

GAS COMBUSTION REPORTING  
DETAILED RUN SUMMARY SHEET

1503015010

Date 5-20-67

Purpose: *To study availability and yield with 4-11" shale using Green Temp. AD  
to recycle moisture, dilution gas and B of Mines type SS through exp. 2*

TOAS

GENERAL		SPENT SHALE PROPERTIES	
Run No.	R-2 C1037-4	Fischer Assay, Gal/ton	0.4
Length, hours	12	Mineral CO <sub>2</sub> , Wt %	13.7
Retort Type Number	RC-VII	Ash, Wt %	84.1
Oil Recovery System Number	C-2	Carbon (total), Wt %	5.66
Total Raw Shale Charged, lbs.	98.02	Organic Carbon, Wt %	1.97
Bed Height above Dist., ft	5 1/2'	Hydrogen (total), Wt %	0.18
Type Air Dist.	AD-X	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	6'	Oil, Wt %	99.8
RATES AND QUANTITIES		Density, lb/gal	7.752
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	296	Gravity, API	20.5
Spent Shale, % of RS	81.3	Ash, Wt %	
Liquid Product, lbs/hr	1563.7	PRODUCT GAS PROPERTIES	
Oil Collected, gal/ton RS	22.3	Water Vapor, lbs/MSCF (dry)	15.4
Air, SCF/ton RS (dry)	5610	Oil, lbs/MSCF (dry)**	0.107
Total Recycle*, SCF/ton RS (wet)	13100	Analysis (dry)	
Dilution, SCF/ton RS (wet)	2420	CO <sub>2</sub> , Vol %	75.5
Calc. Vent Gas SCF/ton RS (dry)	6820	O <sub>2</sub> , Vol %	0.8
Gas Losses, SCF/ton RS (wet)	421	N <sub>2</sub> + Argon, Vol %	65.1
Propane, SCF/ton RS	26.2	CH <sub>4</sub> , Vol %	1.5
TEMPERATURES AND HEAT BALANCE		CO, Vol %	2.4
Retort Offgas, °F	136	H <sub>2</sub> , Vol %	4.4
Spent Shale, F	857	Other, Vol %	0.3
Raw Shale, °F	71	Gross Heating Value (calc), Btu/SCF	68.5
Recycle Gas Inlet, °F	250	Carbon (Total), lbs/MSCF (dry)	10.8
Dilution Gas Inlet, °F	250	Hydrogen (Total), lbs/MSCF (dry)	0.53
Air Inlet, °F	144	YIELDS AND BALANCES	
Retort Air Inlet, F	144	Oil Collected, Vol % RSFA	83.5
Heat of Comb. MBtu/ton RS	534	Oil in Gas**, Vol % RSFA	0.1
Heat Lost, MBtu/ton RS	-86	Oil in Spent Shale, Vol % RSFA	0.8
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	84.4
Fischer Assay, gal/ton RS	26.7	Carbonate Decomposition, %	35.6
Oil, Wt %	10.1	Water Recovered, lb/ton RS	122.9
Water, Wt %	1.2	Ash Balance, % - As Measured	-
Gas, Wt %	2.1	Ash Balance, % - Assumed	25.100
Mineral CO <sub>2</sub> , Wt %	17.3	Overall Balance, %	101.0
Ash, Wt %	68.4	Carbon Balance, % - Organic	93.5
Moisture, Wt % (Uncrushed)	0.65	Carbon Balance, % - Total	96.8
Carbon (Total), Wt %	16.2	Hydrogen Balance, % - Organic	91.3
Hydrogen (Total), Wt %	1.73	Hydrogen Balance, % - Total	107.7
Nominal Size Range, inches	1/4" - 11"	Water Balance, %	155.2
5 % passing thru	0.263	MISCELLANEOUS	
98 % passing thru	1.05	Avg. Retort ΔP, in H <sub>2</sub> O/ft	0.43
D <sub>a</sub>	0.650	ΔP Above Air Dist., in H <sub>2</sub> O/ft	0.36
D <sub>y</sub>	0.757	NaCl Soln., Wt %	-
Line Burner °F	900	NaCl Rate, gal/ton RS	-

Comments: *One orped on air line changed to 4-25 inches about midway balance. Strong bit indicate shale flow somewhat slower on NC and NW legs.*

\*Measured Recycle + Dilution Gas  
 \*\* Oil Mist + Condensibles to 80 °F  
 \*\*\* Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. Jones DATE June 8, 1967

104  
6/2

//A100

2080, C1057-4 2-2 5-22-57

A. YIELDS

FAY	8.349E 01	DRYGAS	5.821E 03	MISGTA	1.313E-01
H2	3.001E 02	OTHER	2.045E 01	UNRETD	3.053E-01
CH4	1.023E 02	CO	5.457E 01	SPY	2.133E 01
CO	1.537E 02	CO2GAS	3.959E 01	WGTG	1.229E 02
CO2	1.739E 03	CILCO	2.229E 01		

B. MEASURED GAS RATES

TECH	1.968E 02	DIL	2.480E 02	WVWTC	7.762E 03
AIR	5.612E 03	TEG	1.310E 04	TOP	0.0

C. MOL WT & HEATING VALUE OF WGT GAS

HWG	2.279E 01	HWGT	4.575E 02	WGT	3.084E 01
GETU	6.854E 01				

D. COMBUSTION PRODUCTS

CO2	6.206E 02	CO	1.464E 02	H2O	4.129E 01
CHR	5.247E 00	COMBOP	1.045E 01		

E. MATERIAL IN

ORGCIN	2.330E 02	PSR	2.953E 02	ORGIN	3.247E 01
MATIN	2.447E 03				

F. MATERIAL OUT

ORCVO	4.031E 01	COKEC	2.272E 01	UNRETH	2.346E-01
ORCOOL	1.433E 02	ORCVG	3.074E 00	COVEN	1.965E 00
UNRETC	2.507E 00	ORCROL	1.913E 01	ORCCLP	6.054E 01
ORCVOP	1.737E 01	ORCSSP	1.345E 01	WCCVOP	6.293E 00

G. MATERIAL BALANCES

OVALL	1.010E 02	ORW	2.150E 01	ORBAL	1.103E 02
ASH	0.0	TC	2.682E 01	WATER	1.559E 00
ORGC	2.347E 01	THC	1.077E 02	GASL	4.214E 02
ASHE	-1.000E 00				

H. HEAT IN

ORCMB	5.339E 05	ORHOC	3.593E 05	ORAIR	7.543E 03
ORPROP	2.962E 01	ORILC	1.210E 04	ORCYL	4.791E 04
ORSHIN	5.099E 05				

I. HEAT OUT

ORCOPD	1.995E 05	ORERO	2.565E 04	ORCOV	4.355E 04
ORISO	4.094E 03	ORFGAS	2.345E 04	ORCS	3.177E 05
ORCASL	6.279E 03	ORLCS	0.0	ORFCS	-2.511E 04
ORJCT	5.099E 05				

J. MISCELLANEOUS

ORCS	1.220E 00	ORPOIL	1.655E-01	OROL	3.096E 03
ORV	1.543E 01	ORCS	1.655E 01	OROP	2.615E 01

END MESSAGE

END OUTPUT

# HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION					
0	2080,	C1037-4K-2 5-20-67					
1	WRS	OLRS	TRS	B	MRS	← RAW SHALE	
2	FA	GRS	CORS	XA			
3	ASRS	CRS	HRS	BP	TOG		
4	CRA	MFA	TA	PA	WA	LBHL	← AIR
5	CRRG	MFRG	TRG	PRG	CRTG	MFTG	← RECYCLE A TOTAL GAS
6	CRDG	MFDG	TDG	PDG			← DILUTION G
7	P	TP	PP	W	N		← PROPANE A NUCLEATING AGENT
8	WSS	OLSS	GSS	SS			← SPENT SHALE
9	COSS	ASSS	CSS	HSS	TSS		
10	OILLP	COL	HOL	DOL	WLP		← LIQUID PRODUCT
11	CRVG	MVVG	TVG	WG	OILM	M	← VENT GAS
12	CG	H	COOG	OG	NG		
13	MEG	COG	HHG	OTG	HG		
14	CRVP	VPMF	TVP	PVP			← VENT PURGE
15	TVPC	VPOIL	VPW	GL			

**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 5-20-67

Run No. C1037-4

Sample Time: RS 18:15; SS 23:15

FISCHER ASSAY

RAW SHALE       SPENT SHALE

<u>26.6</u>	<u>0.4</u>	Gal/Ton
<u>0.905</u>	<u>—</u>	S.G., g/ml
<u>10.1</u>	<u>0.1</u>	Oil, wt %
<u>1.6</u>	<u>0.4</u>	Water, wt %
<u>86.2</u>	<u>88.3</u>	Sp. Shale, wt %
<u>2.1</u>	<u>0.2</u>	Gas & Loss, wt %

5/1965      None      COKING TENDENCY

RETORT SHALE MOISTURE

0.65 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.41 wt %

MINERAL CO<sub>2</sub>

<sup>EHA</sup>  17.3      <sup>EHA</sup>  13.7      wt %

ASH (SHALE)

<sup>EHA</sup>  68.3      <sup>EHA</sup>  84.1      wt %

MOISTURE

<sup>EHA</sup>  0.21      <sup>EHA</sup>  0.03      wt %

CARBON

<sup>EHA</sup>  16.2      <sup>EHA</sup>  5.66      wt %

HYDROGEN

<sup>EHA</sup>  1.73      <sup>EHA</sup>  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<sub>2</sub>", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS \_\_\_\_\_

DATE COMPLETED MAY 23 1967

CHECKED BY JEP

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-20-67

Run No. 31037-4

LIQUID PRODUCTS

D3 PUMPOUT

T3 PUMPOUT

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>1</u>	<u>2</u>
<i>W</i> WATER, wt %	<u>0.2</u>					
GRAVITY, °API	<u>20.5</u>					

OIL ASH, wt %

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

*W*

OIL WT, g 172

WATER VOL, ml 4

GRAVITY OIL, °API 43.3

VENT GAS

*W*

MAJOR COMPONENTS

CO<sub>2</sub> 25.5 vol %  
 O<sub>2</sub> 0.3 "  
 N<sub>2</sub> 64.3 "  
 CH<sub>4</sub> 1.5 "  
 CO 2.4 "  
 H<sub>2</sub> 4.4 "  
 Ar 0.3 "  
 Others 0.3 "

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> \_\_\_\_\_ "

*W*

CARBON, 10.8 lbs/MSCFDG

*W*

HYDROGEN, 0.53 lbs/MSCFDG

COMMENTS \_\_\_\_\_

DATE COMPLETED MAY 22 1967

CHECKED BY REP

OSRC-12B

# SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. 10-2-4 SAMPLE NO. 7-1-1 DATE 3-2-57  
 UNIT 10-2-4 DESCRIPTION 7-1-1  
 APPROX. SHALE SIZE 8-2-7 SHAKING TIME 7-1-1 ANALYSIS BY J. S. S.  
 TOTAL SAMPLE WT. GROSS 210 - TARE 21.0 = NET 189

SCREEN SIZE		WEIGHTS			SCREEN SIZE	Di *	1/Di	% RETAINED	CUM. % RETAINED	% PASSING
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.						
	4.25									
	3.00				(3.125)	(0.3200)				
	2.50				(2.625) 2.750	(0.3809) 0.3636				
	2.00				2.250	0.4444				
	1.50				1.750	0.5714				100.00
	1.05		224	191	(1.067) 1.275	(0.9199) 0.7843	10.51			89.50
	0.742		571	205	0.896	1.116	46.96			42.54
	0.525		371	195	0.634	1.577	22.91			19.63
	0.371		262	193	0.448	2.232	8.86			10.77
	0.263	3	250	183	0.317	3.154	7.22			3.55
	0.185	4	225	177	0.224	4.464	1.90			1.65
	0.131	6	125	193	0.158	6.329	0.25			1.40
	0.093	8	205	205	0.112	8.928	0.13	98.74		1.27
	0.065	10	172	183	0.093	10.75	0.00			1.27
	PAN		210	210			1.27			0.00
TOTAL ON SCREENS AND PAN										
LOSS (BY DIFFERENCE)										
TOTAL SAMPLE WEIGHT										

$\sum_{+8m}^m Di$	2.74763	$\sum_{+8m}^m Xi$	
$1/\sum_{+8m}^m Di$	15.1976	$\sum_{+8m}^m Xi / Di$	
$D_a$	0.64970	$\sum_{+8m}^m Xi Di$	
$D_v$	0.76717		

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