8.5	.40	.120	28.1	24.2
25B	2,575	2,165	2,060	1,845	56.6	51.0	39.0	386.1	15.5	4.0	9.9	.40	.103	30.4	25.7
Ave.	2,306	2,018	1,918	1,803	71.8	58.8	42.3	394.1	29.1	8.1	9.4	.68	.193	30.6	23.9

TABLE 2. - Calculated results on pilot-plant runs, using low-temperature steam (runs 15A - 25B) - Cont.

Run No.	Carbon balance: Total carbon in coal, lb./hr.	Carbon balance: Fixed carbon in coal, lb./hr.	Carbon balance: Based on measurement of gas volume: Carbon in syn. gas, lb./hr.	Carbon balance: Based on measurement of gas volume: Ungasified carbon, lb./hr.	Carbon balance: Based on measurement of gas volume: Total carbon gasified, %	Carbon balance: Based on measurement of gas volume: Fixed carbon gasified, %	Carbon balance: Based on measurement of residue: Total carbon gasified, %	Carbon balance: Based on measurement of residue: Fixed carbon gasified, %	Hydrogen balance: H_2 in coal, lb./hr.	Hydrogen balance: H_2 in steam, lb./hr.	Hydrogen balance: Total to gen., lb./hr.	Hydrogen balance: In dry syn. gas, lb./hr.	Hydrogen balance: In undecomposed steam, lb./hr.
	33	34	36	37	38	39	40	41	43	44	45	46	47
15A	172.6	121.9	175.1	-2.5	101.4	102.1	81.6	75.4	10.1	42.7	52.8	17.1	35.7
15B	172.6	121.9	158.9	13.7	92.1	88.8	81.1	74.7	10.1	35.3	45.4	18.0	27.4
15C	172.6	121.9	162.8	9.8	94.3	92.0	82.6	75.4	10.1	27.3	37.4	17.7	19.7
16A	187.9	133.3	180.3	7.6	96.0	94.3	86.1	80.3	11.1	27.0	38.1	19.0	19.1
16B	187.9	133.3	189.1	-1.2	100.6	100.9	86.1	80.3	11.1	33.0	44.1	21.0	23.1
16C	187.9	133.3	182.2	5.7	97.0	95.7	86.1	80.3	11.1	38.3	49.4	19.4	30.0
17	175.9	124.1	170.1	5.8	96.7	95.3	83.3	77.3	10.3	16.3	26.6	18.3	8.3
18	165.0	116.4	153.6	11.4	93.1	90.2	84.9	79.3	9.7	10.9	20.6	14.0	6.6
19	174.7	124.1	165.7	9.0	94.8	92.7	78.9	71.2	10.1	6.7	16.8	12.2	4.6
20	341.9	241.1	303.7	38.2	88.8	84.2	85.2	79.7	20.1	33.1	53.2	31.2	22.0
21	291.4	205.5	243.1	48.3	83.4	76.5	89.3	85.4	17.1	35.0	52.1	27.2	24.9
22A	346.3	252.5	253.8	92.5	73.3	63.4	81.0	73.9	20.3	28.9	49.2	25.5	23.7
22B	346.3	252.5	272.8	73.5	78.8	70.9	86.5	81.6	20.3	30.9	51.2	29.0	22.2
23A	325.4	237.2	247.8	77.6	76.2	67.3	79.5	72.1	19.1	20.2	39.3	25.6	13.7
23B	325.4	237.2	249.2	76.2	76.6	67.9	80.0	72.9	19.1	19.1	38.2	25.4	12.8
24A	336.9	247.1	233.4	105.5	68.9	57.3	83.8	77.8	19.9	10.1	30.0	24.0	6.0
24B	336.9	247.1	232.5	106.4	68.6	56.9	75.9	67.2	19.9	10.0	29.9	24.6	5.3
25A	316.9	277.2	257.4	59.5	81.2	78.5	83.2	77.2	18.6	19.8	38.4	24.6	13.8
25B	316.9	277.2	282.4	34.5	89.1	87.6	91.0	87.8	18.6	19.8	38.4	25.4	13.0
Ave.	257.1	189.7	216.5	40.6	86.9	82.2	83.4	77.4	15.1	24.4	39.5	22.1	17.5

Run No.	Oxygen balance: O_2 in coal, lb./hr.	Oxygen balance: O_2 in steam, lb./hr.	Oxygen balance: Process oxygen, lb./hr.	Oxygen balance: Total to generator, lb./hr.	Oxygen balance: In dry synthesis gas, lb./hr.	Oxygen balance: In undecomposed steam, lb./hr.	Steam balance: Undecomposed steam from H_2 balance, lb./hr.	Steam balance: Undecomposed steam from O_2 balance, lb./hr.	Steam balance: Average undecomposed steam, lb./hr.	Steam balance: Total steam introduced, lb./hr.	Steam balance: Steam decomposed, lb./hr.	Computed equilibrium temperatures: Shift reaction, °F.	Computed equilibrium temperatures: CO_2 reaction, °F.
	48	50	51	52	53	54	55	56	57	58	59	60	61
15A	17.6	341.4	235.8	594.8	348.0	246.8	322.0	278.0	300.0	388.0	64.0	1,910	1,109
15B	17.6	282.9	230.1	530.6	312.0	218.6	247.0	246.0	246.0	318.0	72.0	1,780	1,110
15C	17.6	218.2	223.4	459.2	318.0	141.2	177.6	159.0	168.3	245.5	77.2	1,580	1,135
16A	19.2	216.0	224.0	459.2	328.0	131.2	172.0	148 0	160.0	243.0	83.0	1,730	1,182
16B	19.2	264.0	224.6	507.8	347.0	160.8	208.0	181.0	194.0	297.0	103.0	1,806	1,177
16C	19.2	306.9	224.6	550.7	350.0	200.7	270.0	226.0	248.0	345.0	97.0	1,865	1,149
17	17.9	129.9	215.3	363.1	274.0	89.1	74.8	100.2	87.5	146.0	58.5	1,930	1,890
18	17.0	87.0	200.0	304.0	240.0	64 0	59.4	72.0	65.7	98.0	32.3	2,100	1,288
19	16.3	53.4	183.4	253.1	228.0	25.1	41.4	28.2	34.8	60.0	25.2	3,990	1,510
20	34.9	265 0	408.0	707.9	500.0	207.9	198.0	234.0	216.0	298.0	82.0	2,505	1,252
21	29.4	280.0	335.0	644.4	409.0	235.4	224.0	265.0	244.0	315.0	71.0	2,260	1,230
22A	39.7	231.0	343.0	613.7	426.9	186.8	213.1	210.2	211.7	259.9	48.2	2,144	1,246
22B	39.7	247.0	343.7	630.4	441.6	188.8	199.1	212.4	206.0	277.9	71.9	2,091	1,264
23A	37.1	161.9	314.6	513.6	385.9	127.7	122.9	143.6	133.3	182.0	48.7	2,272	1,136
23B	37.1	153.0	297.6	487.7	373.4	114.3	115.0	128.5	121.8	172.1	50.3	2,318	1,332
24A	38.7	61.0	260.6	400.3	332.8	67.5	54.0	76.0	65.0	91.0	26.0	2,326	1,399
24B	38.7	80.0	269.4	388.1	326.1	62.0	47.5	69.6	58.7	90.0	31.3	2,265	1,399
25A	36.2	158.4	319.7	514.3	403.5	110.8	124.0	124.6	124.3	178.0	53.7	2,124	1,316
25B	36.2	158.4	373.1	567.7	435.8	131.9	116.1	148.3	132.2	178.0	45.8	2,318	1,332
Ave.	27.9	195.5	276.1	499.5	356.8	142.7	157.2	160.6	158.8	219.9	61.1	2,159	1,256

TABLE 2. - Calculated results on pilot-plant runs, using low-temperature steam (runs 15A - 25B) - Cont.

Heat balance, millions of B.t.u. per hour

Run No.	Net heat of combustion of coal	Sensible heat in steam	Total heat in	Net heat of combustion of gas	Sensible heat in gas	Sensible heat in undecomposed steam	Sensible heat of residue	Net heat of combustion of unburned c	Total heat out	Heat loss measured by heat balance, B.t.u./hr.	Calculated heat loss from shell 10^6 B.t.u./hr.	Calculated heat stored in bricks, 10^6 B.t.u./hr.	Calculated heat loss, B.t.u./lb. coal
	62	63	65	66	67	68	69	70	71	72	73	74	75
15A	2.920	0.032	2.952	1.766	0.298	0.237	0.015	0.000	2.334	0.618	0.070	0.423	2,035
15B	2.920	.026	2.946	1.762	.302	.202	.022	.145	2.433	.513	.073	.322	1,630
15C	2.920	.020	2.940	1.806	.314	.146	.022	.136	2.424	.516	.089	.107	792
16A	3.180	.019	3.199	2.117	.346	.139	.023	.129	2.748	.451	.105	.891	3,773
16B	3.180	.024	3.204	2.281	.360	.172	.016	.000	2.849	.355	.108	.396	1,909
16C	3.180	.028	3.208	2.063	.397	.232	.022	.071	2.785	.423	.113	.390	1,905
17	3.005	.013	3.018	2.320	.384	.082	.021	.071	2.878	.140	.114	.355	1,908
18	2.816	.008	2.824	2.018	.300	.056	.023	.162	2.559	.269	.087	.419	2,196
19	3.003	.005	3.008	2.259	.325	.031	.024	.128	2.767	.241	.106	.077	749
20	5.837	.024	5.861	3.943	.585	.203	.066	.549	5.346	.515	.091	.929	2,136
21	4.974	.026	5.000	3.216	.570	.241	.076	.701	4.804	.196	.105	.411	1,268
22A	5.959	.021	5.980	3.206	.503	.196	.058	1.352	5.315	.665	.069	1.006	2,206
22B	5.959	.023	5.982	3.643	.535	.199	.042	1.076	5.595	.387	.074	.419	1,011
23A	5.660	.014	5.674	3.394	.502	.131	.061	1.070	5.158	.516	.088	.524	1,336
23B	5.660	.015	5.675	3.494	.501	.121	.060	1.115	5.291	.384	.089	.306	862
24A	5.894	.007	5.901	3.433	.433	.061	.046	1.538	5.511	.390	.115	.516	1,323
24B	5.894	.007	5.901	3.456	.438	.055	.068	1.551	5.568	.333	.107	-.006	212
25A	5.511	.015	5.526	3.426	.507	.163	.052	.873	5.021	.505	.083	1.222	2,926
25B	5.511	.015	5.526	3.752	.575	.138	.034	.512	5.011	.515	.089	.720	1,805
Ave.	4.420	.018	4.438	2.809	.437	.148	.040	.588	4.021	.417	.093	.496	1,683

Thermal efficiencies

Run No.	A	B	C	D
	76	77	78	79
15A	61.2	60.5	75.5	75.5
15B	60.3	59.8	74.0	77.5
15C	61.9	61.4	74.4	77.6
16A	66.4	66.0	78.5	81.3
16B	71.7	71.2	82.5	85.5
16C	64.9	64.3	80.8	82.4
17	77.2	76.9	89.9	91.6
18	71.7	71.5	82.0	86.0
19	75.2	75.1	85.1	86.1
20	67.6	67.3	78.3	84.5
21	64.7	64.3	77.9	87.8
22A	53.8	53.6	63.4	79.2
22B	61.1	60.9	72.5	85.1
23A	60.0	59.8	69.0	82.2
23B	61.7	61.6	70.6	84.4
24A	58.2	58.2	65.1	83.3
24B	58.6	58.6	65.4	83.9
25A	62.2	62.0	71.4	82.5
25B	68.1	67.9	78.7	85.2
Ave.	64.6	64.3	75.7	83.4

A. Net heat of combustion of gas (B.t.u.)/net heat of combustion of coal.

B. Net heat of combustion of gas (B.t.u.)/total heat in.

C. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F./total heat in.

D. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F. plus 70% of the heat of combustion of ungasified carbon/total heat in.

TABLE 3. - Calculated results on pilot-plant runs, using intermediate-temperature steam (runs 26A - 31B)

Run No.	Conditions: Duration, hr.	Raw-coal rate, lb./hr.	Process-steam rate, lb./hr. (includes moisture from P.G.C.)	Process-oxygen rate, S.C.F./hr. (includes excess O_2 from P.O.C.)	Steam-inlet temp., °F.	Input ratios: Steam/lb. raw coal, lb.	Oxygen/lb. raw coal, lb.	Synthesis gas analysis, percent: CO_2	H_2	CO	CH_4 + Ill.	N_2	Outlet temp., °F.	Gross heating value, B.t.u./S.C.F.	Syn. gas, thousands of S.C.F./hr.	($CO+H_2$), thousands of S.C.F./hr.	H_2:CO ratio
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
26A	1.65	399	493	3,605	1,570	1.24	0.76	20.6	40.6	35.1	1.4	1.99	1,802	261.0	13.40	10.14	1.16
26B	2.00	399	489	3,657	1,655	1.23	.78	22.0	39.7	35.2	1.1	1.7	1,925	256.0	13.80	10.24	1.13
27	4.00	417	500	3,580	2,024	1.20	.71	19.5	39.7	38.1	1.0	1.3	2,004	258.5	14.80	11.50	1.04
28	4.00	428	484	3,571	1,600	1.13	.70	20.8	38.4	38.2	1.2	1.0	2,100	263.1	14.33	10.98	1.01
29	3.00	443	464	3,310	2,015	1.05	.63	20.2	38.2	37.3	.9	2.7	2,056	255.9	13.98	10.55	1.02
30A	2.00	421	470	3,775	2,066	1.12	.76	20.7	38.0	39.1	1.0	.9	2,116	263.4	15.24	11.75	.97
30B	2.75	421	464	3,761	2,042	1.10	.76	18.6	39.1	40.4	.9	.7	2,192	261.7	15.95	12.68	.97
31A	1.50	425	461	3,967	2,002	1.08	.79	19.9	37.7	39.5	1.1	1.5	2,132	263.4	15.35	11.85	.95
31B	2.50	425	468	3,882	1,997	1.10	.77	19.6	37.1	39.9	1.0	2.1	2,194	261.7	15.73	12.11	.93
Ave.	2.60	420	477	3,672	1,899	1.14	.74	20.2	38.7	38.1	1.1	1.5	2,058	260.5	14.73	11.31	1.02

Run No.	Generator temp., °F.: 4.5 ft. above floor of generator	11.5 ft. above floor of generator	16.5 ft. above floor of generator	In horizontal outlet	Residue (dry basis): lb./hr.	Carbon, percent	Ratios/1,000 S.C.F. ($CO+H_2$): Coa., lb.	Oxygen, S.C.F.	Steam introduced, lb.	Steam decomposed, lb.	Ratios/lb. raw coal: Process oxygen, S.C.F.	Steam introduced, lb.	Steam decomposed, lb.	Synthesis gas, S.C.F.	$CO + H_2$, S.C.F.
	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
26A	2,270	1,860	1,802	1,750	102.4	61.1	39.3	355.5	46.6	7.9	9.05	1.24	0.201	33.6	25.4
26B	2,375	1,952	1,925	1,770	62.5	61.9	39.0	357.1	47.8	9.2	9.17	1.23	.257	34.6	25.7
27	2,341	2,071	2,004	1,790	72.9	60.7	36.3	306.0	43.5	9.7	8.41	1.20	.267	35.5	27.6
28	2,430	2,130	2,100	1,885	34.4	63.5	39.0	325.0	44.1	7.4	8.31	1.13	.189	33.5	25.7
29	2,393	2,105	2,056	1,820	35.2	67.2	42.0	313.6	44.0	6.2	7.47	1.05	.149	31.6	23.8
30A	2,490	2,100	2,116	1,795	29.9	61.7	35.8	321.0	40.0	8.1	8.97	1.12	.225	36.2	27.9
30B	2,536	2,175	2,192	1,993	24.6	56.4	33.2	297.0	36.6	8.6	8.93	1.10	.258	37.9	30.1
31A	2,468	2,155	2,132	1,857	25.7	61.2	35.9	335.0	38.9	7.3	9.33	1.08	.203	36.1	27.9
31B	2,498	2,226	2,194	1,916	27.8	56.5	35.1	321.0	38.6	7.9	9.13	1.10	.225	37.0	28.5
Ave.	2,422	2,086	2,058	1,832	46.2	61.1	37.3	325.7	42.5	8.0	8.75	1.14	.217	35.1	27.0

Run No.	Carbon balance: Based on measurement of gas volume: Total carbon in coal, lb./hr.	Fixed carbon in coal, lb./hr.	Total carbon in P.O.C. entering generator, lb./hr.	Carbon in syn. gas, lb./hr.	Ungasified carbon lb./hr.	Total carbon gasified, %	Fixed carbon gasified, %	Based on measurement of residue: Total carbon gasified, %	Fixed carbon gasified, %	Hydrogen balance: H_2 in coal, lb./hr.	H_2 in steam, (including H_2 from P.G.C.), lb./hr.	Total to generator, lb./hr.	In dry synthesis gas, lb./hr.	In undecomposed steam, lb./hr
	33	34	35	36	37	38	39	40	41	42	43	45	46	47
26A	296.5	211.5	15.3	228.9	67.6	77.2	68.0	78.8	71.2	21.2	54.8	76.0	30.7	45.3
26B	296.5	211.5	14.1	243.1	53.4	82.0	74.8	87.0	82.1	21.2	54.3	75.5	30.6	44.9
27	309.8	221.0	19.2	258.0	51.8	83.3	76.5	85.8	80.5	22.1	55.6	77.7	32.7	45.0
28	296.6	211.0	13.6	262.5	34.1	88.5	85.1	92.6	89.8	23.5	53.8	77.3	30.9	46.4
29	307.0	218.4	17.0	244.0	63.0	79.5	71.2	92.3	88.9	24.4	51.6	76.0	30.4	45.6
30A	289.2	205.4	17.2	279.4	9.8	96.6	95.2	95.2	93.6	21.5	52.2	73.7	32.5	41.2
30B	289.2	205.4	16.3	289.0	.2	99.9	99.9	95.2	93.6	21.5	51.6	73.1	34.8	38.3
31A	294.5	209.1	14.3	282.5	12.0	95.9	94.3	94.6	92.7	21.7	51.2	72.9	32.4	40.5
31B	294.5	209.1	14.5	289.6	4.9	98.3	97.7	94.7	92.8	21.7	52.0	73.7	32.5	41.2
Ave.	297.1	211.4	15.7	264.1	33.0	89.0	84.7	90.7	87.2	22.1	53.0	75.1	31.9	43.2

TABLE 3. - Calculated results of pilot-plant runs, using intermediate-temperature steam (runs 26A - 31B) - Cont.

Run No.	Oxygen balance: O_2 in coal, lb./hr.	O_2 in P.O.C. entering generator, lb./hr.	O_2 in steam, lb./hr.	Process oxygen, lb./hr.	Total to generator, lb./hr.	Steam balance: In dry synthesis gas, lb./hr.	In undecomposed steam, lb./hr.	Undecomposed steam from H_2 balance, lb./hr.	Undecomposed steam from O_2 balance, lb./hr.	Average undecomposed steam, lb./hr.	Total steam introduced, lb./hr.	Steam undecomposed, lb./hr.	Computed equilibrium temperatures: Shift reaction, °F.	CO reaction, °F.
	48	49	50	51	52	53	54	55	56	57	58	59	60	61
26A	26.3	44.2	438.2	301.6	810.5	439.0	371.5	407.7	417.6	412.6	493.0	80.2	2,481	1,207
26B	26.3	49.3	434.7	297.6	807.9	466.1	341.8	404.1	384.5	394.3	489.0	94.7	2,444	1,204
27	27.5	63.4	444.4	284.2	819.5	488.6	330.9	405.0	372.3	388.7	500.0	111.3	2,257	1,239
28	70.2	50.3	430.2	286.7	837.4	498.3	345.1	417.6	388.2	402.9	484.0	81.1	2,350	1,224
29	72.6	61.3	412.4	264.1	810.4	467.5	342.9	410.4	385.8	398.1	464.0	65.9	2,481	1,221
30A	73.3	67.5	417.8	312.0	860.6	523.2	337.4	370.8	379.6	375.2	470.0	94.8	2,140	1,246
30B	73.3	57.8	412.4	309.7	853.2	528.0	325.2	344.7	365.9	355.3	464.0	108.7	2,150	1,246
31A	71.8	63.2	409.8	316.9	861.7	529.8	341.9	364.5	384.6	374.6	461.0	86.4	2,195	1,229
31B	71.8	59.6	416.0	316.1	863.5	531.3	332.2	370.8	373.7	372.3	468.0	95.7	2,210	1,238
Ave.	57.0	56.3	424.0	298.8	836.1	495.1	341.0	388.4	383.6	386.0	477.0	91.0	2,268	1,228

Heat balance, millions of B.t.u. per hour

Run No.	Net heat of combustion of coal	Sensible heat in steam	Sensible heat in P.O.C. gases	Total heat in	Net heat of combustion of gas	Sensible heat in gas	Sensible heat in undecomposed steam	Sensible heat of residue	Net heat of combustion of unburned C	Total heat out	Heat loss measured by heat balance, B.t.u./hr.	Calculated heat loss from shell, 10^6 B.t.u./hr.	Calculated heat stored in brick, 10^6 B.t.u./hr.	Calculated heat loss B.t.u./lb. coal
	62	63	64	65	66	67	68	69	70	71	72	73	74	75
26A	5.074	0.400	0.033	5.507	3.207	0.585	0.372	0.062	0.907	5.073	0.434	0.116	0.958	2,692
26B	5.074	.392	.030	5.496	3.244	.566	.384	.033	.561	4.788	.708	.112	.663	1,942
27	5.303	.510	.048	5.861	3.604	.638	.397	.066	.649	5.337	.524	.081	.518	1,436
28	4.904	.373	.030	5.307	3.478	.657	.435	.022	.317	4.909	.398	.121	.313	1,024
29	5.044	.471	.038	5.553	3.298	.604	.496	.023	.343	4.764	.789	.119	.248	828
30A	4.917	.495	.038	5.450	3.699	.685	.408	.034	.269	5.095	.355	.119	.645	1,815
30B	4.917	.474	.035	5.426	3.962	.733	.403	.031	.203	5.332	.094	.218	.119	563
31A	5.011	.461	.033	5.505	3.738	.693	.412	.037	.249	5.129	.376	.122	.392	1,209
31B	5.011	.468	.037	5.516	3.810	.731	.423	.035	.249	5.248	.268	.135	.329	1,056
Ave.	5.028	.449	.036	5.513	3.550	.648	.424	.037	.416	5.075	.438	.115	.465	1,396

Thermal efficiencies

Run No.	A	B	C	D
	76	77	78	79
26A	63.2	58.2	71.8	83.1
26B	63.9	59.0	72.2	79.3
27	68.0	61.5	76.4	84.1
28	70.9	65.5	83.0	87.2
29	65.4	59.4	75.3	79.7
30A	75.2	67.9	86.0	89.4
30B	80.5	73.0	92.7	95.3
31A	74.6	67.9	85.8	89.0
31B	76.0	69.1	88.1	91.2
Ave.	70.9	64.6	81.2	86.4

A. Net heat of combustion of gas (B.t.u.)/net heat of combustion of coal.

B. Net heat of combustion of gas (B.t.u.)/total heat in.

C. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F./total heat in.

D. Net heat of combustion of gas plus sensible heat in undecomposed steam and in dry gas above 400°F. plus 70% of the heat of combustion of ungasified carbon/total heat in.

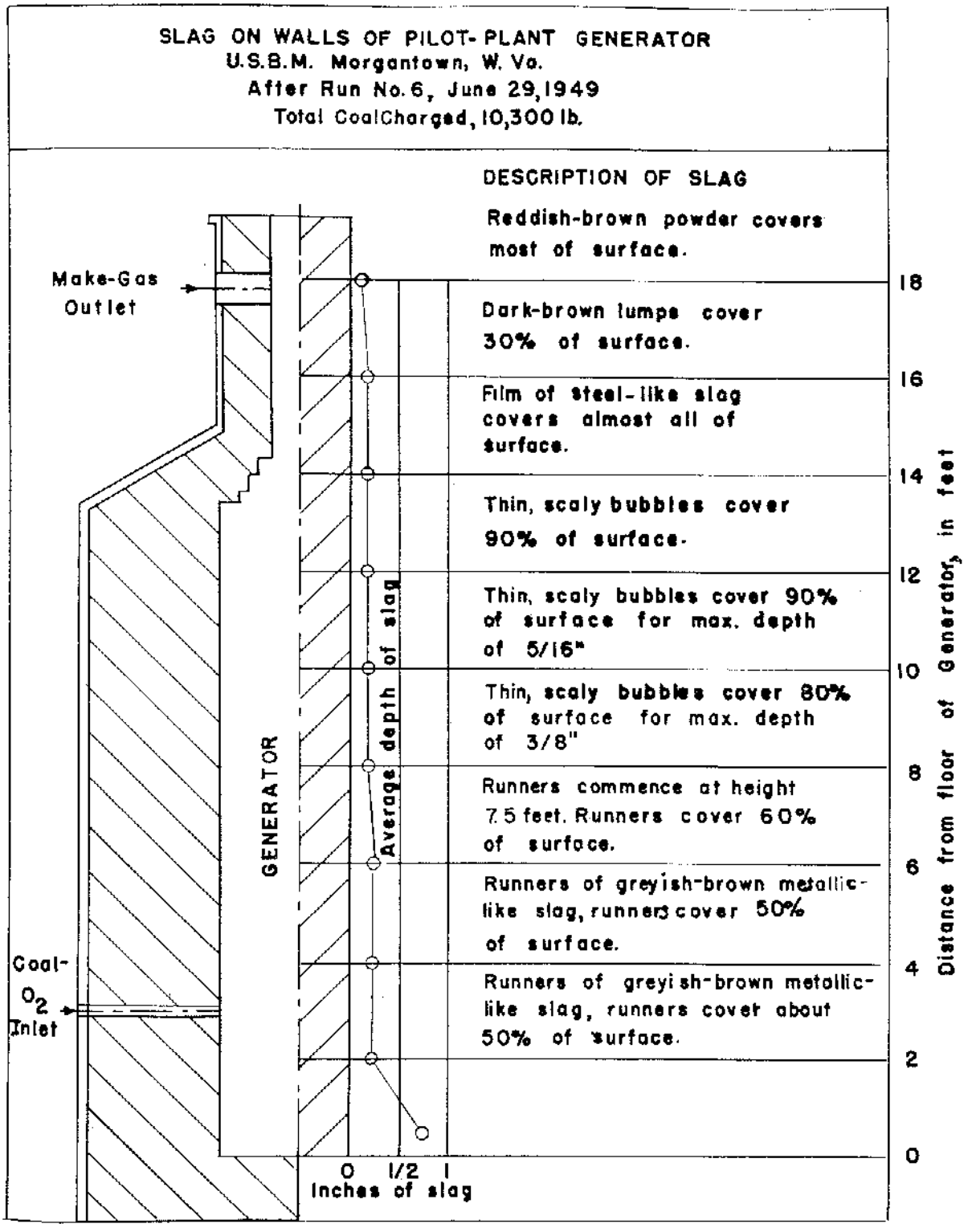

Figure 25. - Typical slag distribution in gas generator.