GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

1513018633

Date 7-4-67

Purpose: To determine operability and yield with 1/4-2 1/2 inch shale at 500 mass rate and with hot air. (w/o dilution gas.)

GENERAL	
Run No.	R-1 C1049-8
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-7
Total Raw Shale Charged, ~~lbs.~~ TONS	165.83
Bed Height above Dist., ft	9½
Type Air Dist.	ADXI
Bed Below Air Dist., ft	6
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	501
Spent Shale, % of RS	82.5
Liquid Product, lbs/hr	7676.0
Oil Collected, gal/ton RS	22.9
Air, SCF/ton RS (dry)	4680
Total Recycle*, SCF/ton RS(wet)	12250
Dilution, SCF/ton RS (wet)	—
Calc. Vent Gas SCF/ton RS(dry)	6312
Gas Losses, SCF/ton RS(wet)	574
Propane, SCF/ton RS	27.1
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	145
Spent Shale, F	512
Raw Shale, °F	96
Recycle Gas Inlet, °F	256
Dilution Gas Inlet, °F	—
Air Inlet, °F	133
Retort Air Inlet, F	133
Heat of Comb. MBtu/ton RS	420
Heat Lost, MBtu/ton RS	26
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	29.2
Oil, Wt %	11.1
Water, Wt %	0.7
Gas, Wt %	2.2
Mineral CO_2, Wt %	17.3
Ash, Wt %	67.7
Moisture, Wt % (Uncrushed)	1.05
Carbon (Total), Wt %	17.5
Hydrogen (Total), Wt %	1.85
Nominal Size Range, inches	1/4"-2 1/2"
5 % passing thru	0.371
98 % passing thru	2.50
Da	1.014
Dv	1.361
Line Burner °F	850

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.3
Mineral CO_2, Wt %	16.1
Ash, Wt %	82.1
Carbon (total), Wt %	6.75
Organic Carbon, Wt %	2.36
Hydrogen (total), Wt %	0.23
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	94.1
Density, lb/gal	7.809
Gravity, API	19.4
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	5.9
Oil, lbs/MSCF(dry)**	0.121
Analysis (dry)	
CO_2, Vol %	23.6
O_2, Vol %	0.3
N_2 + Argon, Vol %	58.7
CH_4, Vol %	2.4
CO, Vol %	4.1
H_2, Vol %	6.7
Other, Vol %	4.2
Gross Heating Value(calc),Btu/SCF	152
Carbon (Total), lbs/MSCF (dry)	13.4*
Hydrogen (Total), lbs/MSCF (dry)	1.17*
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	78.5
Oil in Gas**, Vol % RSFA	0.3
Oil in Spent Shale, Vol % RSFA	2.2
Total Oil Meas., Vol % RSFA	81.0
Carbonate Decomposition, %	23.3
Water Recovered, lb/ton RS	60.0
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	R.S. 100
Overall Balance, %	100.2
Carbon Balance, % - Organic	97.9
Carbon Balance, % - Total	99.9
Hydrogen Balance, % - Organic	87.2
Hydrogen Balance, % - Total	94.6
Water Balance, %	128.9
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.81
ΔP Above Air Dist., in H_2O/ft	0.90
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Increased recycle rate to 2850 SCFM in 3 steps — Product temperatures went to about 210°F. Reduced recycle rate to 2720 SCFM.

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 84 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. Turner DATE July 18, 1967

OSRC-10
Revised 7/19/66

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//A100
2080, C1049-8 R-1 7-4-67

A. YIELDS
FAY      7.846E 01    DRYGAS   6.312E 03    MISTFA   3.352E-01
H2       4.229E 02    OTHER    2.651E 02    UNRETO   7.429E-01
CH4      1.515E 02    02       1.894E 01    SSY      8.246E 01
CO       2.588E 02    CO2DEC   2.326E 01    MH20     6.006E 01
C02      1.490E 03    OILCOL   2.291E 01

B. METERED GAS RATES
RECG     1.225E 04    DIL      0.0          WVENTG   6.518E 03
AIR      4.683E 03    TRECG    1.225E 04    TGF      0.0

C. MOL WT & HEATING VALUE OF VENT GAS
MWWG     2.910E 01    HVGT     9.603E 02    MWDG     3.047E 01
GBTU     1.521E 02

D. COMBUSTION PRODUCTS
C02C     7.350E 02    COC      2.404E 02    H2OC     1.072E 01
CHR      2.571E 01    COMBCP   1.198E 01

E. MATERIAL IN
ORGCIN   2.581E 02    RSR      5.005E 02    ORH2IN   3.601E 01
MATIN    2.384E 03

F. MATERIAL OUT
ORGCVG   6.328E 01    COKEC    3.745E 01    UNRETH   1.831E-01
ORGCOL   1.505E 02    ORH2VG   8.672E 00    COKEH    2.687E 00
UNRETC   1.387E 00    ORH2OL   1.986E 01    ORCOLP   5.829E 01
ORCVGP   2.452E 01    ORCSSP   1.505E 01    HCCVGP   1.254E 01

G. MATERIAL BALANCES
OVALL    1.002E 02    ORH2     8.719E 01    02BAL    1.035E 02
ASH      0.0          TC       9.988E 01    WATER    1.289E 02
ORGC     9.785E 01    TH2      9.456E 01    GASL     5.739E 02
ASHB    -1.000E 00

H. HEAT IN
QCOMB    4.198E 05    QH20C    1.064E 04    QAIR     3.193E 03
QPROP    4.753E 01    QOILC    1.252E 04    QRCYL    4.236E 04
QSUMIN   4.886E 05

I. HEAT OUT
QMC02D   1.304E 05    QKEROD   1.057E 05    QH20V    3.865E 04
QLIQO    3.285E 03    QOFGAS   1.999E 04    QSS      1.601E 05
QGASL    5.379E 03    LBLOSS   0.0          HETLOS   2.501E 04
QSUMOT   4.886E 05

J. MISCELLANEOUS
ORCSS    2.355E 00    VPOIL    1.211E-01    TGL      4.698E 03
VPM      5.873E 00    WCG      1.099E 01    PROP     2.712E 01

END MESSAGE


END OUTPUT
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HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	C1049-8 R-1 7-4-67						
	WRS	OLRS	TRS	B	MRS			RAW SHALE
1	0.7	11.1	96	-1	27638.5			
	FA	GRS	CORS	XA				
2	29.2	2.2	17.3	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	67.7	17.5	1.85	24.37	145			
	CRA	MFA	TA	PA	WA	LBHL		AIR
4	1080.6	1.0	133	108	0.14	0		
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		RECYCLE A TOTAL GAS
5	2829.6	1.0	256	68	0.0	0.0		
	CRDG	MFDG	TDG	PDG				DILUTION G
6	0.0	0.0	0	0				
	P	TP	PP	W	N			PROPANE A NUCLEATIN AGENT
7	7.19	0.4	128.6	293.3	0.0			
	WSS	OLSS	GSS	SS				SPENT SHALE
8	0.5	0.1	0.0	0.0				
	COSS	ASSS	CSS	HSS	TSS			
9	16.1	82.1	6.75	0.23	512			
	OILLP	COL	HOL	DOL	WLP			LIQUID PRODUCT
10	2472.3	84.1	11.1	7.809	203.7			
	CRVG	MFVG	TVG	WG	OILM	M		VENT GAS
11	1545.8	1.0	254	0.0	0.0	0		
	CG	H	COOG	OG	NG			
12	13.4	0	23.6	0.3	58.7			
	MEG	COG	HHG	OTG	HG			
13	2.4	4.1	6.7	4.2	1.17			
	CRVP	VPMF	TVP	PVP				VENT PURGE
14	5.4	2.2	171	28				
	TVPC	VPOIL	VPW	GL				
15	84	53.9	3.4	75.7				

used sample for Test N-7

used sample for Test No 7

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.

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7/4/67 Run No. C 1049-8

Sample Time: RS 2P.00 ; SS _____

FISCHER ASSAY		
(X) RAW SHALE	(X) SPENT SHALE	
28.9	0.3	Gal/Ton
.913	.—	S.G., g/ml
11.0	0.1	Oil, wt %
1.7	0.5	Water, wt %
85.1	99.4	Sp. Shale, ~~wt~~ %
22	0.0	Gas & Loss, wt %
slight	None	COKING TENDENCY

( ) RETORT SHALE MOISTURE

1.05 wt %

(X) RAW SHALE FISCHER ASSAY MOISTURE

0.68 wt %

MINERAL CO_2		
(X) 17.2	(X) 16.1	wt %
ASH (SHALE)		
(X) 67.2	(X) 82.1	wt %
MOISTURE		
(X) 0.18	(X) 0.03	wt %
CARBON		
(X) 17.4	(X) 6.75	wt %
HYDROGEN		
(X) 1.84	(X) 0.23	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 JUL 6 1967 CHECKED BY REP

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7/4/67 Run No. C1049-8

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
EGB	1	2	3	4	1	2
⊗ WATER, wt %	5.9					
⊗ GRAVITY, °API	19.4					
⊗ OIL ASH, wt %						

◯ DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

EGB ⊗

OIL WT, g 647.0 ~~658.5~~

WATER VOL, ml 11.5

GRAVITY OIL, °API 42.5

VENT GAS

PW ◯ MAJOR COMPONENTS

CO_2	23.6	vol %	CH_4	.	vol %
O_2	0.3	"	C_2H_4-C_2H_6	.	"
N_2	58.0	"	C_3H_8	.	"
CH_4	2.4	"	C_3H_6	.	"
CO	4.1	"	i C_4H_{10}	.	"
H_2	6.7	"	n C_4H_{10}	.	"
Ar	0.7	"	$\emptyset C_3H_6$	.	"
Others	4.2	"	n C_5H_{12}	.	"

◯ CARBON, N/C lbs/MSCFDG ◯ HYDROGEN, . lbs/MSCFDG

COMMENTS

DATE COMPLETED JUL 6 1967 CHECKED BY REP

OSRC-12B

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C1049-8- SAMPLE NO. 8 DATE 7-4-67

UNIT RETORT #3 DESCRIPTION Tyler

APPROX. SHALE SIZE _____ SHAKING TIME 10 MIN. ANALYSIS BY _____

TOTAL SAMPLE WT. GROSS 77.8 – TARE 6.6 = NET 71.2

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50			16.7	0
	2.00		28.6	20.2	8.4
	1.50		46.4	23.5	22.9
	1.05		33.8	19.2	14.6
	0.742		31.1	20.5	10.6
	0.525		25.7	18.6	7.1
	0.371		22.4	19.2	3.2
	0.263	3	20.6	18.4	2.2
	0.185	4	19.8	19.4	.4
	0.131	6	19.5	19.4	.1
	0.093	8	20.6	20.5	.1
	0.065	10	19.5	19.2	.3
	PAN		22.2	21.0	1.2
TOTAL ON SCREENS AND PAN					71.1
LOSS (BY DIFFERENCE)					.1
TOTAL SAMPLE WEIGHT					71.2

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	0		100.0
2.00	2.250	0.4444	11.81		88.19
1.50	1.750	0.5714	32.28		55.96
1.05	(1.087) 1.275	(0.9199) 0.7843	20.53		35.43
0.742	0.896	1.116	14.91		20.52
0.525	0.634	1.577	9.99		10.53
0.371	0.448	2.232	4.50		6.03
0.263	0.317	3.154	3.09		2.94
0.185	0.224	4.464	0.56		2.38
0.131	0.158	6.329	0.14		2.24
0.093	0.112	8.928	0.14	97.80	2.10
0.065			0.42		1.69
PAN			1.69		0
LOSS					
TOTAL					

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

REMARKS: _____

$\sum_{+8m}^{m} Di$		$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$		$\sum_{+8m}^{m} Xi / Di$	0.96586
Da	1.0136	$\sum_{+8m}^{m} Xi\ Di$	1.33237
Dv	1.3609		

98.29
.92
97.80