

GAS COMBUSTION REPORTING  
DETAILED RUN SUMMARY SHEET

1513015016

Date 5-22-67

Purpose: *To study operability and yield with 1 inch shalvane oven type A-10  
to recycle handling, w/o dilution control by means type 55 double glass tube*

GENERAL		SPENT SHALE PROPERTIES	
Run No.	C 1038-1	Fischer Assay, Gal/ton	0.0
Length, hours	12	Mineral CO <sub>2</sub> , Wt %	11.7
Retort Type Number	RC-VII	Ash, Wt %	87.1
Oil Recovery System Number	C-1	Carbon (total), Wt %	4.88
7015 Total Raw Shale Charged, lbs.	98.93	Organic Carbon, Wt %	1.69
Bed Height above Dist., ft	5 1/2'	Hydrogen (total), Wt %	0.16
Type Air Dist.	A0-X	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	6'	Oil, Wt %	98.8
RATES AND QUANTITIES		Density, lb/gal	7.788
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	299	Gravity, API	19.8
Spent Shale, % of RS	79.2	Ash, Wt %	
Liquid Product, lbs/hr	1435.7	PRODUCT GAS PROPERTIES	
Oil Collected, gal/ton RS	19.7	Water Vapor, lbs/MSCF (dry)	8.3
Air, SCF/ton RS (dry)	4920	Oil, lbs/MSCF (dry)**	0.081
Total Recycle*, SCF/ton RS (wet)	12900	Analysis (dry)	
Dilution, SCF/ton RS (wet)	-	CO <sub>2</sub> , Vol %	29.8
Calc. Vent Gas SCF/ton RS (dry)	6550	O <sub>2</sub> , Vol %	0.3
Gas Losses, SCF/ton RS (wet)	374	N <sub>2</sub> + Argon, Vol %	59.4
Propane, SCF/ton RS	-	CH <sub>4</sub> , Vol %	1.5
TEMPERATURES AND HEAT BALANCE		CO, Vol %	2.9
Retort Offgas, °F	136	H <sub>2</sub> , Vol %	4.1
Spent Shale, F	649	Other, Vol %	2.0
Raw Shale, °F	78	Gross Heating Value (calc), Btu/SCF	77.3
Recycle Gas Inlet, °F	250	Carbon (Total), lbs/MSCF (dry)	12.6
Dilution Gas Inlet, °F	-	Hydrogen (Total), lbs/MSCF (dry)	0.57
Air Inlet, °F	153	YIELDS AND BALANCES	
Retort Air Inlet, F	153	Oil Collected, Vol % RSFA	77.7
Heat of Comb. MBtu/ton RS	482	Oil in Gas**, Vol % RSFA	0.3
Heat Lost, MBtu/ton RS	-104	Oil in Spent Shale, Vol % RSFA	0.0
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	78.0
Fischer Assay, gal/ton RS	25.4	Carbonate Decomposition, %	47.0
Oil, Wt %	9.6	Water Recovered, lb/ton RS	79.4
Water, Wt %	1.3	Ash Balance, % - As Measured	-
Gas, Wt %	1.76	Ash Balance, % - Assumed	RS-100
Mineral CO <sub>2</sub> , Wt %	17.5	Overall Balance, %	98.7
Ash, Wt %	69.0	Carbon Balance, % - Organic	89.6
Moisture, Wt % (Uncrushed)	0.95	Carbon Balance, % - Total	92.8
Carbon (Total), Wt %	15.6	Hydrogen Balance, % - Organic	92.8
Hydrogen (Total), Wt %	1.63	Hydrogen Balance, % - Total	92.7
Nominal Size Range, inches	1/4" - 1"	Water Balance, %	90.5
5 % passing thru	0.263	MISCELLANEOUS	
98 % passing thru	1.05	Avg. Retort ΔP, in H <sub>2</sub> O/ft	0.44
Da	0.590	ΔP Above Air Dist., in H <sub>2</sub> O/ft	0.27
Dy	0.702	NaCl Soln., Wt %	-
		NaCl Rate, gal/ton RS	-

Comments: *op. an. Combustion, have analyzed 40% split  
Duffinity, experienced in holding constant RS feed rate.*

\*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. Turner DATE June 8, 1967

//A100

2030, C1088-1 5-22-67

A. YIELDS

FAY	7.780E 01	DRY GAS	6.551E 03	WGTFA	2.685E-01
H2	2.685E 02	OTHER	1.310E 02	WGTTO	0.0
CH4	9.826E 01	CO	1.965E 01	EDY	7.922E-01
CO	1.000E 02	CO2DEC	4.704E 01	WRCO	7.935E 01
CO2	1.952E 03	GILCO	1.972E 01		

B. METERED GAS RATES

RECO	1.257E 04	DIL	0.0	VENTG	7.314E 05
AIR	4.915E 03	TRCO	1.032E 04	TSF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

WVWG	2.983E 01	HVOT	5.664E 02	WVDC	3.187E 01
GBTU	7.751E 01				

D. COMBUSTION PRODUCTS

CO2C	4.385E 02	CO	1.765E 02	H2CO	4.184E 01
CHR	4.489E 00	CO2OP	9.738E 00		

E. MATERIAL IN

ORCOIN	2.155E 02	RSR	2.906E 02	ORCOIN	2.962E 01
MATIN	2.396E 03				

F. MATERIAL OUT

ORCOV	3.700E 01	COKEO	9.671E 01	UNRPTH	0.0
ORCOOL	1.898E 00	ORCOV	3.485E 00	COYFH	2.003E 00
UNRPTH	0.0	ORCOOL	1.765E 01	ORCOOP	5.969E 01
ORCOVP	1.760E 01	ORCOER	1.284E 01	WCOVOP	7.951E 00

G. MATERIAL BALANCES

CVALL	9.865E 01	ORHP	9.295E 01	COBAL	9.035E 01
ASH	0.0	TC	9.879E 01	WATER	9.047E 01
ORCO	8.963E 01	THO	9.263E 01	GASL	3.789E 02
ASHB	-1.000E 00				

H. HEAT IN

QCOYE	4.210E 05	QH2OC	6.132E 03	CAIR	6.799E 03
QRCOP	0.0	QOILC	1.075E 04	QRCYL	4.692E 04
QSUMIN	5.506E 05				

I. HEAT OUT

QWCO2C	2.667E 05	QWCOV	9.038E 04	QH2OV	5.214E 04
QWILCO	3.265E 05	QWCOAE	2.406E 04	QSS	2.150E 05
QWASL	4.737E 03	QWCOEN	0.0	QWTCOS	-1.041E 05
QWCOCT	5.526E 05				

J. NITROGEN

QWCOE	1.875E 00	QWCOIL	5.137E-02	QWTC	3.019E 00
QWCOV	2.055E 00	QWCO	1.439E 01	QWCO	0.0

END REPORT

THE ENGINEER

# HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION					
0	2080,	C 1038-1 5-22-67					
1	WRS 1.3	OLRS 9.6	TRS 78	B -1	MRS 16487.7	← RAW SHALE	
2	FA 25.4	GRS 1.76	CORS 17.5	XA 55.22			
3	ASRS 69.0	CRS 15.6	HRS 1.63	BP 24.40	TOG 136		
4	CRA 676.2	MFA 1.0	TA 153	PA 141	WA 0.14	LBHL 0	← AIR
5	CRRG 1795.5	MFRG 1.0	TRG 250	PRG 79	CRTG 0.0	MFTG 0.0	← RECYCLE A TOTAL GAS
6	CRDG 0.0	MFDG 0.0	TDG 0	PDG 0			← DILUTION G
7	P 0.0	TP 0	PP 0	W 158.1	N 0.0		← PROPANE A NUCLEATING AGENT
8	WSS 0.3	OLSS 0.0	GSS 0.0	SS 0.0			← SPENT SHALE
9	COSS 11.7	ASSS 87.1	CSS 4.88	HSS 0.16	TSS 649		
10	OILLP 1266.4	COL 84.1	HOL 11.1	DOL 7.788	WLP 169.3		← LIQUID PRODUCT
11	CRVG 1027.7	MVFG 1.0	TVG 250	WG 0.0	OILM 0.0	M 0	← VENT GAS
12	CG 12.6	H 0	COOG 29.8	OG 0.3	NG 59.4		
13	MEG 1.5	COG 2.9	HHG 4.1	OTG 2.0	HG 0.57		
14	CRVP 1.6	VPMF 1.83	TVP 133	PVP 75			← VENT PURGE
15	TVPC 80	VPOIL 17.6	VPW 3.0	GL 14.6			

**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 5-23-67

Run No. C1037-9  
C1038-1

Sample Time: RS 0615; SS 1115

FISCHER ASSAY

*EHA*

RAW SHALE       SPENT SHALE

<u>25.3</u>	<u>0.0</u>	Gal/Ton
<u>0.919</u>	<u>—</u>	S.G., g/ml
<u>9.60</u>	<u>0.0</u>	Oil, wt %
<u>1.70</u>	<u>0.3</u>	Water, wt %
<u>87.0</u>	<u>99.6</u>	Sp. Shale, wt %
<u>1.75</u>	<u>0.1</u>	Gas & Loss, wt %
<u>SLIGHT</u>	<u>none</u>	COKING TENDENCY

RETORT SHALE MOISTURE  
0.95 wt %

*BK/III*

RAW SHALE FISCHER ASSAY MOISTURE  
0.43 wt %

MINERAL CO<sub>2</sub>

*BK/III*  17.5      *BK/III*  11.7 wt %

ASH (SHALE)

*BK/III*  68.8      *EST*  87.1 wt %

MOISTURE

*BK/III*  0.22      *EST*  0.03 wt %

CARBON

*EHA*  15.6      *EST*  4.88 wt %

HYDROGEN

*EHA*  1.63      *EST*  0.16 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 24 1967

CHECKED BY REP

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-23-67

Run No. C10379  
C1038-1

LIQUID PRODUCTS

D3 PUMPOUT

T3 PUMPOUT

*Σ 144*

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>1</u>	<u>2</u>
WATER, wt %	<u>1.2</u>					
GRAVITY, °API	<u>19.8</u>					

OIL ASH, wt %

DISTILLATION (See attached sheet - OSRC-24)

*Σ 144*  
*(X)*

VENT PURGE PRODUCT

OIL WT, g 211.4  
WATER VOL, ml 46.0  
GRAVITY OIL, °API 46.3

VENT GAS

*Σ 144*  
*(X)*

MAJOR COMPONENTS

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

CO<sub>2</sub> 19.8 vol %  
O<sub>2</sub> 0.3 "  
N<sub>2</sub> 58.7 "  
CH<sub>4</sub> 1.5 "  
CO 2.9 "  
H<sub>2</sub> 4.1 "  
Ar 0.7 "  
Others 2.0 "

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

*Σ 144*  
*(X)*

CARBON, 18.6 lbs/MSCFDG

HYDROGEN, 0.57 lbs/MSCFDG

COMMENTS \_\_\_\_\_

DATE COMPLETED MAY 24 1967

CHECKED BY PEP

OSRC-12B

# SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. 56022-1 SAMPLE NO. 9 DATE 5-23-67

UNIT TEST DESCRIPTION TY Lab

APPROX. SHALE SIZE 1/4" - 1" SHAKING TIME 10 min ANALYSIS BY Stratton & Smith

TOTAL SAMPLE WT. GROSS 78 - TARE 102 = NET 63.2

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					(0.3200)				
	2.50					(0.3809) 2.750				
	2.00					2.250	0.4444			
	1.50					1.750	0.5714			100.00
	1.05		22.4	19.1	3.3	(1.087) 1.275	0.7845	5.21		94.81
	0.742		47.0	20.5	26.5	0.896	1.116	41.80		53.01
	0.525		35.5	18.5	17.0	0.634	1.577	26.81		26.20
	0.371		26.4	19.2	7.2	0.448	2.232	11.36		14.84
	0.263	3	24.3	18.4	5.9	0.317	3.154	9.31		5.53
	0.185	4	21.3	19.4	1.9	0.224	4.464	3.00		2.53
	0.131	6	19.6	19.3	.3	0.158	6.329	0.47		2.06
	0.093	8	20.5	20.4	.1	0.112	8.928	0.16	98.12	1.90
	0.065	10	19.4	19.2	.2	0.065		0.32		1.52
	PAN		21.9	20.9	1.0			1.52		0.06
TOTAL ON SCREENS AND PAN					63.4					
LOSS (BY DIFFERENCE)					- .2					
TOTAL SAMPLE WEIGHT					63.2					

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

REMARKS:

$\sum_{+8m}^m Di$	0.62918	$\sum_{+8m}^m Xi$	
$1/\sum_{+8m}^m Di$	1.66235	$\sum_{+8m}^m Xi/Di$	
De	0.59024	$\sum_{+8m}^m Xi Di$	
Dv	0.70238		