GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

1513018014

Date 6-24-67

Purpose: To determine operability and yield with [illegible] shale with hot air (without dilution)

GENERAL	
Run No.	C1047-2
Length, hours	12
Retort Type Number	RC VII
Oil Recovery System Number	C-1
Total Raw Shale Charged, ~~lbs.~~ Tons	99.11
Bed Height above Dist., ft	9½
Type Air Dist.	HD XI
Bed Below Air Dist., ft	6
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	299
Spent Shale, % of RS	81.6
Liquid Product, lbs/hr	1725.1
Oil Collected, gal/ton RS	24.6
Air, SCF/ton RS (dry)	4320
Total Recycle*, SCF/ton RS(wet)	13900
Dilution, SCF/ton RS (wet)	—
Calc.Vent Gas SCF/ton RS(dry)	5830
Gas Losses, SCF/ton RS(wet)	410
Propane, SCF/ton RS	20.2
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	139
Spent Shale, F	503
Raw Shale, °F	91
Recycle Gas Inlet, °F	280
Dilution Gas Inlet, °F	—
Air Inlet, °F	144
Retort Air Inlet, F	144
Heat of Comb. MBtu/ton RS	410
Heat Lost, MBtu/ton RS	12
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	28.8
Oil, Wt %	11.0
Water, Wt %	1.0
Gas, Wt %	2.0
Mineral CO_2, Wt %	18.1
Ash, Wt %	66.5
Moisture, Wt % (Uncrushed)	
Carbon (Total), Wt %	17.7
Hydrogen (Total), Wt %	1.78
Nominal Size Range, inches	¼"-2½"
5 % passing thru	0.371
98 % passing thru	2.50
D_a	1.081
D_v	1.465
Line Burner °F	870

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.0
Mineral CO_2, Wt %	16.6
Ash, Wt %	81.5
Carbon (total), Wt %	6.89
Organic Carbon, Wt %	2.36
Hydrogen (total), Wt %	0.18
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	97.4
Density, lb/gal	7.768
Gravity, API	20.2
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	5.7
Oil, lbs/MSCF(dry)**	0.111
Analysis (dry)	
CO_2, Vol %	23.9
O_2, Vol %	0.0
N_2 + Argon, Vol %	58.6
CH_4, Vol %	2.4
CO, Vol %	4.0
H_2, Vol %	6.5
Other, Vol %	4.6
Gross Heating Value(calc),Btu/SCF	110.2
Carbon (Total), lbs/MSCF (dry)	12.3
Hydrogen (Total), lbs/MSCF (dry)	0.76
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	85.5
Oil in Gas**, Vol % RSFA	0.3
Oil in Spent Shale, Vol % RSFA	0.0
Total Oil Meas., Vol % RSFA	85.8
Carbonate Decomposition, %	25.2
Water Recovered, lb/ton RS	59.1
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	RS 100
Overall Balance, %	99.7
Carbon Balance, % - Organic	96.0
Carbon Balance, % - Total	98.2
Hydrogen Balance, % - Organic	90.0
Hydrogen Balance, % - Total	92.0
Water Balance, %	91.9
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.33
ΔP Above Air Dist., in H_2O/ft	0.39
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Operations good. 3 high levels on LR-3 - [illegible] line burner temperatures to even out air distribution temperatures.

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 86 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed [signature]   DATE July 12, 1967

OSRC-10

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 .100
 ..D< C:047-2 6-24-67

   YIELDS
DRY      8.549E 01   DRYGAS   5.834E 03   MISTFA   2.905E-01
H2       3.792E 02   OTHER    2.683E 02   UNRETO   0.0
CH4      1.400E 02   O2       0.0         SSY      8.160E 01
CO       2.333E 02   CO2DEC   2.517E 01   MH2O     5.906E 01
CO2      1.394E 03   OILCOL   2.462E 01

B. METERED GAS RATES
RECG     1.393E 04   DIL      0.0         WVENTG   5.905E 03
AIR      4.320E 03   TRECG    1.393E 04   TGF      0.0

C. MOL WT & HEATING VALUE OF VENT GAS
MWWG     2.928E 01   HVGT     6.428E 02   MWDG     3.063E 01
GBTU     1.102E 02

D. COMBUSTION PRODUCTS
CO2C     5.552E 02   COC      2.171E 02   H2OC     2.345E 01
CHR      9.301E 00   COMBCP   9.523E 00

E. MATERIAL IN
ORGCIN   2.571E 02   RSR      2.991E 02   ORH2IN   3.379E 01
MATIN    2.354E 03

F. MATERIAL OUT
ORGCVG   4.745E 01   COKEC    3.848E 01   UNRETH   0.0
ORGCOL   1.608E 02   ORH2VG   7.135E 00   COKEH    2.024E 00
UNRETC   0.0         ORH2OL   2.123E 01   ORCOLP   6.256E 01
ORCVGP   1.846E 01   ORCSSP   1.497E 01   HCCVGP   8.935E 00

G. MATERIAL BALANCES
OVALL    9.967E 01   ORH2     8.993E 01   O2BAL    9.907E 01
ASH      0.0         TC       9.815E 01   WATER    9.190E 01
ORGC     9.599E 01   TH2      9.200E 01   GASL     6.284E 02
ASHB    -1.000E 00

H. HEAT IN
QCOMB    4.104E 05   QH2OC    1.053E 04   QAIR     4.222E 03
QPROP    5.090E 01   QOILC    1.339E 04   QRCYL    5.744E 04
QSUMIN   4.960E 05

I. HEAT OUT
QMCO2D   1.476E 05   QKEROD   1.040E 05   QH2OV    4.540E 04
QLIQO    3.409E 03   QOFGAS   2.094E 04   QSS      1.566E 05
QGASL    5.863E 03   LBLOSS   0.0         HETLOS   1.220E 04
QSUMOT   4.960E 05

J. MISCELLANEOUS
ORCSS    2.35[illegible]E 00   VPOIL    1.114E-01   TGL      2.967E 03
VPM      5.706E 00   WCG      1.071E 01   PROP     2.019E 01

END MESSAGE


END OUTPUT



-GOODBYE
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HEAT AND MATERIAL BALANCE FOR PILOT RETORTS – DATA SHEET

PROGRAM ID: 2080 | USER IDENTIFICATION: C1047-2 R-1 6-24-67

1	WRS: 1.0	OLRS: 11.0	TRS: 91	B: -1	MRS: 16518.4		← RAW SHALE
2	FA: 28.8	GRS: 2.0	CORS: 18.1	XA: 55.22			← RAW SHALE
3	ASRS: 65.5	CRS: 17.7	HRS: 1.78	BP: 24.38	TOG: 139		← RAW SHALE
4	CRA: 595.4	MFA: 1.0	TA: 144	PA: 124	WA: 0.14	LBHL: 0	← AIR
5	CRRG: 1928.2	MFRG: 1.0	TRG: 280	PRG: 73	CRTG: 0.0	MFTG: 0.0	← RECYCLE A TOTAL GAS
6	CRDG: 0.0	MFDG: 0.0	TDG: 0	PDG: 0			← DILUTION G
7	P: 3.2	TP: 0.4	PP: 128.4	W: 166.9	N: 0.0		← PROPANE A NUCLEATIN AGENT
8	WSS: 0.5	OLSS: 0.0	GSS: 0.0	SS: 0.0			← SPENT SHALE
9	COSS: 16.6	ASSS: 81.5	CSS: 6.89	HSS: 0.18	TSS: 503		← SPENT SHALE
10	OILLP: 1579.6	COL: 84.1	HOL: 11.1	DOL: 7.768	WLP: 145.5		← LIQUID PRODUCT
11	CRVG: 863.9	MFVG: 1.0	TVG: 270	WG: 0.0	OILM: 0.0	M: 0	← VENT GAS
12	CG: 12.3	H: 0	COOG: 23.9	OG: 0.0	NG: 58.6		← VENT GAS
13	MEG: 3.4	COG: 4.0	HHG: 6.5	OTG: 4.6	HG: 0.76		← VENT GAS
14	CRVP: 2.7	VPMF: 2.19	TVP: 155	PVP: 41			← VENT PURGE
15	TVPC: 86	VPOIL: 35.9	VPW: 2.3	GL: 86.9			← VENT PURGE

OPTIONS:

1. *B Enter "1" to Calculate with Spent Shale Rate and Ash Analyses,*
   Or "0" to Calculate with Measured Rates,
   Or "-1" to Calculate with Raw Shale Rate and Ash Analyses.
2. *M Enter "1" to Calculate with Measured Moisture and Mist,*
   Or "0" to Calculate from Vent Purge Data.
3. *H Enter "1" to Calculate using Retort #2,*
   Or "0" to Calculate using Retort #3.

C1047-2 6-26-67 EA

Mesh	wt's gms	wt's %
8	235.5	34.0
14	210.2	30.4
28	95.1	15.7
35	28.7	4.1
48	15.7	2.3
65	16.4	2.4
100	17.2	2.5
150	14.0	2.0
PAN	59.5	8.6
TOTAL	692.3	100.0

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-25-67 Run No. C 1047-2

Sample Time: RS 0615 ; SS _____

FISCHER ASSAY

RAW SHALE	SPENT SHALE	
28.6	0.0	Gal/Ton
.912	0.0	S.G., g/ml
10.9	0.0	Oil, wt %
1.6	0.5	Water, wt %
85.3	99.5	Sp. Shale, ~~wt~~ %
2.0	0.0	Gas & Loss, wt %
Slight	None	COKING TENDENCY

RETORT SHALE MOISTURE

Est 10 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.77 wt %

	RAW SHALE	SPENT SHALE	
MINERAL CO_2	18.1	16.6	wt %
ASH (SHALE)	66.3	81.5	wt %
MOISTURE	0.24	0.07	wt %
CARBON	16.7	6.89	wt %
HYDROGEN	1.75	0.18	wt %
BENZENE EXTRACTABLES	.	.	wt %

SHALE RICHNESS DISTRIBUTION (See attached graph)

SCREEN ANALYSIS (See back of this sheet)

All results are "as received" unless noted. "Moisture" designates the moisture content of the -48 mesh material used for "Ash", "Mineral CO_2", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS _____

DATE COMPLETED JUN 27 1967 CHECKED BY RCP

OSRC-12A

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-25-67 Run No. C 1047-2

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	2.6					
GRAVITY, °API	20.2					
OIL ASH, wt %						

○ DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 431.3

WATER VOL, ml ~~431.3~~ 57.0

GRAVITY OIL, °API 41.9

VENT GAS

⊗ MAJOR COMPONENTS

CO_2	13.9	vol %
O_2	0.0	"
N_2	57.9	"
CH_4	2.4	"
CO	4.0	"
H_2	6.5	"
Ar	0.7	"
Others	4.6	"

⊗ CARBON, ~~16.1~~ 12.8 lbs/MSCFDG

○ C_1 thru C_4, plus n-Pentane

CH_4	.	vol %
C_2H_4-C_2H_6	.	"
C_3H_8	.	"
C_3H_6	.	"
i C_4H_{10}	.	"
n C_4H_{10}	.	"
øC_3H_6	.	"
n C_5H_{12}	.	"

HYDROGEN, ~~0.83~~ 0.76 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUN 26 1967 CHECKED BY REP

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C 1047-2 SAMPLE NO. 1 DATE 6-29-[illegible]

UNIT [illegible] DESCRIPTION TY [illegible]

APPROX. SHALE SIZE [illegible] SHAKING TIME [illegible] ANALYSIS BY [illegible]

TOTAL SAMPLE WT. GROSS 79.3 − TARE 6.0 = NET 73.3

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50		20.3	16.7	3.6
	2.00		31.0	20.2	10.8
	1.50		46.9	23.4	23.5
	1.05		31.4	19.2	12.2
	0.742		29.2	20.5	8.7
	0.525		25.7	19.5	6.2
	0.371		22.1	19.2	2.9
	0.263	3	20.6	17.4	3.2
	0.185	4	19.7	19.4	.3
	0.131	6	19.5	19.3	.2
	0.093	8	20.4	20.4	.0
	0.065	10	19.7	19.2	.1
	PAN		22.3	20.9	1.4
TOTAL ON SCREENS AND PAN					73.1
LOSS (BY DIFFERENCE)					−.2
TOTAL SAMPLE WEIGHT					73.3

SCREEN SIZE	Di *	1/Di	% RETAINED	CUM. % RETAINED	% PASSING
4.25					
3.00	(3.125)	(0.3200)			
2.50	(2.625) 2.750	(0.3809) 0.3636	4.91		95.08
2.00	2.250	0.4444	14.73		80.35
1.50	1.750	0.5714	32.06		48.29
1.05	(1.087) 1.275	(0.9199) 0.7843	16.64		31.65
0.742	0.896	1.116	11.87		19.78
0.525	0.634	1.577	9.82		9.96
0.371	0.448	2.232	3.96		6.00
0.263	0.317	3.154	3.00		3.00
0.185	0.224	4.464	0.41		2.59
0.131	0.158	6.329	0.27		2.32
0.093	0.112	8.928	0.00	97.67	2.32
0.065			0.14		2.18
PAN			1.91		0.27
LOSS			0.27	—	0.00
TOTAL			99.99	—	—
			—	—	—

* NUMBERS IN PARENTHESES SHOULD BE USED WHEN THESE SCREEN SIZES REPRESENT THE TOP OF THE SHALE SIZE RANGE.

$\sum_{+8m}^{m} Di$	1.43073	$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$	0.903581	$\sum_{+8m}^{m} Xi / Di$	
Da	1.08091	$\sum_{+8m}^{m} Xi\ Di$	
Dv	1.46486		

REMARKS: [illegible] PAN

IT FIXED PLEASE

OSRC-4