

GAS COUSTION REPORTING  
DETAILED RUN SUMMARY SHEET

151306011

Date 5-20-67

Purpose: To study operability and yield with #1 shale using open type #10  
L to recycle Recycle, dilution gas and B. of #1 shale SS down of 71 sq. ft.

GENERAL		SPENT SHALE PROPERTIES	
Run No.	R-2 C1037-5	Fischer Assay, Gal/ton	0.3
Length, hours	12	Mineral CO <sub>2</sub> , Wt %	13.4
Retort Type Number	RC-VII	Ash, Wt %	85.5
Oil Recovery System Number	C-1	Carbon (total), Wt %	5.66
<b>TONS</b> Total Raw Shale Charged, lbs.	95.88	Organic Carbon, Wt %	2.00
Bed Height above Dist., ft	5 1/2'	Hydrogen (total), Wt %	0.17
Type Air Dist.	AD-E	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	6'	Oil, Wt %	99.4
RATES AND QUANTITIES		Density, lb/gal	7.752
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	289	Gravity, API	20.5
Spent Shale, % of RS	79.8	Ash, Wt %	-
Liquid Product, lbs/hr	1510.7	PRODUCT GAS PROPERTIES	
Oil Collected, gal/ton RS	22.2	Water Vapor, lbs/MSCF(dry)	7.1
Air, SCF/ton RS (dry)	5660	Oil, lbs/MSCF(dry)**	0.069
Total Recycle*, SCF/ton RS (wet)	13400	Analysis (dry)	
Dilution, SCF/ton RS (wet)	2470	CO <sub>2</sub> , Vol %	26.6
Calc. Vent Gas SCF/ton RS (dry)	7020	O <sub>2</sub> , Vol %	0.7
Gas Losses, SCF/ton RS (wet)	141	N <sub>2</sub> + Argon, Vol %	63.8
Propane, SCF/ton RS	22.9	CH <sub>4</sub> , Vol %	1.5
TEMPERATURES AND HEAT BALANCE		CO, Vol %	2.6
Retort Offgas, °F	135	H <sub>2</sub> , Vol %	4.2
Spent Shale, F	819	Other, Vol %	0.6
Raw Shale, °F	71	Gross Heating Value(calc), Btu/SCF	78.1
Recycle Gas Inlet, °F	250	Carbon (Total), lbs/MSCF (dry)	11.5
Dilution Gas Inlet, °F	250	Hydrogen (Total), lbs/MSCF (dry)	0.60
Air Inlet, °F	141	YIELDS AND BALANCES	
Retort Air Inlet, F	141	Oil Collected, Vol % RSFA	81.7
Heat of Comb. MBtu/ton RS	534	Oil in Gas**, Vol % RSFA	0.2
Heat Lost, MBtu/ton RS	-75	Oil in Spent Shale, Vol % RSFA	0.8
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	82.7
Fischer Assay, gal/ton RS	27.2	Carbonate Decomposition, %	38.2
Oil, Wt %	10.4	Water Recovered, lb/ton RS	84.4
Water, Wt %	1.2	Ash Balance, % - As Measured	-
Gas, Wt %	2.1	Ash Balance, % - Assumed	RS100
Mineral CO <sub>2</sub> , Wt %	17.3	Overall Balance, %	98.9
Ash, Wt %	68.2	Carbon Balance, % - Organic	93.4
Moisture, Wt % (Uncrushed)	0.69	Carbon Balance, % - Total	96.5
Carbon (Total), Wt %	16.5	Hydrogen Balance, % - Organic	89.6
Hydrogen (Total), Wt %	1.77	Hydrogen Balance, % - Total	94.8
Nominal Size Range, inches	1/4"-1"	Water Balance, %	111.2
5 % passing thru	0.263	MISCELLANEOUS	
98 % passing thru	1.05	Avg. Retort ΔP, in H <sub>2</sub> O/ft	0.44
D <sub>a</sub>	0.591	ΔP Above Air Dist., in H <sub>2</sub> O/ft	0.40
D <sub>v</sub>	0.702	NaCl Soln., Wt %	-
Line Burner °F	900	NaCl Rate, gal/ton RS	-

Comments: Conveyor belt No. 20 down. Operations good

\*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 Carl E. Jones

DATE June 8, 1967

//4100

2030, C1037-5 3-2 5-20-67

A. YIELDS

FAY	8.174E 01	DRYGAS	7.015E 03	WISTSA	8.309E-01
H2	2.945E 02	OTHER	4.238E 01	UNPEIC	7.570E-01
CH4	1.052E 02	OP	4.911E 01	SSY	7.377E 01
CO	1.734E 02	CS2DEC	3.522E 01	NH2O	6.437E 01
CO2	1.855E 03	CILCOL	2.305E 01		

B. REFERRED GAS RATES

REFG	1.093E 04	DIL	3.455E 03	WVENTG	7.319E 03
AIR	5.656E 03	IPFG	1.340E 04	TCF	0.0

C. YCL HT & HEATING VALUE OF VENT GAS

NH2G	0.942E 01	HVGT	5.477E 02	WVOC	3.111E 01
GRH	3.807E 01				

D. COMBUSTION PRODUCTS

CO2C	6.622E 02	CO	1.651E 02	H2OC	3.720E 01
CH4	0.335E 00	CONCOP	1.115E 01		

E. MATERIAL IN

CRCCIN	2.377E 02	RSR	2.894E 02	CRNIN	3.303E 01
NATIN	2.450E 03				

F. MATERIAL OUT

CRCCO	4.532E 01	COXIC	3.058E 01	WV2PM	1.771E-01
CRCCOL	1.449E 02	CRHPVC	2.435E 02	COXEN	1.309E 00
UNPEIC	1.340E 03	CRHCOL	1.715E 01	CRCOLP	6.017E 01
CRCVIP	1.894E 01	CRCSIP	1.543E 01	WCV2P	7.314E 00

G. MATERIAL BALANCES

CVALL	9.321E 01	GRH2	8.957E 01	CRPAL	1.283E 02
ASH	0.0	TC	9.649E 01	WATER	1.112E 02
CRCC	9.335E 01	TH2	9.475E 01	CASL	1.412E 00
ASH3	-1.003E 00				

H. HEAT IN

COOVR P	5.342E 05	CH2OC	6.174E 03	GAIR	7.220E 03
OPROP	7.505E 01	CGILC	1.205E 04	CRCYL	4.831E 04
CRUKIN	6.091E 05				

I. HEAT OUT

CRCS2D	2.142E 05	CRK2CD	9.335E 04	CR2CV	4.444E 04
CLICO	4.015E 03	COFCAS	2.846E 04	SS3	2.313E 05
CRASL	2.275E 03	IBLOSS	0.0	NETLOS	-7.520E 04
CRUGCT	6.031E 05				

J. MISCELLANEOUS

CRGFB	2.007E 00	WFOIL	6.241E-02	TSL	3.224E 03
VRH	7.035E 00	WCC	1.227E 01	RFCE	2.000E 01

11) CRGFB

11) CRGFB

# HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	← USER IDENTIFICATION →					
0	2080,	C1037-SR-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 AND TOTAL GAS
6	CRDG	MFDG	TDG	PDG			← DILUTION GAS
7	P	TP	PP	W	N		← PROPANE AND 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	COG	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

0.69

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-21-67

Run No. C1039-5

Sample Time: RS 0615; SS \_\_\_\_\_

FISCHER ASSAY

RAW SHALE  SPENT SHALE

RETORT SHALE MOISTURE  
0.69 wt %

avg  
C1037-4  
↓  
C1037-6  
↓  
86 gr sample  
86 gr

	<u>27.1</u>	<u>0.3</u>	Gal/Ton
	<u>0.906</u>	<u>—</u>	S.G., g/ml
	<u>10.3</u>	<u>0.1</u>	Oil, wt %
	<u>1.7</u>	<u>0.3</u>	Water, wt %
	<u>86.1</u>	<u>99.6</u>	Sp. Shale, wt %
	<u>2.1</u>	<u>0.0</u>	Gas & Loss, wt %
	<u>—</u>	<u>None</u>	COKING TENDENCY

no sample  
 RAW SHALE FISCHER ASSAY MOISTURE  
0.51 wt %

MINERAL CO<sub>2</sub>

17.6  13.4 wt %

ASH (SHALE)

69.7  85.5 wt %

MOISTURE

6.25  0.03 wt %

CARBON

14.8  5.66 wt %

HYDROGEN

1.50  0.17 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 25 1967

CHECKED BY REP

OSRC-12A  
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-21-67

Run No. C 1037-5

LIQUID PRODUCTS

D3 PUMPOUT

T3 PUMPOUT

	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>1</u>	<u>2</u>
<input checked="" type="checkbox"/> WATER, wt %	<u>0.6</u>					
GRAVITY, °API	<u>20.5</u>					
<input type="checkbox"/> OIL ASH, wt %						
<input type="checkbox"/> DISTILLATION (See attached sheet - OSRC-24)						

VENT PURGE PRODUCT

OIL WT, g 17.6  
 WATER VOL, ml 1.0  
 GRAVITY OIL, °API 42.5

VENT GAS

<input checked="" type="checkbox"/> MAJOR COMPONENTS	<input type="checkbox"/> C <sub>1</sub> thru C <sub>11</sub> , plus n-Pentane
CO <sub>2</sub> <u>2.6.6</u> vol %	CH <sub>4</sub> _____ vol %
O <sub>2</sub> <u>0.7</u> "	C <sub>2</sub> H <sub>4</sub> -C <sub>2</sub> H <sub>6</sub> _____ "
N <sub>2</sub> <u>63.0</u> "	C <sub>3</sub> H <sub>8</sub> _____ "
CH <sub>4</sub> <u>1.5</u> "	C <sub>3</sub> H <sub>6</sub> _____ "
CO <u>2.6</u> "	i C <sub>4</sub> H <sub>10</sub> _____ "
H <sub>2</sub> <u>4.2</u> "	n C <sub>4</sub> H <sub>10</sub> _____ "
Ar <u>0.8</u> "	∅C <sub>3</sub> H <sub>6</sub> _____ "
Others <u>0.6</u> "	n C <sub>5</sub> H <sub>12</sub> _____ "

CARBON, 11.5 lbs/MSCFDG

HYDROGEN, 0.60 lbs/MSCFDG

COMMENTS \_\_\_\_\_

DATE COMPLETED MAY 22 1967

CHECKED BY REO

# SCREEN ANALYSIS (ATA SHEET (TY-LAB))

RUN NO. C. 1037 - # 5 SAMPLE NO. 5-21-67  
 UNIT Material 3 DESCRIPTION Top Soil  
 APPROX. SHALE SIZE \_\_\_\_\_ SHAKING TIME \_\_\_\_\_ ANALYSIS BY Smith, Carter  
 TOTAL SAMPLE WT. GROSS 88.4 - TARE 6.6 = NET 81.8

SCREEN SIZE		WEIGHTS			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	(0.3609) 0.3636			
	2.00				2.250	0.4444			
	1.50				1.750	0.5714			
	1.05		23.1	19.2	(1.087) 1.275	(0.9199) 0.7843	4.77		95.22
	0.742		55.2	20.5	0.896	1.116	42.54		52.69
	0.525		39.5	18.5	0.634	1.577	25.67		27.02
	0.371		29.2	19.3	0.448	2.232	10.88		16.14
	0.263	3	26.7	18.3	0.317	3.154	10.27		5.87
	0.185	4	21.0	19.4	0.224	4.464	2.81		3.06
	0.131	6	19.6	19.3	0.158	6.329	0.37		2.69
	0.093	8	20.6	22.5	0.112	8.928	0.12	97.43	2.57
	0.065	10	19.2	19.2			0.00		2.57
	PAN		22.7	20.9			2.20		0.37
TOTAL ON SCREENS AND PAN							0.37		0.00
LOSS (BY DIFFERENCE)							100.00		-
TOTAL SAMPLE WEIGHT							-		-

$\sum_{i=1}^m D_i$	0.62407	$\sum_{i=1}^m X_i$	
$1/\sum_{i=1}^m D_i$	1.64977	$\sum_{i=1}^m X_i / D_i$	
$D_a$	0.59056	$\sum_{i=1}^m X_i D_i$	
$D_r$	0.70211		

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