GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

1513018027

Date 7-1-67

Purpose: To determine oil yield with 1 or 2 inch shale at 500 megawatts and with hot dist. (w/o dilution gas)

GENERAL	
Run No.	C1049-2
Length, hours	12
Retort Type Number	RC VII
Oil Recovery System Number	C-2
Total Raw Shale Charged, ~~lbs.~~ Tons	162.42
Bed Height above Dist., ft	9½
Type Air Dist.	AD XI
Bed Below Air Dist., ft	6
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft²)	490
Spent Shale, % of RS	84.4
Liquid Product, lbs/hr	2297.7
Oil Collected, gal/ton RS	20.2
Air, SCF/ton RS (dry)	4720
Total Recycle*, SCF/ton RS(wet)	11930
Dilution, SCF/ton RS (wet)	—
Calc. Vent Gas SCF/ton RS(dry)	6004
Gas Losses, SCF/ton RS(wet)	157
Propane, SCF/ton RS	19.5
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	142
Spent Shale, F	542
Raw Shale, °F	97
Recycle Gas Inlet, °F	765
Dilution Gas Inlet, °F	—
Air Inlet, °F	140
Retort Air Inlet, F	140
Heat of Comb. MBtu/ton RS	437
Heat Lost, MBtu/ton RS	51
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	25.3
Oil, Wt %	9.6
Water, Wt %	0.7
Gas, Wt %	2.2
Mineral CO_2, Wt %	17.8
Ash, Wt %	68.8
Moisture, Wt % (Uncrushed)	1.0 Est.
Carbon (Total), Wt %	16.1
Hydrogen (Total), Wt %	1.67
Nominal Size Range, inches	¼"-2½"
5 % passing thru	0.371
98 % passing thru	2.50
Da	1.099
Dv	1.478
Line Burner °F	860

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.0
Mineral CO_2, Wt %	16.6
Ash, Wt %	81.5
Carbon (total), Wt %	6.80
Organic Carbon, Wt %	2.27
Hydrogen (total), Wt %	0.23
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	93.2
Density, lb/gal	7.788
Gravity, API	19.8
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	6.2
Oil, lbs/MSCF(dry)**	0.116
Analysis (dry)	
CO_2, Vol %	23.5
O_2, Vol %	0.1
N_2 + Argon, Vol %	62.2
CH_4, Vol %	2.4
CO, Vol %	4.1
H_2, Vol %	5.8
Other, Vol %	1.9
Gross Heating Value(calc),Btu/SCF	142
Carbon (Total), lbs/MSCF (dry)	12.9
Hydrogen (Total), lbs/MSCF (dry)	1.11
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	79.9
Oil in Gas**, Vol % RSFA	6.4
Oil in Spent Shale, Vol % RSFA	0.0
Total Oil Meas., Vol % RSFA	80.3
Carbonate Decomposition, %	21.3
Water Recovered, lb/ton RS	58.3
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	R.S.100
Overall Balance, %	99.7
Carbon Balance, % - Organic	100.6
Carbon Balance, % - Total	101.6
Hydrogen Balance, % - Organic	90.1
Hydrogen Balance, % - Total	95.8
Water Balance, %	112.7
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.71
ΔP Above Air Dist., in H_2O/ft	0.66
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Operations good. Recycle rate measured to compensate for calculation error.

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 83 °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

//A100
2080, C1049-2 7-1-67

A. YIELDS

FAY	7.987E 01	DRYGAS	6.004E 03	MISTFA	3.543E-01
H2	3.482E 02	OTHER	1.141E 02	UNRETO	0.0
CH4	1.441E 02	O2	6.004E 00	SSY	8.442E 01
CO	2.462E 02	CO2DEC	2.127E 01	MH2O	5.833E 01
CO2	1.411E 03	OILCOL	2.021E 01		

B. METERED GAS RATES

RECG	1.193E 04	DIL	0.0	WVENTG	6.635E 03
AIR	4.720E 03	TRECG	1.193E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWWG	2.887E 01	HVGT	8.512E 02	MWDG	3.029E 01
GBTU	1.418E 02				

D. COMBUSTION PRODUCTS

CO2C	6.970E 02	COC	2.277E 02	H2OC	1.689E 01
CHR	1.546E 01	COMBCP	1.293E 01		

E. MATERIAL IN

ORGCIN	2.267E 02	RSR	4.902E 02	ORH2IN	3.225E 01
MATIN	2.384E 03				

F. MATERIAL OUT

ORGCVG	5.738E 01	COKEC	3.830E 01	UNRETH	0.0
ORGCOL	1.324E 02	ORH2VG	8.635E 00	COKEH	2.938E 00
UNRETC	0.0	ORH2OL	1.747E 01	ORCOLP	5.839E 01
ORCVGP	2.532E 01	ORCSSP	1.690E 01	HCCVGP	1.238E 01

G. MATERIAL BALANCES

OVALL	9.965E 01	ORH2	9.005E 01	O2BAL	1.019E 02
ASH	0.0	TC	1.016E 02	WATER	1.127E 02
ORGC	1.006E 02	TH2	9.579E 01	GASL	1.572E 02
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	4.370E 05	QH2OC	1.089E 04	QAIR	3.742E 03
QPROP	3.998E 01	QOILC	1.102E 04	QRCYL	4.202E 04
QSUMIN	5.047E 05				

I. HEAT OUT

QMCO2D	1.227E 05	QKEROD	9.440E 04	QH2OV	3.765E 04
QLIQO	2.650E 03	QOFGAS	1.757E 04	QSS	1.768E 05
QGASL	1.523E 03	LBLOSS	0.0	HETLOS	5.143E 04
QSUMOT	5.047E 05				

J. MISCELLANEOUS

ORCSS	2.268E 00	VPOIL	1.163E-01	TGL	4.552E 03
VPM	6.248E 00	WCG	1.161E 01	PROP	1.952E 01

END MESSAGE

END OUTPUT

HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	C1049-2	7-1-67					
	WRS	OLRS	TRS	B	MRS			RAW SHALE
1	0.7	9.6	97	-1	27070.0			
	FA	GRS	CORS	XA				
2	25.3	2.2	17.8	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	68.8	16.1	1.67	24.42	142			
	CRA	MFA	TA	PA	WA	LBHL		AIR
4	1065.0	1.0	140	113	0.14	0		
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		RECYCLE AN TOTAL GAS
5	2685.4	1.0	265	67	0.0	0.0		
	CRDG	MFDG	TDG	PDG				DILUTION GA
6	0.0	0.0	0	0				
	P	TP	PP	W	N			PROPANE AN NUCLEATING AGENT
7	5.07	0.4	127.9	273.4	0.0			
	WSS	OLSS	GSS	SS				SPENT SHALE
8	0.5	0.0	0.0	0.0				
	COSS	ASSS	CSS	HSS	TSS			
9	16.6	81.5	6.80	0.23	542			
	OILLP	COL	HOL	DOL	WLP			LIQUID PRODUCT
10	2130.1	84.1	11.1	7.788	167.6			
	CRVG	MFVG	TVG	WG	OILM	M		VENT GAS
11	1536.0	1.0	263	0.0	0.0	0		
	CG	H	COOG	OG	NG			
12	12.9	0	23.5	0.1	62.2			
	MEG	COG	HHG	OTG	HG			
13	2.4	4.1	5.8	1.9	1.11			
	CRVP	VPMF	TVP	PVP				VENT PURGE
14	5.6	2.20	172	27				
	TVPC	VPOIL	VPW	GL				
15	83	52.8	3.9	79.6				

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 7-1-67 Run No. C 1049-2

Sample Time: RS 1915 ; SS 2245

FISCHER ASSAY		
(X) RAW SHALE	(X) SPENT SHALE	
25.0	0.0	Gal/Ton
.916	.	S.G., g/ml
9.5	0.0	Oil, wt %
1.7	0.5	Water, wt %
86.6	99.2	Sp. Shale, ~~wt~~ %
2.2	0.3	Gas & Loss, wt %
slight	none	COKING TENDENCY

( ) RETORT SHALE MOISTURE

Est 1.0 wt %

(X) RAW SHALE FISCHER ASSAY MOISTURE

0.53 wt %

MINERAL CO_2		
(X) 17.9	(X) 16.6	wt %
ASH (SHALE)		
(X) 68.4	(X) 81.5	wt %
MOISTURE		
(X) 0.30	(X) 0.03	wt %
CARBON		
(X) 16.0	(X) 6.80	wt %
HYDROGEN		
(X) 1.66	(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 5 1967 CHECKED BY

OSRC-12A
Revised 6/30/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7-1-67 Run No. C-1049-2

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	6.8					
GRAVITY, °API	19.8					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 633.1

WATER VOL, ml 26.0

GRAVITY OIL, °API 41.4

VENT GAS

MAJOR COMPONENTS

CO_2	23.5	vol %
O_2	0.1	"
N_2	61.5	"
CH_4	2.9	"
CO	4.1	"
H_2	5.8	"
Ar	0.7	"
Others	1.9	"

CARBON, 12.9 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}	.	"
ϕC_3H_6	.	"
n C_5H_{12}	.	"

HYDROGEN, 1.11 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUL 3 1967 CHECKED BY KEP

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C-1049-2 SAMPLE NO. 2 DATE 7-1-67

UNIT R.T.F #3 DESCRIPTION TY-LAB

APPROX. SHALE SIZE _____ SHAKING TIME 10 MIN. ANALYSIS BY [illegible]

TOTAL SAMPLE WT. GROSS 78.7 – TARE 6.6 = NET 72.1

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		31.8	20.2	11.6
	1.50		45.5	23.4	22.1
	1.05		33.2	19.2	14.0
	0.742		27.9	20.5	7.4
	0.525		24.9	18.5	6.4
	0.371		22.0	19.2	2.8
	0.263	3	20.9	18.5	2.4
	0.185	4	19.8	19.4	.4
	0.131	6	19.5	19.3	.2
	0.093	8	20.5	20.4	.1
	0.065	10	19.2	19.2	.1
	PAN		21.9	21.0	.9
TOTAL ON SCREENS AND PAN					72.0
LOSS (BY DIFFERENCE)					.1
TOTAL SAMPLE WEIGHT					72.1

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	5.00		95.00
2.00	2.250	0.4444	16.11		78.89
1.50	1.750	0.5714	30.69		48.20
1.05	(1.067) 1.275	(0.9199) 0.7843	19.44		28.76
0.742	0.896	1.116	10.78		18.98
0.525	0.634	1.577	8.89		9.59
0.371	0.448	2.232	3.89		5.70
0.263	0.317	3.154	3.33		2.37
0.185	0.224	4.464	0.56		1.81
0.131	0.158	6.329	0.28		1.53
0.093	0.112	8.928	0.14	98.61	1.39
0.065			0.14		1.25
PAN			1.25		0
LOSS					
TOTAL					

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

$\sum_{+8m}^{m} Di$		$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$		$\sum_{+8m}^{m} Xi / Di$	0.89698
Da	1.0990	$\sum_{+8m}^{m} Xi\ Di$	1.45697
Dv	1.4775		

REMARKS: _____

OSRC-4