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Mobil Oil Corporation

RESEARCH DEPARTMENT
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PROGRAM ENGINEERING CENTER
OIL SHALE RESEARCH CENTER

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File 108.05

LWV
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WWB
CVF
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CG

- W. H. Decker - Sinclair Research, Inc.
- R. T. Ellington, Jr. - Sinclair Oil and Gas Company
- K. M. Elliott - Mobil Oil Corporation
- Att: W. W. Hamilton
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- E. J. Moll - Mobil Oil Corporation
- R. Mungen - Pan American Petroleum Corporation
- B. L. Schulman - Esso Research and Engineering Company
- D. C. Smith - Phillips Petroleum Company
- J. H. Smith - Continental Oil Company
- R. V. Smith - Phillips Petroleum Company
- W. O. Taff - Humble Oil and Refining Company

Gentlemen:

This letter with attachments covers the operations on Retort No. 3 from Runs C1020 through C1026. These operations were continuations of the study to solve the startup and operating problems associated with the 1/4 to 1 inch shale. Various mechanical changes and operating techniques were used. The major changes tried were:

1. Additional runs to determine the effect of orifice size changes in the bayonets on the 54 A/D. Run C1019-1, in the last transmittal letter, indicated some success.
2. Shorter bayonets in the 54 bayonet type A/D. (9 1/4 inch versus 18 inch).
3. Dilution gas to the retort.
4. A revised 36 bayonet type A/D. (See Drawing No. RB 419).

None of these changes gave a satisfactory operation with the 1/4 to 1 inch shale. A duplicate of the conditions used in C1019-1, reported in the last transmittal letter, resulted in failure. One 12-hour material balance (C1025-1) was obtained

while adding dilution gas. Operation was ragged and borderline. A summary of the operations is given in Table 1. The Log of Operations is given in Table 2.

The data from the Mining Section includes: the sag rod measurements taken from the roof in "Able," "Charlie," Adit 5 and Rooms 1, 2 and 3. Pillar convergence measurements from Pillars 23B, 23D, and 23F. Also blasting and drilling data accumulated since February 3, 1967.

C1020 And C1021

These two runs were made to further assess the effect of changing orifice sizes in the 54 A/D bayonets to approach equal air to cross sectional area ratios. Run C1019-1, reported in the last transmittal letter, dated March 29, 1967, had shown some promise as the retort ran long enough to obtain one 12-hour material balance.

The startup procedure for Run C1020 was the same as that used in Run C1019-1, which was:

1. 300 lbs/(hr)(ft²) shale rate.
2. 5,400 to 5,600 SCF/T air equivalent oxygen consumption rate.
3. 14,700 SCF/T recycle rate.
4. 1,300 F line burner temperature.

Run C1020 had to be shut down approximately 11 1/2 hours after the line burner temperature was increased to 1,300 F. The temperatures became badly skewed as the line burner was phased out of the system. Changing the pattern of air and recycle distribution and refiring the line burner did not correct the situation. A bridged-clinkered material was found on the west bayonets extending from the north-south to the west walls. The material did not contain very much hard clinkered shale.

The startup procedure for C1021 was a duplicate of that used in Retort No. 2. It differed from C1020 in that the severity was lower (5,000 to 5,200 SCF/T air equivalent oxygen consumption rate) and the recycle rate was higher (15,700 SCF/T). Also, the 300 mass rate lineout period was eliminated, going directly to the 500 mass rate in eight steps (8 hours). The unit had to be shut down approximately 25 hours after the line burner was fired. The temperatures became skewed and the fire was finally lost in the center of the retort. The retort could not be revived by changing process variables. A massive clinker was found on the north side from east to west covering the first 4 rows of bayonets on all headers.

C1022 And C1023

These two runs were made to duplicate the observation made in Retort No. 2 while running the 3/4 to 1 1/2 inch shale. The 39 inch bayonets, with the gull wing from the raw shale flow below the air inlets, gave an inoperable situation with the narrow shale fraction. The 21 inch bayonet, with the gull wing from the shale flow 6 inches above the air inlets, gave the best operations in Retort No. 2. The bayonets in Retort No. 3 were reduced from about 18 inches to 9 1/4 inches on the 54 bayonet A/D. Also, the liner ended approximately 17 1/4 inches above the A/D inlets. Both attempts were unsuccessful. Temperatures became badly skewed and the unit had to be shut down in both cases. Clinkers were found resting on the A/D after each run. More clinkers were found after C1023 than after C1022.

C1024 Through C1025-2

These runs were made to test the hypothesis that the addition of dilution gas to the combustion zone would keep the temperatures below the shale fusion point. Before making these runs, the normal length bayonets were reinstalled and piping was arranged to inject dilution gas (vent gas) into the line burner through the secondary air line. Also, the 6 compartments were removed from below the A/D. Neither of the runs was successful. Although Run C1025-1 ran long enough to obtain a 12-hour material balance. The operations were ragged and bridges occurred below the A/D which caused erratic flow through the spent shale drawoff pipes. The yield from the Run C1025-1 was 98% but the data are highly questionable.

The first attempt (C1024) with dilution had to be aborted approximately 8 hours after the line burner was fired at 1,300 F. The fire was lost in the middle of the retort. The retort was free of clinkers after shutdown.

As mentioned above, C1025-1 was a 12-hour balance with bridging occurring in the spent shale drawoff pipes. The inlet to the No. 1 Screw Conveyor became bridged after 7 hours into the balance. Air and recycle rates were reduced while the bridge was being dislodged. The retort was off conditions for approximately 32 minutes. The operations became progressively worse after C1025-1 and the unit had to be shut down after approximately 5 hours into C1025-2. This run was aborted. Clinkers were found below the A/D as well as on the bayonets on the east and center headers. The clinkers extended and rested on the headers also.

C1026

This run was made to test the hypothesis that streamlining the headers and opening up the hardware would allow agglomerates to pass through without being held up and fused. It was also thought that the uneven temperature distribution may prevent the formation of large deleterious agglomerates. The air distributor had 36 bayonets (See Drawing RB 419) with 3 yokes on each header containing 4 bayonets each. There was 18 inches clearance

between the yokes. This A/D configuration did not solve the problem with 1/4 to 1 inch shale. The unit had to be shut down about 8 hours after raising the line burner temperature to 1,300 F because of badly skewed temperatures. Clinkers were found over all the east header extending over to the center header covering most of the bayonets on the two north yokes. There was a clearance around all the walls with no bridge-clinkered material adhering to the walls.

Further work with the 1/4 to 1 inch shale will be held in abeyance until the revised air distributor is available for study. In the meantime, the effort will be focused on improving the operations using the 1 to 2 1/2 inch shale. Various air distributor configurations will be tried.

The Equipment Lease Agreement of April 28, 1966 for the Allis-Chalmers tooth type double roll secondary crusher calls for operating records to be kept for the equipment as part of the rental consideration. Attached are these operating records for the period from the initial operation of the crusher (July 22, 1966) to the installation of the new rolls on November 3, 1966.

Crusher throughput in tons per hour (TPH) has been back calculated from the crusher plant product rates. For closed circuit operations, rates are given in TPH of new feed plus TPH of circulating load estimated by the method given on page 53 of "Screening Machinery, Selection of Vibrating Screens, General Information," PM 1.1, June 1963. Power data has not been recorded because no power recording facilities were installed during this period.

Yours truly,



R. H. Cramer
Program Manager

EETurner:sre
Attachments

cc: S. L. Meisel w/o attach

TABLE 1

SHAKEDOWN OPERATIONS - RETORT NO. 3

C1020 THROUGH C1026

March 20 to April 3, 1967

	<u>C1020</u>	<u>C1021</u>	<u>C1022</u>
Date	3/21/67	3/22/67	3/25/67
Shale size, inches	1/4 to 1	1/4 to 1	1/4 to 1
Da	--	--	--
Dv	--	--	--
Fischer Assay, GAL/T	25.2	25.6	26.0
Nominal Run Conditions			
Shale Rate,			
lbs/(hr) (ft ²) (1)	500	500	500
Air, SCF/T	4,900	4,900	4,900
Recycle, SCF/T	11,500	11,500	11,500
Dilution, SCF/T	--	--	--
Line Burner temp., °F	--	--	--
Offgas Temperature, °F	--	--	--
Spent Shale Temp., °F	--	--	--
Retort Pressures, in/ft			
Overall	--	--	--
Above A/D	--	--	--
Maximum, Above A/D	--	--	--
Yield, % Fischer Assay	--	--	--
Fischer Assay, GAL/T			
On Spent Shale	--	0.5	--
Gravity, °API	19.7	19.2	(17.9)
Startup Procedure			
Shale, lbs/(hr) (ft ²)	300	300	300
Air-oxygen Con-			
sumption, SCF/T (2)	5,400 to 5,600	5,000 to 5,200	5,000 to 5,200
Recycle, SCF/T	14,700	15,700	15,700
Dilution, SCF/T	--	--	--
Line Burner Temp. °F	1,300	1,300	1,300

Remarks	Unit was shut down about 11 1/2 hours after firing line burner due to skewed temperatures.	Unit was shut down about 25 hours after firing the line burner. Lost fire in center of retort.	Bayonets, 9 1/4" shorter were installed. Liner 17 1/4" above air inlet. Unit shut down about 8 hours after firing line burner.
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Clinker found on west side covering all bayonets on west header extending from north to south wall.	Massive clinker found on the north side from east to west covering the first 4 rows bayonets on all headers.	Clinker found on first 3 rows of bayonets on center header from north wall.
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(1) Mass rate calculated on stainless steel cross sectional area.

(2) Initial air rate = 7,500 SCF/T.

TABLE 1 (Page 2)

SHAKEDOWN OPERATIONS - RETORT NO. 3

C1020 THROUGH C1026

March 20, to April 3, 1967

	<u>C1023</u>	<u>C1024(3)</u>	<u>C1025-1(3)</u>
Date	3/26/67	3/28/67	3/30/67
Shale size, inches	1/4 to 1	1/4 to 1	1/4 to 1
Da	--	--	--
Dv	--	--	--
Fischer Assay, GAL/T	25.2	23.9	24.7
Nominal Run Conditions			
Shale Rate, lbs/(hr) (ft ²) (1)	500	300	300
Air, SCF/T	4,900	5,000	5,770
Recycle, SCF/T	11,500	10,000	12,000
Dilution, SCF/T	--	2,500	1,980
Line Burner Temp., °F	--	800	1,000
Offgas Temperature, °F	--	--	140
Spent Shale Temp., °F	--	--	500
Retort Pressures, in/ft			
Overall	--	--	0.62
Above A/D	--	--	0.79
Maximum, Above A/D	--	--	--
Yield, % Fischer Assay	--	--	98
Fischer Assay, GAL/T			
On Spent Shale	--	--	0.8
Gravity, OAPI	19.8	19.8	20.0
Startup Procedure			
Shale, lbs/(hr) (ft ²)	300	300	300
Air-oxygen Consumption, SCF/T (2)	5,000 to 5,200	5,000 to 5,200	5,000 to 5,200
Recycle, SCF/T	15,700	15,700	15,700
Dilution, SCF/T	--	--	--
Line Burner Temp., °F	1,300	1,300	1,300
Remarks	Bayonets, 9 1/4" shorter, were installed. Liner 17 1/4" above air inlet. Unit shut down about 8 hours after firing the line burner. Clinker found on center header from north wall over first 3 rows of bayonets extending to the last header covering first 3 rows of bayonets but clear between clinker and north and east wall.	Long bayonets put back in. Liner 8" above air inlet ports. Removed the vertical baffles for the 6 compartments. Shut down approximately 8 hours after firing line burner. Lost fire in retort. Dilution put in when O ₂ = about 1.3%. Retort was free of clinkers - walls were oily.	Ragged operation. Bridge at inlet to No. 1 Screw Conveyor after 7 hours on balance air reduced to clear bridge. Back on condition after 32 minutes. NW drawoff pipe empty at end of balance.

(1) Mass rate calculated on stainless steel cross sectional area.
 (2) Initial air rate = 7,500 SCF/T.
 (3) Dilution gas added when O₂ concentration reached about 1.3% for C1024 and 4% for C1025. Line burner temperature left on at 800 to 1,000° F.

TABLE 1 (Page 3)

SHAKEDOWN OPERATIONS - RETORT NO. 3

C1020 THROUGH C1026

March 20, to April 3, 1967

	<u>C1025-2(3)</u>	<u>C1026(4)</u>
Date	3/31/67	4/2/67
Shale size, inches	1/4 to 1	1/4 to 1
Da	--	--
Dv	--	--
Fischer Assay, GAL/T	24.7	24.6
Nominal Run Conditions		
Shale Rate,		
lbs/(hr) (ft ²) (1)	300	500
Air, SCF/T	--	4,900
Recycle, SCF/T	--	11,500
Dilution, SCF/T	--	--
Line Burner Temp., °F	1,000	--
Offgas Temperature, °F	--	--
Spent Shale Temp., °F	--	--
Retort Pressures, in/ft		
Overall	--	--
Above A/D	--	--
Maximum, Above A/D	--	--
Yield, % Fischer Assay	--	--
Fischer Assay, GAL/T		
On Spent Shale	--	--
Gravity, °API	20.0	--
Startup Procedure		
Shale, lbs/(hr) (ft ²)	--	300
Air-oxygen Consumption		
SCF/T (2)	--	5,000 to 5,200
Recycle, SCF/T	--	15,700
Dilution, SCF/T	--	--
Line Burner Temp., °F	--	1,300
Remarks	<p>Aborted after 5 hours. Badly skewed temperatures. O₂ break through.</p> <p>Clinkers found below A/D. Large clinker resting on southwest spent shale pipe. Clinkers also on center and east headers and bayonets.</p>	<p>36 bayonet type A/D installed (See Drawing RB 419). Unit shut down approximately 8 1/2 hours after sustained line burner temperature was obtained at 1,300 F. Badly skewed temperatures.</p> <p>Clinker found over all bayonets on east header. Clinker extended over to center header covering most of the bayonets on first two yokes from the north. Clearance around all walls.</p>

(1) Mass rate calculated on stainless steel cross sectional area.
 (2) Initial air rate = 7,500 SCF/T.
 (3) Dilution gas added when O₂ concentration reached about 1.3% for C1024 and 4% for C1025. Line burner temperature left on at 800 to 1,000° F.
 (4) New design 36 bayonet with streamlined headers were installed. (Drawing RB41)

TABLE 2

LOG OF OPERATIONS

RUNS C1020 THROUGH C1026

March 20, 1967 to April 3, 1967

3/20/67

- 0000 - Normal turnaround items.
1615
- 1615 Started recycle blower.
- 1630 Started filling retort.
- 2300 Drawdown test started by L. J. Skowronek.

3/21/67

- 0220 Drawdown test completed.
Started refilling retort.
- 0530 Retort full. Tested high and low level alarms.
- 0540 Started 4-hour circulation at 8.4 tons per hour.
- 0930 Fired line burner at 400 F.
- 0945 Increased line burner temperature to 1,300 F for Run C1020. Used same procedure as used in C1019.
300 mass rate
5,400 to 5,600 SCF/T air constant oxygen consumption
14,700 SCF/T recycle
7,500 SCF/T air rate initially.
Startup sequence follows:

	<u>O₂, Vol.%</u>	<u>Air, SCFM</u>	<u>Recycle SCFM</u>	<u>Line Burner</u>	<u>Temperatures, °F</u>		
					<u>East TC TR1-1</u>	<u>Center TC TR1-15</u>	<u>West TC TR2-1</u>
1050	5.8	985	2,025	1,300	300	275	150
1110	--	920	ESP on	1,300	--	--	--
1120	3.0	885	2,025	1,300	320	300	185
1130	Adjusted air headers to give more air to west header.						
1135	2.25	845	--	1,300	370	390	235
1145	1.6	820	--	1,300	450	440	280
1245	0.9	800	--	1,300	670	585	465
1255	Spent shale screw feeder started squeaking.						
1400	0.55	780	--	1,300	925	830	840
1426	0.45	780	1,979	1,200	970	1,035	985
1436	0.40	780	1,929	1,100	965	970	1,000
1444	0.45	780	1,879	1,000	1,010	1,045	980
1453	0.45	780	1,800	900	1,000	1,030	1,020
1503	0.40	780	1,750	800	1,080	1,140	1,110

	O ₂ , Vol.%	Air, SCFM	Recycle SCFM	Temperatures, °F			
				Line Burner	East TC TR1-1	Center TC TR1-15	West TC TR2-1
1513	0.35	780	1,700	700	1,010	1,070	1,050
1520	0.45	780	1,650	600	1,030	1,220	1,040
1522	Offgas temperature has 7 F split with TR5-5 the highest. Adjusted air to headers to give less air to center header. Line burner off.						
1537	0.40	750	1,650	off	1,210	1,800	1,250
1640	Adjusted air to give same flow to all headers.						
1715	Adjusted air to give more flow to east side. (East side temperature decreasing).						
1730	--	750	1,650	--	600	--	--
	Shale rate decreased to try and increase TR1-1.						
1830	Increased shale rate to 8.4 lbs/hr.						
1840	Increased recycle to east and center headers - west side getting hot and east and center getting cold.						
1900	Fired line burner.						
1910	Started shutdown - TR2-1 = 1,900 F with east and center couples cold.						
2118	South center spent shale drawoff light indicated pipe empty.						
2232	South center spent shale drawoff light indicated pipe now full of shale.						

3/22/67

- 030 Clinker found on west bayonets extending from north-south to west wall. Clinker did not contain much hard material. Inspected and tightened baffle plate on Screw Conveyor No. 1; found loose.
- 0620 Started filling retort.
- 0830 - Abbreviated drawdown test made by L. J. Skowronek due to the southeast side drawing off faster than rest of retort. Drawdown indicated satisfactory shale flow. First observation of slow flow on southeast side due to filling rather than a mechanical reason.
- 1020
- 1300 Retort full. Checked high and low level alarms.
- 1330 Started 3-hour circulation at 8.4 tons per hour.
- 1840 Line burner fired at 400 F for C1021.
- 1850 Increased line burner temperature to 1,300 F.
 Startup procedure:
 Shale - 300 lbs/(hr) (ft²)
 Air - 7,500 SCF/T - 1,035 SCFM
 5,000 to 5,200 SCF/T air consumption
 Recycle - 15,700 SCF/T - 2,170 SCFM
 Line burner temperature - 1,300 F
 Will not lineout at 300 mass rate but go directly to 500 mass rate in eight steps (8 hours).

Sequence of startup changes:

	O ₂ , Vol%	Air, SCFM	Recycle, SCFM	Shale, SCF/T	Temperatures			
					Line Burner	TR1-1	TR1-15	TR2-1
1850	--	1,035	2,170	8.4	1,300	--	--	--
1957	5.55	955	2,170	8.4	1,300	--	--	--
2005	3.8	855	2,170	8.4	1,300	--	--	--
2015	2.65	800	2,170	8.4	1,300	--	--	--
2021	1.9	765	2,170	8.4	1,300	--	--	--
2106	1.1	735	2,170	8.4	1,300	--	--	--
2251	Rebalanced air to headers.			8.4	1,300	--	--	--
2300	0.5	725	2,170	8.4	1,200	--	--	--
2330	--	725	2,170	8.4	1,100	--	--	--
2350	0.3	715	2,170	8.4	1,100	--	--	--
2400	--	715	2,170	8.4	1,000	--	--	--

3/23/67

0045	12 F split in offgas temperatures.				--	1,005	960	1,235
0100	--	--	--	--	900	--	--	--
0120	LR-3 indicated a bridge fell.							
0145	--	715	2,170	8.4	900	1,140	825	1,220
	Offgas temperatures - TR5-2 = 156 F, TR5-3 = 149 F, TR5-4 = 151 F, TR5-5 = 148 F.							
0200	--	715	2,170	8.4	800	--	--	--
330	--	760	2,225	9.4	Off at 0335	--	--	--
0347	--	--	--	10.4	--	--	--	--
0400	--	805	2,385	10.4	--	--	--	--
0500	--	850	2,385	10.4	--	--	--	--
0512	--	880	2,350	10.5	--	1,220	1,150	1,020
0550	--	900	2,410	10.5	--	--	--	--
0600	--	900	2,410	11.1	--	--	--	--
0645	--	940	2,465	11.1	--	--	--	--
0700	--	940	2,465	11.85	--	--	--	--
0720	--	970	2,465	11.85	--	1,065	1,100	1,000
0745	--	990	2,525	11.85	--	--	--	--
0800	--	990	2,525	12.5	--	1,165	1,060	1,000
0815	--	1,010	2,525	12.5	Spent shale sample had several fist size clinkers.			
0845	0.4	1,030	2,585	12.5	--	1,110	1,250	920
	TR5-2 = 143; TR5-3 = 146; TR5-4 = 159; TR5-5 = 151.							
0900	--	--	--	13.2	--	--	--	--
	Start PTC1021.							
0930	--	1,080	2,585	13.2	--	1,055	1,040	1,020
	TR5-2 = 145; TR5-3 = 147; TR5-4 = 162; TR5-5 = 147							
0955	--	1,125	2,645	13.2	--	--	--	--
1010	--	1,125	2,645	13.9	--	--	--	--
	On 500 mass rate conditions							
1120	ESP amperes ranging from 20 to 80.							
.130	0.45	1,125	2,845	13.9	--	1,160	1,300	1,070
	TR5-2 = 146 F, TR5-3 = 145 F, TR5-4 = 155 F, TR5-5 = 156 F.							
1205	0.55	1,125	2,645	13.9	TR1-15 = 1,200 to 1,600 F;			
	TR1-1 and TR2-1 = 1,000 to 1,100 F.							

- 1340 TR1-15 down to 625 F.
Increased air to center header.
- 1350 TR1-15 = 580 F. Increased recycle to 2,780 SCFM.
- 1415 TR1-15 = 1,000 F. Set equal rates to recycle headers.
- 1430 TR1-15 decreasing. Increased recycle to center header.
- 1520 Increased air to 1,150 SCFM.

TR1-1 = 1,050	TR5-2 = 142 F
TR1-15 = 660	TR5-3 = 142 F
TR2-1 = 965	TR5-4 = 167 F
O ₂ = 0.45%	TR5-5 = 191 F

- 1609 Increased recycle to 2,850 SCFM.

TR1-1 = 1,000 F	TR5-2 = 143 F	TR5-5 = 200 F
TR1-15 = 510 F	TR5-3 = 143 F	
TR2-1 = 1,200 F	TR5-4 = 161 F	

- 1627 - ESP power requirements varying - Alarm sounded - reduced power
1650 control from 80 to 0. Reset at 32 (26 amps) volts 300 and increased to 40 at 1650.

1700 TR1-1 = 1,000 F	TR5-2 = 146 F	TR5-5 = 207 F
TR1-15 = 550 F	TR5-3 = 143 F	
TR2-1 = 1,085 F	TR5-4 = 164 F	

1900 TR1-1 = 1,20 F	TR5-2 = 148 F	TR5-5 = 218 F
TR1-15 = 630 F	TR5-3 = 144 F	
TR2-1 = 935 F	TR5-4 = 164 F	

- 1920 ESP alarm sounded - Reset at 40.

- 1952 Increased recycle to 2,900 SCFM.

2015 Increased recycle to 2,950 SCFM.

TR1-1 = 800 F	TR1-15 = 330 F	TR2-1 = 660 F
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- 2027 Fired line burner at 400 F.

- 2043 Increased line burner temperature to 1,300 F.

- 2100 End C1021-1
Start C1021-2
Both test periods were aborted.

- 2220 Started shutdown.

3/24/67

- 0001 - Massive clinker on north side covering over 50% of retort. Extended
1030 from east to west wall to the north wall.

1030 - Turnaround.
 2400 Normal maintenance.
 Short bayonets (9 1/4 inches shorter) installed.
 Liner left in same place - now 17 1/4 inches above air outlets.

3/25/67

0045 Started filling retort.
 0530 Retort full - Started lineout shale circulation.
 0900 Fired line burner at 400 F for C1022.
 0915 Increased line burner temperature to 1,300 F.
 Startup conditions for C1022
 Shale = 8.4 tons per hour
 Air = 1,035 SCFM
 Recycle = 2,170 SCFM

	O ₂ Vol. %	Air, SCFM	Recycle, SCFM	Temperatures, °F			
				Line Burner	TR1-1	TR1-15	TR2-1
1010	5.3	1,015	2,170	1,300	--	--	--
1018	3.8	925	2,170	1,300	--	--	--
1026	2.25	850	2,170	1,300	--	--	--
034	1.65	820	2,170	1,300	--	--	--
1109	1.0	805	2,170	1,300	235	285	220
1136	0.7	790	2,170	1,300	235	325	255
1220	0.5	790	2,170	1,200	295	355	300
1250	0.45	790	2,170	1,100	285	290	380
Adjusted air to increase air to east and center headers.							
1310	Adjusted recycle to increase gas to east and center headers.						
1320	0.4	790	2,170	1,000	265	245	525
String test shows slow flow on west side of retort.							
1420	0.3	775	2,170	900	330	325	590
1450	0.25	775	2,170	800	395	300	625
1520	--	775	2,170	700	--	--	--
1535	--	775	2,170	1,300	--	--	--
1653	--	740	2,170	1,300	--	--	--

1715 Started shutdown - Temperatures skewed badly.
 1715 - Retort emptied. Relatively small clinker found on first three rows of bayonets on center air header from north wall.
 2400

3/26/67

0145 Started to fill retort.
 0625 Retort full. Started shale circulation.
 0700 Started string tests.
 1000 Fired line burner at 400 F for C1023.

1015 Increased line burner temperature to 1,300 F.
 Shale - 8.4 tons per hour
 Air - 1,035 SCFM
 Recycle - 2,170 SCFM

	O ₂ , Vol. %	Air, SCFM	Recycle, SCFM	Raw Shale Tons/Hour	Line Burner	Temperatures, °F		
						TR1-1	TR1-15	TR2-1
1100	7.55	1,000	2,170	8.4	1,300	--	--	--
1103	5.55	950	2,170	8.4	1,300	--	--	--
1112	3.8	855	2,170	8.4	1,300	--	--	--
1121	2.65	800	2,170	8.4	1,300	--	--	--
1130	ESP turned on.							
1139	1.85	735	2,170	8.4	1,300	195	290	200
1300	Increased air to east and center headers.					225	295	300
1325	Reduced gas to west recycle header.					235	275	340
1415	--	735	2,170	8.4	1,300	150	150	--
1455	0.55	735	2,170	8.4	1,300	Cold	Cold	Hot
1510	0.5	735	2,170	8.4	1,200	150	150	550
String tests show fast flow in southeast section; slow flow in northeast section.								
1540	--	735	2,170	8.4	1,100	--	--	--
1610	--	735	2,170	8.4	1,000	--	--	--
1645	--	735	2,170	8.4	900	--	--	--
1710	--	735	2,170	8.4	800	--	--	--

1800 Retort and offgas temperatures became badly skewed. Started shut down. Aborted C1023.

1800 - Retort empty. Clinker found on center air header from north wall
 2400 over first three rows of bayonets extending to the east header covering first three rows of bayonets. Clear area between clinker and north and east wall.

3/28/67

Normal turnaround maintenance items.
 Reinstalled the longer bayonets (original 54 bayonets).
 Adjusted bed height to 7 feet.
 Removed vertical baffles to give the six compartments below A/D.
 Installed piping to add dilution gas to combustion zone.
 Added 1 1/4 inch skirt to northwest feed chute.

0015 Retort full. Started lineout shale circulation at 8.4 tons per hour.

0045 Calibrated dilution orifice meter.

0200 Started flow of string into top of retort to keep running analysis of shale flow. Calibrated.

0425 Fired line burner at 400 F.

0440 Line burner turned off. Gas chromatography would not work properly.

- 0845 Gas Chromatograph still not working. Trouble with counter head for string test on northeast section.
- 1400 Gas Chromatograph still not working. Fired line burner at 400 F. Analytical lab will run vent gas samples in laboratory annex.
- 1415 Increased line burner temperature to 1,300 F for C1024 startup.
Conditions to be:
Shale - 8.4 tons per hour.
Air - 1,035 SCFM.
Recycle - 2,170 SCFM
Dilution to be 2,500 SCF/T

Startup sequence:

	O ₂ , Vol. %	Air, SCFM	Recycle SCFM	Dilution SCFM	Shale t/hr	Temperatures, °F				
						Line Burner	TR1-1	TR1-15	TR2-	
1506	7.5	1,035	2,170	--	8.4	1,300	150	230	125	
1517	5.9	970	2,170	--	8.4	1,300	--	--	--	
1521	5.4	940	2,170	--	8.4	1,300	--	--	--	
1531	4.4	880	2,170	--	8.4	1,300	Center heating faste			
1538	ESP on.									
1548	3.4	830	1,600	--	8.4	800	--	--	--	
1600	--	830	1,600	350	8.4	800	--	--	--	
1602	--	725	1,600	350	8.4	800	--	--	--	
1620	Increased recycle to west header.									
1645	Equalized recycle flow to all headers.									
1649	--	725	2,000	350	8.4	800	--	--	--	
1723	--	725	2,000	350	8.4	900	--	--	--	
1736	--	725	2,000	350	8.4	1,000	Retort cooling off.			
1824	--	725	2,200	350	8.4	1,000	--	--	--	
1842	--	725	2,200	350	8.4	1,100	--	--	--	
1900	--	725	2,200	350	8.4	1,200	Retort cooling off.			
1945	Increased air flows to east and center to increase temperatures.									
2010	2.1	725	2,000	350	8.4	1,200	--	--	--	
2046	Reduced recycle to west header.									
2116	--	760	1,800	350	8.4	1,200	--	--	--	
2121	Level in retort dropped suddenly - bridge fell.									
2136	--	800	1,800	300	Raw shale increased to retain level.	1,200	--	--	--	
2148	--	--	--	--	8.4	--	--	--	--	
2155	--	800	1,200	300	8.4	1,200	--	--	--	
2208	Apparently lost fire in retort - Started shutdown. Aborted C1024.									

3/29/67

- 0001 - Retort was free of clinkers.
- 2130 Normal turnaround items.
- 2130 Started filling retort.

3/30/67

- 0045 Retort full - Started circulation lineout at 8.4 tons per hour.
- 0400 Started string tests in top of retort.
- 0630 - Had trouble with top pressure controller, air and recycle controllers.
- 0710 Held up firing until controllers corrected by instrumentmen.
- 0905 Fired line burner at 400 F for startup of C1025.
- 0915 Increased line burner temperatures to 1,300 F.

Startup sequence:

	O ₂ , Vol. %	Air, SCFM	Recycle, SCFM	Dilution, SCFM	Shale Rate Tons/Hour	Temperatures, °F			
						Line Burner	TR1-1	TR1-15	TR5-5
0915	--	1,035	2,170	--	8.4	1,300	Several technical memos		
1020	6.7	1,000	2,170	--	8.4	1,300	taking pertinent data		
1029	5.9	975	2,170	--	8.4	1,300	on separate sheets.		
1033	4.6	925	2,170	--	8.4	1,300	--	--	--
1035	4.5	900	2,170	80	8.4	1,300	ESP turned on.		
1047	3.9	875	2,170	160	8.4	1,300	--	--	--
1055	--	875	2,170	220	8.4	1,300	--	--	--
1100	2.9	825	2,170	220	8.4	1,300	--	--	--
105	Reduced recycle to center header.								
1108	--	825	2,000	220	8.4	1,300	--	--	--
1133	2.4	875	2,000	220	8.4	1,300	--	--	--
1150	2.2	925	2,000	220	8.4	1,300	--	--	--
1210	--	925	2,000	290	8.4	1,300	--	--	--
1200 -	Vibrator feeder No. 6 off - Raised raw shale feed to bring up level.								
1213									
1225	1.8	875	2,000	290	8.4	1,300	--	--	--
1238	0.8	825	2,000	290	8.4	1,300	--	--	--
1240	--	775	2,000	400	8.4	1,200	--	--	--
1251	--	775	1,950	400	8.4	1,100	--	--	--
1317	Equalized recycle to all headers.								
1325	--	825	1,950	400	8.4	1,000	--	--	--
1356	--	800	1,950	400	8.4	1,000	--	--	--
1419	--	800	1,850	400	8.4	1,000	--	--	--
1430	Increased recycle to center header.								
1527	--	800	1,825	400	8.4	1,000	--	--	--
1622	--	800	1,755	400	8.4	1,000	--	--	--
1857	--	800	1,680	400	8.4	1,000	--	--	1,600
2045	--	775	1,680	400	8.4	1,000	--	--	--

- 2100 Started C1025-1.
- 2148 Center is cooling off - Raised air to 800 SCFM.
- 2350 TR1-15 back up to 1,050 F.

3/31/67

- 0010 TR5-5 offgas temperature is 6 F hotter than other offgas temperatures.

- 0020 Reduced recycle to 1,650 SCFM.
- J138 TR5-2 = 138 F TR1-1 = 1,190 F
TR5-3 = 137 F TR1-15 = 1,440 F
TR5-4 = 137 F TR2-1 = 1,110 F
TR5-5 = 148 F
- 0353 High level on Gamm-O-Tron shut off belts - East and west side heating up fast - TR5-5 is 158 F. Retort bottom pressure = 9.3 inches H₂O - Reduced recycle to 1,400 SCFM.
- 0400 Bridge occurred at inlet to spent shale Screw No. 1. Reduced air to 300 SCFM while cleaning out bridge. When air reduced, line burner temperature went to 1,600 F - Reduced dilution gas until line burner temperature began to decrease.
- 0420 Started bringing back on conditions.
- 0432 Back on conditions.
Air - 780 SCFM
Recycle - 1,600 SCFM
Dilution - 400 SCFM
- 0710 Switched from Bin No. 1 to No. 3. Shale in No. 1 looked wet.
- 0740 South Center spent shale pipe alarm sounded indicating empty pipe - Sounded full with hammer test.
- 0800 No measured water since the decanter was put into system 17 hours previously. Put 3 feet of water in water tank and started circulating pump to decanter.
- 0843 North west spent shale pipe alarm sounded. Pipe empty - beat on pipe and shale began to flow through pipe. High level on Gamm-O-Tron (LR-3) occurred.
- 0900 End C1025-1
Started C1025-2
- 0908 Level in retort dropped as indicated on LR-3. North west spent shale pipe empty. Increased raw shale rate to regain retort level.
- 0928 Northwest spent shale pipe full as indicated by light. Level in retort fell (LR-3). Increased raw shale rate to reestablish level.
- 1007 Removed all air from east header - high temperatures.
- 1016 Northwest spent shale light went on. All vibrators turned on spent shale with-drawal system. Light went out indicating full pipe.
- 1023 - West vibrators on during this period.
1050
- 1200 West and center above A/D cold - Offgas temperatures split about 30 F.
- 1217 Increased air to 850 SCFM.

- 1230 O₂ = 1.6%
- 1355 Increased air to 900 SCFM.
Increased recycle 100 SCFM.
- 1420 Temperatures skewed badly.
Started shutdown - Aborted C1025-2.
- 1420 - Clinkers found below the A/D - Some were adhering to the wall. A
2300 large clinker was resting on the southwest spent shale pipe. Clinkers
were also resting on the center and east headers and bayonets.

4/1/67

Normal maintenance items.
36 bayonet A/D installed (See Drawing RB 419)
Bed height = 7 feet

4/2/67

- 0010 Started recycle blower.
- 0045 Started filling retort.
- 0550 Retort full. Started circulating shale at 8.4 tons per hour.
- 0600 Started string test.
- 0945 Fired line burner at 400 F for C1026.
- 1000 Increased line burner temperature to 1,300 F.
- 1015 Difficulties with line burner thermocouples.
Line burner turned off.
- 1118 Line burner on - Using manual control as automatics not working properly.
- 1118 - Difficulties with line burner kicking off even on hand control due
1241 to temperature reaching 1,600 F and the override cutting off line burner.
- 1241 Line burner on at 1,300 F - for C1026.
Startup conditions same as C1021.
- 300 mass rate
5,000 to 5,200 SCF/T AEOC - Air equivalent oxygen consumption.
7,500 SCF/T air initially.
15,700 SCF/T recycle.

Sequence of startup.

	O ₂ , Vol. %	Air, SCFM	Recycle, SCFM	Raw Shale Tons/Hour	Line Burner	Temperatures, °F		
						TR1-1	TR1-15	TR2-1
1346	5.55	975	2,170	8.4	1,300	--	--	--
1250	2.25	865	2,170	8.4	1,300	--	--	--
1339	2.3	800	2,170	8.4	1,300	--	--	--
1409	1.8	765	2,170	8.4	1,300	--	--	--
1530	No. 2 Screw Conveyor kicked off - back on after 5 minutes.							
1539	1.1	765	2,170	8.4	1,300	1,135	1,270	385
1600	1.1	765	2,170	8.4	1,300	1,120	985	355
	TR5-2 = 134 F; TR5-3 = 134 F; TR5-4 = 133 F; TR5-5 = 136 F.							
1620	Screw conveyor No. 2 failed again.							
1640	--	765	2,170	8.4	1,300	1,125	480	500
1653	0.85	765	2,170	8.4	1,300	--	--	--
1715	Screw Conveyor No. 2 off again - Air reduced.							
1718	Screw Conveyor back on. Air back to 765 SCFM.							
1800	0.9	765	2,170	8.4	1,300	1,050	740	540
1837	Screw conveyor No. 2 kicked off. Back on.							
1900	0.8	765	2,170	8.4	1,300	1,130	940	905
	Offgas temperatures split 12 F - East side hotter.							
2010	0.6	725	2,170	8.4	1,300	--	--	--
2023	--	--	2,170	8.4	1,100	--	--	--
2040	--	--	2,170	9.5 to 10.5	1,100	1,885	805	1,060

2100 Temperatures skewed badly - Started shutdown. Aborted C1026. Experienced two stoppage of shale above Screw Conveyor No. 1

4/3/67

0220 Retort empty - Clinker found over all the bayonets on east header - Clinker extended over to the center header and covered most of the bayonets on the first two yokes from the north. The bridged material did not extend to the wall at any place.

The next run will be made with 1 to 2 1/2 inch shale using the original 36 bayonet A/D design with the three over three header layout and with the stainless steel liner.