

Date 8-23-67

Purpose: Demonstrate principle of liquid removal to improve yield and operability

GENERAL	
Run No.	PT C1057
Length, hours	12
Retort Type Number	RC - XII
Oil Recovery System Number	C-5
Total Raw Shale Charged, lbs.	98.13
Bed Height above Dist., ft	7 1/2'
Type Air Dist.	A0 - XIII
Bed Below Air Dist., ft	6'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	296
Spent Shale, % of RS	79.4
Liquid Product, lbs/hr	1360.09
Oil Collected, gal/ton RS	20.5
Air, SCF/ton RS (dry)	4910
Total Recycle*, SCF/ton RS(wet)	16900
Dilution, SCF/ton RS (wet)	-
Calc. Vent Gas SCF/ton RS(dry)	6450
Gas Losses, SCF/ton RS(wet)	1250
Propane, SCF/ton RS	-
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	147
Spent Shale, F	323
Raw Shale, °F	85
Recycle Gas Inlet, °F	248
Dilution Gas Inlet, °F	-
Air Inlet, °F	152
Retort Air Inlet, F	152
Heat of Comb. MBtu/ton RS	449
Heat Lost, MBtu/ton RS	40
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	26.7
Oil, Wt %	10.3
Water, Wt %	1.1
Gas, Wt %	2.0
Mineral CO <sub>2</sub> , Wt %	17.7
Ash, Wt %	66.5
Moisture, Wt % (Uncrushed)	Est. 1.0
Carbon (Total), Wt %	16.9
Hydrogen (Total), Wt %	1.74
Nominal Size Range, inches	1/4" - 1"
5 % passing thru	0.263
98 % passing thru	1.05
D <sub>a</sub>	0.621
D <sub>v</sub>	0.715

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	2.9
Mineral CO <sub>2</sub> , Wt %	13.3
Ash, Wt %	83.8
Carbon (total), Wt %	6.72
Organic Carbon, Wt %	3.09
Hydrogen (total), Wt %	0.30
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	95.2
Density, lb/gal	7.722
Gravity, API	26.1
Ash, Wt %	-
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	11.8
Oil, lbs/MSCF(dry)**	0.175
Analysis (dry)	
CO <sub>2</sub> , Vol %	27.6
O <sub>2</sub> , Vol %	0.6
N <sub>2</sub> + Argon, Vol %	60.2
CH <sub>4</sub> , Vol %	1.6
CO, Vol %	5.1
H <sub>2</sub> , Vol %	4.7
Other, Vol %	0.2
Gross Heating Value(calc), Btu/SCF	88.0
Carbon (Total), lbs/MSCF (dry)	12.3
Hydrogen (Total), lbs/MSCF (dry)	0.67
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	76.8
Oil in Gas**, Vol % RSFA	0.5
Oil in Spent Shale, Vol % RSFA	8.5
Total Oil Meas., Vol % RSFA	85.8
Carbonate Decomposition, %	40.4
Water Recovered, lb/ton RS	92.2
Ash Balance, % - As Measured	-
Ash Balance, % - Assumed	RS-100
Overall Balance, %	98.5
Carbon Balance, % - Organic	92.6
Carbon Balance, % - Total	94.7
Hydrogen Balance, % - Organic	91.4
Hydrogen Balance, % - Total	99.9
Water Balance, %	121.9
MISCELLANEOUS	
Avg. Retort ΔP, in H <sub>2</sub> O/ft	1.51
ΔP Above Air Dist., in H <sub>2</sub> O/ft	2.55
Pressure Above Deck H <sub>2</sub> O" PI-8	0.6
Pressure Below Deck H <sub>2</sub> O" PI-10	16.0

Comments: Good operability

\*Measured Recycle + Dilution Gas  
 \*\* Oil Mist + Condensibles to 79 °F  
 \*\*\* Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed B. L. Reynolds DATE Sept 6, 1967

0 2080, PT C1057 8-23-67

1	WRS 1.1 H <sub>2</sub> O, WT % FA	OLRS 10.3 OIL, WT % GRS	TRS 85 TEMP., °F CORS	B -1 XA	MRS 16355.7 RATE, lb/HR	← RAW SHALE
2	26.7 OIL, GAL/TON ASRS	2.0 GAS LOSS, WT % CRS	17.7 CO <sub>2</sub> , WT % HRS	55.22 RETORT XS, FT <sup>2</sup> BP	TOG 147 OFFGAS TEMP., °F	
3	66.5 ASH, WT %	16.9 CARBON, WT %	1.74 H <sub>2</sub> , WT %	24.40 BARO. PRESS., IN Hg		
4	CRA 667.1 CHART READING, SCFM	MFA 1.0 METER FACTOR	TA 152 TEMP., °F	PA 136 PRESS., IN H <sub>2</sub> O	WA 0.14 H <sub>2</sub> O, lb/MSCF	← AIR LBHL 0 HEAT LOSS, BTU/HR
5	CRRG 2278.0 RECYCLE CHART READING, SCFM	MFRG 1.0 METER FACTOR	TRG 248 TEMP., °F	PRG 81 PRESS., IN H <sub>2</sub> O	CRTG 0.0 TOTAL GAS CHART READING	← RECYCLE / TOTAL GAS MFTG 0.0 METER FACTOR
6	CRDG 0.0 CHART READING	MFDG 0.0 METER FACTOR	TDG 0 TEMP., °F	PDG 0 PRESS., IN H <sub>2</sub> O		← DILUTION
7	P 0.0 SCFM	TP 0 TEMP., °F	PP 0 PRESS., IN H <sub>2</sub> O	W 165.2 H <sub>2</sub> O ADDED, lb/HR	N 0.0 NUCL. AGENT, lb/HR	← PROPANE / NUCLEATING AGENT
8	WSS 0.5 H <sub>2</sub> O, WT % COSS	OLSS 1.1 OIL, WT % ASSS	GSS 0.5 GAS, WT % CSS	SS 0.0 RATE, lb/HR HSS	TSS 323 TEMP., °F	← SPENT SHALE
9	13.3 CO <sub>2</sub> , WT %	83.8 ASH, WT %	6.72 CARBON, WT %	0.30 H <sub>2</sub> , WT %		
10	OILLP 1294.8 DRY OIL, lb/HR	COL 84.1 CARBON, WT %	HOL 11.1 H <sub>2</sub> , WT %	DOL 7.722 DENSITY, lb/GAL	WLP 65.3 H <sub>2</sub> O, lb/HR	← LIQUID PRODUCT
11	CRVG 961.1 CHART READING, SCFM CG	MFIG 1.0 METER FACTOR H	TVG 238 TEMP., °F COOG	WG 0.0 H <sub>2</sub> O, lb/MSCF OG	OILM 0.0 OIL MIST, lb/MSCF NG	← VENT GAS M 0
12	12.3 CARBON, lb/MSCF MEG	0 COG	27.6 CO <sub>2</sub> , VOL % MHG	0.6 O <sub>2</sub> , VOL % OTG	60.2 N <sub>2</sub> , VOL % HG	
13	1.6 CH <sub>4</sub> , VOL %	5.1 CO, VOL %	4.7 H <sub>2</sub> , VOL %	0.2 OTHERS, VOL %	0.67 H <sub>2</sub> , lb/MSCF	
14	CRVP 7.34 CHART READING, TVP	VPMF 1.83 METER FACTOR VPOIL	TVP 72 TEMP., °F VPW	PVP 305 PRESS., IN H <sub>2</sub> O GL	PVPC 47 CONDENSER PRESS. IN H <sub>2</sub> O	← VENT PURGE
15	79 CONDENSER GAS EFFLUENT TEMP., °F	108.6 DRY OIL, G/HR	13.2 H <sub>2</sub> O, lb/HR	84.4 TOP SEAL GAS RATE, SCFM		

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 Moisture and Mist, Externally,  
Or "0" to Calculate from Vent Purge Raw 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 8-24-67

Run No. C1057 PT

Sample Time: RS 0700; SS 1145

FISCHER ASSAY

RAW SHALE       SPENT SHALE

<u>26.5</u>	<u>2.9</u>	Gal/Ton
<u>.915</u>	<u>—</u>	S.G., g/ml
<u>10.2</u>	<u>1.1</u>	Oil, wt %
<u>1.8</u>	<u>0.85</u>	Water, wt %
<u>86.0</u>	<u>97.9</u>	Sp. Shale, wt %
<u>2.0</u>	<u>0.5</u>	Gas & Loss, wt %
<u>slight</u>	<u>none</u>	COKING TENDENCY

MINERAL CO<sub>2</sub>

17.6       12.3      wt %

ASH (SHALE)

16.3       83.8      wt %

MOISTURE

0.30       0.07      wt %

CARBON

16.8       6.72      wt %

HYDROGEN

1.73       0.30      wt %

BENZENE EXTRACTABLES

.       0.62      wt %

RETORT SHALE MOISTURE

Est. 1.0 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.68 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<sub>2</sub>", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS \_\_\_\_\_

DATE COMPLETED

AUG 28 1967

CHECKED BY

REP  
OSRC-12A

Revised 6/20/66

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 8/24/67

Run No. C 1057 PT

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
<input checked="" type="checkbox"/> WATER, wt %	<u>4.8</u> <del>20.4</del>					
<input checked="" type="checkbox"/> GRAVITY, °API	<u>21.1</u>					
<input type="checkbox"/> OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 1303.7  
 WATER VOL, ml 132.0  
 GRAVITY OIL, °API 40.8

VENT GAS

MAJOR COMPONENTS		C <sub>1</sub> thru C <sub>4</sub> , plus n-Pentane	
CO <sub>2</sub>	<u>27.4</u> vol %	CH <sub>4</sub>	_____ vol %
O <sub>2</sub>	<u>0.6</u> "	C <sub>2</sub> H <sub>4</sub> -C <sub>2</sub> H <sub>6</sub>	_____ "
N <sub>2</sub>	<u>59.5</u> "	C <sub>3</sub> H <sub>8</sub>	_____ "
CH <sub>4</sub>	<u>1.6</u> "	C <sub>3</sub> H <sub>6</sub>	_____ "
CO	<u>5.1</u> "	i C <sub>4</sub> H <sub>10</sub>	_____ "
H <sub>2</sub>	<u>4.7</u> "	n C <sub>4</sub> H <sub>10</sub>	_____ "
Ar	<u>0.7</u> "	o C <sub>3</sub> H <sub>6</sub>	_____ "
Others	<u>0.2</u> "	n C <sub>5</sub> H <sub>12</sub>	_____ "
<input checked="" type="checkbox"/> CARBON, <u>12.3</u> lbs/MSCFDG		<input checked="" type="checkbox"/> HYDROGEN, <u>0.67</u> lbs/MSCFDG	

COMMENTS \_\_\_\_\_

DATE COMPLETED AUG 25 1967

CHECKED BY REP

# SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C1057 - PT SAMPLE NO. 1 DATE 8/24/67  
 UNIT RETORT #3 DESCRIPTION TY LAB  
 APPROX. SHALE SIZE 1/2" x 1/4" SHAKING TIME 10 min ANALYSIS BY Lavery  
 TOTAL SAMPLE WT. GROSS 86.0 - TARE 6.6 = NET 79.4

004512

SCREEN SIZE			WEIGHTS								
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED	SCREEN SIZE	D <sub>i</sub> *	1/D <sub>i</sub>	% RETAINED	CUM. % RETAINED	% PASSING
	4.25					4.25					
	3.00					3.00	(3.125)	(0.3200)			
	2.50					2.50	(2.625) 2.750	(0.3809) 0.3636			
	2.00					2.00	2.250	0.4444			
	1.50					1.50	1.750	0.5714			
	1.05		0	0	0	1.05	(1.087) 1.275	(0.9199) 0.7843	0	—	100.0
	0.742		59.2	20.5	38.7	0.742	0.896	1.116	49.36		50.64
	0.525		41.3	18.6	23.2	0.525	0.634	1.577	29.59		21.05
	0.371		24.0	18.7	5.3	0.371	0.448	2.232	6.76		14.29
	0.263	3	22.9	18.4	9.5	0.263	0.317	3.154	12.12		2.17
	0.185	4	20.1	19.4	.7	0.185	0.224	4.464	0.89		1.28
	0.131	6	19.4	19.4	0	0.131	0.158	6.329	0.00		1.28
	0.093	8	20.7	20.1	0	0.093	0.112	8.928	0.00	98.72	1.28
	0.065	10	19.4	19.4	0	0.065			0.00		1.28
	PAN		22.0	21.0	1.0	PAN			1.28		0.00
TOTAL ON SCREENS AND PAN					78.4	LOSS			—	—	—
LOSS (BY DIFFERENCE)					—	TOTAL			100.00	—	—
TOTAL SAMPLE WEIGHT					—				—	—	—

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

REMARKS: \_\_\_\_\_

$\sum_{+8m}^m D_i$	0.70057	$\sum_{+8m}^m X_i$	
$1/\sum_{+8m}^m D_i$	1.59037	$\sum_{+8m}^m X_i / D_i$	
D <sub>a</sub>	0.62073	$\sum_{+8m}^m X_i D_i$	
D <sub>v</sub>	0.71485		