

GAS COMBUSTION RETORTING  
DETAILED RUN SUMMARY SHEET

1518017013

Date 6-4-67

Purpose: *To determine operability and yield without dilution gas using 1/4"-1" shale.*

GENERAL		SPENT SHALE PROPERTIES	
Run No.	C1041-1	Fischer Assay, Gal/ton	2.6
Length, hours	12	Mineral CO <sub>2</sub> , Wt %	14.4
Retort Type Number	RC-VII	Ash, Wt %	82.6
Oil Recovery System Number	C-1	Carbon (total), Wt %	7.31
<i>Tons</i> Total Raw Shale Charged, lbs.	95.91	Organic Carbon, Wt %	3.38
Bed Height above Dist., ft	5 1/2'	Hydrogen (total), Wt %	0.34
Type Air Dist.	10-X	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	6'	Oil, Wt %	96.7
RATES AND QUANTITIES		Density, lb/gal	7.778
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	290	Gravity, API	20.0
Spent Shale, % of RS	80.2	Ash, Wt %	-
Liquid Product, lbs/hr	1748.2	PRODUCT GAS PROPERTIES	
Oil Collected, gal/ton RS	25.4	Water Vapor, lbs/MSCF (dry)	8.6
Air, SCF/ton RS (dry)	4380	Oil, lbs/MSCF (dry)**	0.074
Total Recycle*, SCF/ton RS (wet)	13500	Analysis (dry)	
Dilution, SCF/ton RS (wet)	-	CO <sub>2</sub> , Vol %	26.8
Calc. Vent Gas SCF/ton RS (dry)	5900	O <sub>2</sub> , Vol %	0.4
Gas Losses, SCF/ton RS (wet)	394	N <sub>2</sub> + Argon, Vol %	58.7
Propane, SCF/ton RS	-	CH <sub>4</sub> , Vol %	2.2
TEMPERATURES AND HEAT BALANCE		CO, Vol %	4.4
Retort Offgas, °F	133	H <sub>2</sub> , Vol %	6.2
Spent Shale, F	548	Other, Vol %	1.3
Raw Shale, °F	79	Gross Heating Value (calc), Btu/SCF	62.3
Recycle Gas Inlet, °F	250	Carbon (Total), lbs/MSCF (dry)	10.6
Dilution Gas Inlet, °F	-	Hydrogen (Total), lbs/MSCF (dry)	0.60
Air Inlet, °F	139	YIELDS AND BALANCES	
Retort Air Inlet, F	139	Oil Collected, Vol % RSFA	79.9
Heat of Comb. MBtu/ton RS	897	Oil in Gas**, Vol % RSFA	0.2
Heat Lost, MBtu/ton RS	-60	Oil in Spent Shale, Vol % RSFA	6.7
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	86.8
Fischer Assay, gal/ton RS	31.8	Carbonate Decomposition, %	31.7
Oil, Wt %	12.0	Water Recovered, lb/ton RS	80.0
Water, Wt %	0.9	Ash Balance, % - As Measured	-
Gas, Wt %	2.3	Ash Balance, % - Assumed	RS100
Mineral CO <sub>2</sub> , Wt %	16.9	Overall Balance, %	99.6
Ash, Wt %	66.2	Carbon Balance, % - Organic	90.8
Moisture, Wt % (Uncrushed)	1.13	Carbon Balance, % - Total	93.1
Carbon (Total), Wt %	18.6	Hydrogen Balance, % - Organic	86.2
Hydrogen (Total), Wt %	1.96	Hydrogen Balance, % - Total	95.5
Nominal Size Range, inches	1/4"-1"	Water Balance, %	135.2
5 % passing thru	0.263	MISCELLANEOUS	
98 % passing thru	1.05	Avg. Retort ΔP, in H <sub>2</sub> O/ft	0.37
Da	0.636	ΔP Above Air Dist., in H <sub>2</sub> O/ft	0.35
Dv	0.745	NaCl Soln., Wt %	-
		NaCl Rate, gal/ton RS	-

Comments: *Obtained high yields on 4P-3 indicative bridge  
Adjusted air and recycle rates to keep temperatures  
under control. operation unstable.*

\*Measured Recycle + Dilution Gas

\*\* Oil Mist + Condensibles to 75 °F

\*\*\* Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed *Earl E. Jume*

DATE *June 20, 1967*

8/4/91

//A100

2090, C1041-1 6-4-67

A. YIELDS

FAY	7.937E 01	DRYGAS	5.897E 03	MISIFA	1.761E-01
H2	3.656E 02	OTHER	7.666E 01	UNRETC	6.679E 00
CH4	1.297E 02	OP	2.350E 01	SSY	3.015E 01
CO	2.595E 02	CO2DEC	5.171E 01	NM2C	9.004E 01
CO2	1.589E 03	CILCOL	2.540E 01		

B. METERED GAS RATES

RFCG	1.354E 04	DIL	0.0	WVENIC	6.572E 03
AIR	4.375E 03	TREC6	1.354E 04	TCF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWVG	2.371E 01	HVHT	3.676E 02	VMDC	3.065E 01
BBTU	6.234E 01				

D. COMBUSTION PRODUCTS

CO2C	5.920E 02	COG	2.400E 02	H2CC	1.771E 01
CHR	1.327E 01	COX3CP	9.499E 00		

E. MATERIAL IN

ORGIN	2.797E 02	RSP	2.395E 02	ORN2IN	3.718E 01
MATIN	2.353E 03				

F. MATERIAL OUT

ORCVG	3.364E 01	COXEC	3.943E 01	UNRETH	1.386E 00
ORCOL	1.661E 02	ORN2VG	5.572E 00	COXEM	2.667E 00
UNRETC	1.572E 01	ORN2OL	2.193E 01	ORCOLP	5.940E 01
ORCVGP	1.205E 01	ORCSSP	1.936E 01	HCOVGP	2.598E 00

G. MATERIAL BALANCES

OVALL	9.364E 01	ORN2	2.620E 01	ORBAL	1.054E 02
ASH	0.0	TC	9.306E 01	WATER	1.352E 02
ORGC	9.073E 01	TH2	9.548E 01	GASL	3.941E 02
ASHE	-1.000E 00				

H. HEAT IN

QCOMB	3.965E 05	QH2OC	1.034E 04	QAIR	4.234E 03
QPROP	0.0	QOILC	1.383E 04	QRCYL	4.231E 04
QSUMIN	4.733E 05				

I. HEAT OUT

QMCOD	1.785E 05	QKEROD	1.054E 05	QH2OV	4.533E 04
QLIQ	3.903E 03	QOFGAS	2.311E 04	QSS	1.784E 05
QASL	4.017E 03	LBLOSS	0.0	NETLOS	-6.009E 04
QSUMOT	4.733E 05				

J. MISCELLANEOUS

QTRC	5.879E 00	WPCUL	7.807E-02	TCL	9.019E 03
VPT	7.826E 00	VCO	1.535E 01	PROP	0.0

END MESSAGE

END OUTPUT

# HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION					
0	2080,	C1041-1		6-4-67			
1	WRS 0.9	OLRS 12.0	TRS 79	B -1	MRS 15984.2	← RAW SHALE	
2	FA 31.8	GRS 2.3	CORS 16.9	XA 55.22			
3	ASRS 66.2	CRS 18.6	HRS 1.96	BP 24.37	TOG 133		
4	CRA 583.5	MFA 1.0	TA 139	PA 110	WA 0.14	LBHL 0	← AIR
5	CRRG 1795.5	MFRG 1.0	TRG 250	PRG 76	CRTG 0.0	MFTG 0.0	← RECYCLE A TOTAL GAS
6	CRDG 0.0	MFDG 0.0	TDG 0	PDG 0			← DILUTION C
7	P 0.0	TP 0	PP 0	W 182.7	N 0.0		← PROPANE A NUCLEATING AGENT
8	WSS 0.5	OLSS 1.0	GSS 0.04	SS 0.0			← SPENT SHALE
9	COSS 14.4	ASSS 82.6	CSS 7.31	HSS 0.34	TSS 548		
10	OILLP 1578.9	COL 84.1	HOL 11.1	DOL 7.778	WLP 169.2		← LIQUID PRODUCT
11	CRVG 919.8	MFIG 1.0	TVG 250	WG 0.0	OILM 0.0	M 0	← VENT GAS
12	CG 10.6	H 0	COOG 26.8	OG 0.4	NG 58.7		
13	MEG 2.2	COG 4.4	HHG 6.2	OTG 1.3	HG 0.60		
14	CRVP 5.1	VPMF 1.83	TVP 147	PVP 179			← VENT PURGE
15	TVPC 75	VPOIL 32.2	VPW 70	GL 83.7			

**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 6-5-67

Run No. C-1046-1  
1046-10

Sample Time: RS 11:15; SS 11:15

FISCHER ASSAY

EA

<input checked="" type="checkbox"/> RAW SHALE	<input checked="" type="checkbox"/> SPENT SHALE	
<u>31.4</u>	<u>2.6</u>	Gal/Ton
<del>30.2</del>	<u>—</u>	S.G., g/ml
<u>.909</u>	<u>—</u>	
<u>11.9</u>	<u>1.0</u>	Oil, wt %
<u>2.0</u>	<u>0.5</u>	Water, wt %
<u>83.7</u>	<u>98.1</u>	Sp. Shale, wt %
<u>2.3</u>	<u>0.4</u>	Gas & Loss, wt %
<u>Slight</u>	<u>None</u>	COKING TENDENCY

RETORT SHALE MOISTURE

1.13 wt %

RAW SHALE FISCHER ASSAY MOISTURE

1.13 wt %

MINERAL CO<sub>2</sub>

R  16.8 R  14.4 wt %

ASH (SHALE)

EA  65.9  82.6 wt %

MOISTURE

EA  0.51  0.10 wt %

CARBON

R  18.5 R  7.31 wt %

HYDROGEN

R  1.95 R  0.34 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<sub>2</sub>", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS \_\_\_\_\_

DATE COMPLETED JUN 9 1967

CHECKED BY PPP

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-5-67

Run No. 1041-1  
C-1041-10

LIQUID PRODUCTS

EA

D3 PUMPOUT

T3 PUMPOUT

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>1</u>	<u>2</u>
WATER, wt %	<u>3.3</u>	<del>    </del>	<del>    </del>	<del>    </del>	<del>    </del>	<del>    </del>
GRAVITY, °API	<u>20.0</u>	<del>    </del>	<del>    </del>	<del>    </del>	<del>    </del>	<del>    </del>

OIL ASH, wt %

DISTILLATION (See attached sheet - OSRC-24)

EA

VENT PURGE PRODUCT

OIL WT, g 386.1  
WATER VOL, ml 32.0  
GRAVITY OIL, °API 42.1

BKM

VENT GAS

MAJOR COMPONENTS

CO<sub>2</sub> 26.8 vol %  
O<sub>2</sub> 0.4 "  
N<sub>2</sub> 52.0 "  
CH<sub>4</sub> 2.2 "  
CO 4.4 "  
H<sub>2</sub> 6.2 "  
Ar 0.7 "  
Others 1.3 "

C<sub>1</sub> thru C<sub>4</sub>, plus n-Pentane

CH<sub>4</sub>      vol %  
C<sub>2</sub>H<sub>4</sub>-C<sub>2</sub>H<sub>6</sub>      "  
C<sub>3</sub>H<sub>8</sub>      "  
C<sub>3</sub>H<sub>6</sub>      "  
i C<sub>4</sub>H<sub>10</sub>      "  
n C<sub>4</sub>H<sub>10</sub>      "  
C<sub>3</sub>H<sub>6</sub>      "  
n C<sub>5</sub>H<sub>12</sub>      "

CARBON, 10.6 lbs/MSCFDG

HYDROGEN, 0.60 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUN 6 1967

CHECKED BY

REP  
OSRC-12R

# SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C-1047-14 SAMPLE NO. \_\_\_\_\_ DATE 6-5-67  
 UNIT 1" 3 DESCRIPTION Ty Lab  
 APPROX. SHALE SIZE 1/2"-1" SHAKING TIME 10 min ANALYSIS BY John H. Seay  
 TOTAL SAMPLE WT. GROSS 95.4 - TARE 10.0 = NET 85.4

SCREEN SIZE			WEIGHTS								
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED	SCREEN SIZE	D <sub>i</sub> *	1/2 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		28.1	19.2	8.9	1.05	(1.087) 1.275	(0.9199) 0.7843	10.02		89.98
	0.742		61.0	20.5	40.7	0.742	0.896	1.116	45.83		44.15
	0.525		38.0	18.4	19.6	0.525	0.634	1.577	22.07		22.08
	0.371		28.3	19.3	9.0	0.371	0.448	2.232	10.14		11.94
	0.263	3	25.0	18.5	6.5	0.263	0.317	3.154	8.22		3.72
	0.185	4	21.6	19.4	2.2	0.185	0.224	4.464	2.48		1.24
	0.131	6	19.5	19.4	.1	0.131	0.158	6.329	0.11		1.13
	0.093	8	20.5	20.5	.0	0.093	0.112	8.928	0.00	98.87	1.13
	0.065	10	19.2	19.2	.0	0.065			0.00		1.13
	PAN		21.9	20.9	1.0	PAN			1.13		0.00
TOTAL ON SCREENS AND PAN					88.8	LOSS			-	-	-
LOSS (BY DIFFERENCE)					.6	TOTAL			100.00	-	-
TOTAL SAMPLE WEIGHT					89.4				-	-	-

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

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

$\sum_{+8m}^m D_i$	0.73669	$\sum_{+8m}^m X_i$	
$1/\sum_{+8m}^m D_i$	1.55493	$\sum_{+8m}^m X_i / D_i$	
D <sub>a</sub>	0.63584	$\sum_{+8m}^m X_i D_i$	
D <sub>v</sub>	0.74511		

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