

GAS COMBUSTION REPORTING  
DETAILED RUN SUMMARY SHEET

1513017003

Date 5-28-67

Purpose: To determine operability and yield with heat distribution from using type-1 rich shale - Mobil Tech Force recommendations

GENERAL	
Run No.	C1039-3
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-1
Tons Total Raw Shale Charged, lbs.	97.9
Bed Height above Dist., ft	5 1/2'
Type Air Dist.	AD-X
Bed Below Air Dist., ft	6'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	296
Spent Shale, % of RS	77.8
Liquid Product, lbs/hr	1808.6
Oil Collected, gal/ton RS	24.9
Air, SCF/ton RS (dry)	5630
Total Recycle*, SCF/ton RS (wet)	13300
Dilution, SCF/ton RS (wet)	2560
Calc. Vent Gas SCF/ton RS (dry)	7100
Gas Losses, SCF/ton RS (wet)	967
Propane, SCF/ton RS	20.4
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	137
Spent Shale, F	762
Raw Shale, °F	67
Recycle Gas Inlet, °F	250
Dilution Gas Inlet, °F	250
Air Inlet, °F	136
Retort Air Inlet, F	136
Heat of Comb. MBtu/ton RS	540
Heat Lost, MBtu/ton RS	-98
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	27.7
Oil, Wt %	10.5
Water, Wt %	1.0
Gas, Wt %	1.7
Mineral CO <sub>2</sub> , Wt %	16.7
Ash, Wt %	67.9
Moisture, Wt % (Uncrushed)	2.02
Carbon (Total), Wt %	16.9
Hydrogen (Total), Wt %	1.81
Nominal Size Range, inches	1/4" - 1"
5 % passing thru	0.0654
98 % passing thru	1.05
D <sub>a</sub>	0.613
D <sub>v</sub>	0.733
Line Burner °F	840

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.4*
Mineral CO <sub>2</sub> , Wt %	11.8
Ash, Wt %	87.3
Carbon (total), Wt %	4.98
Organic Carbon, Wt %	1.76
Hydrogen (total), Wt %	0.16
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	97.45
Density, lb/gal	7.793
Gravity, API	19.7
Ash, Wt %	-
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF (dry)	9.4
Oil, lbs/MSCF (dry)**	0.108
Analysis (dry)	
CO <sub>2</sub> , Vol %	27.8
O <sub>2</sub> , Vol %	0.4
N <sub>2</sub> + Argon, Vol %	62.8
CH <sub>4</sub> , Vol %	1.3
CO, Vol %	3.1
H <sub>2</sub> , Vol %	4.4
Other, Vol %	0.2
Gross Heating Value (calc), Btu/SCF	67.0
Carbon (Total), lbs/MSCF (dry)	11.6
Hydrogen (Total), lbs/MSCF (dry)	0.49
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	88.7
Oil in Gas**, Vol % RSFA	0.4
Oil in Spent Shale, Vol % RSFA	0.7
Total Oil Meas., Vol % RSFA	89.8
Carbonate Decomposition, %	45.0
Water Recovered, lb/ton RS	122.9
Ash Balance, % - As Measured	-
Ash Balance, % - Assumed	RS 100
Overall Balance, %	98.9
Carbon Balance, % - Organic	92.6
Carbon Balance, % - Total	95.7
Hydrogen Balance, % - Organic	90.4
Hydrogen Balance, % - Total	99.4
Water Balance, %	120.4
MISCELLANEOUS	
Avg. Retort ΔP, in H <sub>2</sub> O/ft	0.50
ΔP Above Air Dist., in H <sub>2</sub> O/ft	0.47
NaCl Soln., Wt %	-
NaCl Rate, gal/ton RS	-

Comments: RS off for approximately 3 hours due to failure of 5 S driver operation - Unit locked up in this water calculation on 9 hour balance - yields on RS fed to unit. Data are questionable.

\* 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.

# Very wet shale \* Used S.S. analysis from C1039-2.  
 Signed Earl F. Jones DATE June 20, 1967

6/12/6

//A100

2080, C1039-3 R-1 5-23-67

A. YIELDS

FAY	8.860E 01	DPYGAS	7.097E 03	MISIFA	3.560E-01
H2	3.123E 02	OTHER	1.419E 01	UNRETO	7.407E-01
CH4	9.225E 01	O2	2.339E 01	SSY	7.773E 01
CO	2.200E 02	CO2DESC	4.504E 01	MH2O	1.229E 02
CO2	1.973E 03	OILCOL	2.457E 01		

B. METERED GAS RATES

RECG	1.071E 04	DIL	2.564E 03	MVENTG	7.533E 03
AIR	5.633E 03	TSECG	1.327E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWVG	2.902E 01	HVGT	4.791E 02	MWDC	3.120E 01
GBTU	6.751E 01				

D. COMBUSTION PRODUCTS

CO2C	6.337E 02	COG	2.070E 02	H2CC	4.007E 01
CHR	5.926E 00	COMBCP	1.071E 01		

E. MATERIAL IN

ORECIN	2.433E 02	PSR	2.955E 02	OPH2IN	3.440E 01
MATIN	2.476E 03				

F. MATERIAL OUT

ORCOVB	4.194E 01	COXEC	2.550E 01	UNRETH	1.985E-01
ORCCOL	1.610E 02	OPH2VC	7.055E 00	COXEM	1.594E 00
UNRETC	1.253E 00	ORH2CL	2.125E 01	ORCCLP	6.472E 01
ORCVGP	1.686E 01	ORCSSP	1.100E 01	WCCVGP	6.147E 00

G. MATERIAL BALANCES

CVALL	9.391E 01	OPH2	9.041E 01	O2BAL	1.049E 02
ASH	0.0	TC	9.565E 01	WATER	1.204E 02
OREC	9.253E 01	TH2	9.936E 01	CASL	9.673E 02
ASHE	-1.000E 00				

H. HEAT IN

QCOXB	5.403E 05	QH2CC	8.027E 03	QAIR	7.151E 03
QPRCP	6.564E 01	QOILC	1.340E 04	QFCYL	4.987E 04
QSUYIN	6.183E 05				

I. HEAT OUT

QNOCD	2.437E 05	QKEPOD	9.635E 04	QH2CV	6.580E 04
QLIC	4.269E 03	QOFGAS	3.122E 04	QSS	2.607E 05
QGASL	1.422E 04	LBLOSS	0.0	HETLOS	-9.814E 04
QSUYOT	6.183E 05				

J. MISCELLANEOUS

ORCSS	1.759E 00	VPCIL	1.083E-01	TCL	3.075E 03
VPM	9.403E 00	WCR	1.651E 01	PRCP	2.044E 01

END MESSAGE

END OUTPUT

# HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	← USER IDENTIFICATION →					
0	2080,	C1039-3 R-1 5-28-67					
1	WRS 1.0	OLRS 10.5	TRS 67	B -1	MRS 16320.2	← RAW SHALE	
2	FA 27.7	GRS 1.7	CORS 16.7	XA 55.22			
3	ASRS 67.9	CRS 16.9	HRS 1.81	BP 24.10	TOG 137		
4	CRA 771.4	MFA 1.0	TA 136	PA 121	WA 0.14	LBHL 0	← AIR
5	CRRG 1466.2	MFRG 1.0	TRG 250	PRG 72	CRTG 0.0	MFTG 0.0	← RECYCLE A TOTAL GAS
6	CRDG 3.6	MFDG 119.4	TDG 250	PDG 70			← DILUTION G
7	P 3.2	TP 0.4	PP 132.2	W 336.5	N 0.0		← PROPANE A NUCLEATING AGENT
8	WSS 0.4	OLSS 0.1	GSS 0.1	SS 0.0			← SPENT SHALE
9	COSS 11.8	ASSS 87.3	CSS 4.98	HSS 0.16	TSS 762		
10	OILLP 1562.2	COL 84.1	HOL 11.1	DOL 7.793	WLP 246.5		← LIQUID PRODUCT
11	CRVG 1448.4	MFVG 1.0	TVG 250	WG 0.0	OILM 0.0	M 0	← VENT GAS
12	CG 11.6	H 0	COOG 27.8	OG 0.4	NG 62.8		
13	MEG 1.3	COG 3.1	HHG 4.4	OTG 0.2	HG 0.49		
14	CRVP 4.1	VPMF 1.83	TVP 137	PVP 80			← VENT PURGE
15	TVPC 80	VPOIL 37.8	VPW 5.7	GL 19.0			

*Used S.S.  
from C1039-2*

*126.9*

**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 5-28-67

Run No. C1039-3

Sample Time: RS 18:15; SS \_\_\_\_\_

FISCHER ASSAY

RETORT SHALE MOISTURE

EJ

<input checked="" type="radio"/> RAW SHALE	<input checked="" type="radio"/> SPENT SHALE	used SS from Gal/Ton C1039-2	<input type="radio"/> RAW SHALE FISCHER ASSAY MOISTURE
<u>27.4</u>	<u>0.4</u>		<u>2.02</u> wt %
<u>.913</u>	<u>—</u>	S.G., g/ml	<u>1.05</u> wt %
<u>10.4</u>	<u>0.1</u>	Oil, wt %	
<u>2.0</u>	<u>0.4</u>	Water, wt %	
<u>85.8</u>	<u>99.4</u>	Sp. Shale, wt %	
<u>1.7</u>	<u>0.1</u>	Gas & Loss, wt %	
<u>slight</u>		COKING TENDENCY	

MINERAL CO<sub>2</sub>

EWA

16.7  11.8 wt %

ASH (SHALE)

<sup>67.7</sup>67.5  87.3 wt %

MOISTURE

0.24  0.1 wt %

CARBON

16.9  4.98 wt %

HYDROGEN

1.81  0.16 wt %

BENZENE EXTRACTABLES

.  . wt %

used S.S. analysis  
from C1039-2

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 1 1967

CHECKED BY REP

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-28-67  
5-29-67

Run No. C1039-3

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
<input checked="" type="checkbox"/> WATER, wt %	9.2	2.9	<del>    </del>	<del>    </del>	<del>    </del>	<del>    </del>
<input checked="" type="checkbox"/> GRAVITY, °API	19.7	19.7	<del>    </del>	<del>    </del>	<del>    </del>	<del>    </del>
<input type="checkbox"/> OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

*jk*

OIL WT, g 340

WATER VOL, ml 41

GRAVITY OIL, °API 39.7

VENT GAS

<input checked="" type="checkbox"/> MAJOR COMPONENTS	<input type="checkbox"/> C <sub>1</sub> thru C <sub>4</sub> , plus n-Pentane
CO <sub>2</sub> <u>27.8</u> vol %	CH <sub>4</sub> _____ vol %
O <sub>2</sub> <u>0.4</u> "	C <sub>2</sub> H <sub>4</sub> -C <sub>2</sub> H <sub>6</sub> _____ "
N <sub>2</sub> <u>62.0</u> "	C <sub>3</sub> H <sub>8</sub> _____ "
CH <sub>4</sub> <u>1.3</u> "	C <sub>3</sub> H <sub>6</sub> _____ "
CO <u>3.1</u> "	i C <sub>4</sub> H <sub>10</sub> _____ "
H <sub>2</sub> <u>4.4</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>0.2</u> "	n C <sub>5</sub> H <sub>12</sub> _____ "

CARBON, 11.6 lbs/MSCFDG       HYDROGEN, 0.49 lbs/MSCFDG

COMMENTS \_\_\_\_\_

DATE COMPLETED JUN 1 1967

CHECKED BY REP

OSRC-12B  
(Revised 5/3/66)

# SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. 0-1039-3 SAMPLE NO. 3 DATE 5-28-67

UNIT 1/2 DESCRIPTION TY-LAB

APPROX. SHALE SIZE 1/4-1 SHAKING TIME 10 min. ANALYSIS BY Kelchler's outs

TOTAL SAMPLE WT. GROSS 28.0 - TARE 3.3 = NET 24.7

SCREEN SIZE			WEIGHTS								
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED	SCREEN SIZE	$D_i$ *	$1/D_i$	% 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		21.7	19.1	2.6	1.05	(1.037) 1.275	(0.9199) 0.7843	10.53		89.47
	0.742		22.3	20.2	8.8	0.742	0.896	1.116	35.63		53.84
	0.525		24.1	18.5	5.6	0.525	0.634	1.577	22.67		31.17
	0.371		21.4	19.2	2.2	0.371	0.448	2.232	8.91		22.26
	0.263	3	20.0	18.4	1.8	0.263	0.317	3.154	7.29		14.97
	0.185	4	20.0	19.4	1.6	0.185	0.224	4.464	2.43		12.54
	0.131	6	19.5	18.3	1.2	0.131	0.158	6.329	0.81		11.73
	0.093	8	20.5	20.5	1.0	0.093	0.112	8.928	0.00	88.27	11.73
	0.065	10	19.3	19.3	1.1	0.065			0.40		11.33
	PAN		23.9	21.0	2.7	PAN			10.93		0.40
TOTAL ON SCREENS AND PAN					24.6	LOSS			0.40		0.00
LOSS (BY DIFFERENCE)					1.1	TOTAL			100.00	-	-
TOTAL SAMPLE WEIGHT					24.7				-	-	-

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

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

$\sum_{+8m}^m D_i$	0.64718	$\sum_{+8m}^m X_i$	
$1/\sum_{+8m}^m D_i$	1.44054	$\sum_{+8m}^m X_i / D_i$	
$D_a$	0.61275	$\sum_{+8m}^m X_i D_i$	
$D_v$	0.73318		

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