

GAS COMBUSTION REPORTING
DETAILED RUN SUMMARY SHEET

151301807

Date 6-26-67

Purpose: To determine operability and yield with 2% wet ash with hot air addition. (without dilution gas)

GENERAL	
Run No.	C1697-5
Length, hours	12
Retort Type Number	RC VII
Oil Recovery System Number	C-1
Total Raw Shale Charged, lbs.	99.61
Bed Height above Dist., ft	9 1/2
Type Air Dist.	AD 2.1
Bed Below Air Dist., ft	6
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft ²)	301
Spent Shale, % of RS	81.5
Liquid Product, lbs/hr	1771.4
Oil Collected, gal/ton RS	25.7
Air, SCF/ton RS (dry)	4210
Total Recycle*, SCF/ton RS (wet)	13660
Dilution, SCF/ton RS (wet)	—
Calc. Vent Gas SCF/ton RS (dry)	5670
Gas Losses, SCF/ton RS (wet)	807
Propane, SCF/ton RS	23.7
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	140
Spent Shale, F	512
Raw Shale, °F	95
Recycle Gas Inlet, °F	275
Dilution Gas Inlet, °F	—
Air Inlet, °F	150
Retort Air Inlet, F	150
Heat of Comb. MBtu/ton RS	394
Heat Lost, MBtu/ton RS	0.4
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	30.7
Oil, Wt %	11.7
Water, Wt %	0.55
Gas, Wt %	2.6
Mineral CO ₂ , Wt %	18.1
Ash, Wt %	65.8
Moisture, Wt % (Uncrushed)	1.16
Carbon (Total), Wt %	18.8
Hydrogen (Total), Wt %	1.95
Nominal Size Range, inches	1/4" - 2 1/2"
5 % passing thru	0.371
98 % passing thru	2.50
D ₅₀	1.135
D _v	1.620
Line burner of	925

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.6
Mineral CO ₂ , Wt %	17.2
Ash, Wt %	80.7
Carbon (total), Wt %	7.45
Organic Carbon, Wt %	2.75
Hydrogen (total), Wt %	0.21
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	98.0
Density, lb/gal	7.747
Gravity, API	20.6
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF (dry)	5.4
Oil, lbs/MSCF (dry)**	0.182
Analysis (dry)	
CO ₂ , Vol %	24.2
O ₂ , Vol %	0.0
N ₂ + Argon, Vol %	58.7
CH ₄ , Vol %	2.6
CO, Vol %	4.2
H ₂ , Vol %	6.1
Other, Vol %	4.2
Gross Heating Value (calc), Btu/SCF	136.7
Carbon (Total), lbs/MSCF (dry)	12.9
Hydrogen (Total), lbs/MSCF (dry)	1.06
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	83.6
Oil in Gas**, Vol % RSFA	0.4
Oil in Spent Shale, Vol % RSFA	1.4
Total Oil Meas., Vol % RSFA	85.4
Carbonate Decomposition, %	22.5
Water Recovered, lb/ton RS	50.1
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	75.100
Overall Balance, %	99.9
Carbon Balance, % - Organic	96.5
Carbon Balance, % - Total	97.1
Hydrogen Balance, % - Organic	86.6
Hydrogen Balance, % - Total	88.3
Water Balance, %	93.4
MISCELLANEOUS	
Avg. Retort ΔP, in H ₂ O/ft	0.36
ΔP Above Air Dist., in H ₂ O/ft	0.39
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Recycle gas water measured with reduction in air rate. High recycle gas about one hour.

*Measured Recycle + Dilution Gas
 ** Oil Mist + Condensibles to 83 °F
 *** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. Turner DATE July 17 1967
 OSRC-10
 Revised 7/19/66

//A100

2080, C1047-5 6-26-67

A. YIELDS

FAY	8.364E 01	DRYGAS	5.674E 03	MISTFA	4.337E-01
H2	3.461E 02	OTHER	2.383E 02	UNRETO	1.394E 00
CH4	1.475E 02	O2	0.0	SSY	8.154E 01
CO	2.383E 02	CO2DEC	2.252E 01	MH2O	5.005E 01
CO2	1.373E 03	OILCOL	2.568E 01		

B. METERED GAS RATES

RECG	1.362E 04	DIL	0.0	WVENTG	5.513E 03
AIR	4.210E 03	TRECG	1.362E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWVG	2.940E 01	HVGT	7.757E 02	MWDG	3.069E 01
GBTU	1.367E 02				

D. COMBUSTION PRODUCTS

CO2C	5.951E 02	COC	2.156E 02	H2OC	1.752E 01
CHR	1.307E 01	COMBCP	9.197E 00		

E. MATERIAL IN

ORGCIN	2.794E 02	RSR	3.006E 02	ORH2IN	3.816E 01
MATIN	2.349E 03				

F. MATERIAL OUT

ORGCVG	5.184E 01	COKEC	4.160E 01	UNRETH	3.891E-01
ORGCOL	1.673E 02	ORH2VG	8.093E 00	COKEH	2.488E 00
UNRETC	3.314E 00	ORH2OL	2.208E 01	ORCOLP	5.987E 01
ORCVGP	1.855E 01	ORCSSP	1.608E 01	HCCVGP	9.354E 00

G. MATERIAL BALANCES

OVALL	9.941E 01	ORH2	8.660E 01	O2BAL	9.953E 01
ASH	0.0	TC	9.708E 01	WATER	9.343E 01
ORGC	9.450E 01	TH2	8.825E 01	GASL	8.065E 02
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	3.936E 05	QH2OC	6.311E 03	QAIR	4.272E 03
QPROP	6.233E 01	QOILC	1.392E 04	QRCYL	5.332E 04
QSUMIN	4.715E 05				

I. HEAT OUT

QMC02D	1.321E 05	QKEROD	1.124E 05	QH2OV	3.824E 04
QLIQO	3.338E 03	QOFGAS	1.888E 04	QSS	1.586E 05
QGASL	7.607E 03	LBLOSS	0.0	HETLOS	4.010E 02
QSUMOT	4.715E 05				

J. MISCELLANEOUS

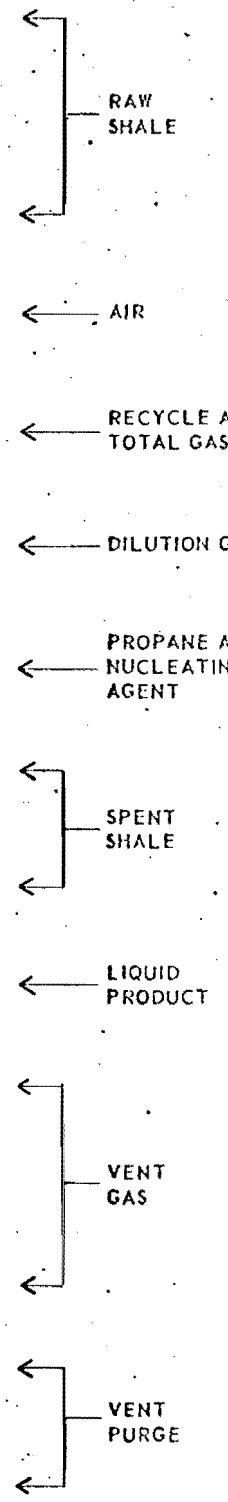
ORCSS	2.754E 00	VPOIL	1.818E-01	TGL	2.876E 03
VPH	5.407E 00	WCG	1.021E 01	PROP	2.367E 01

END MESSAGE

END OUTPUT

HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	← USER IDENTIFICATION →				
0	2080,	C1047-5		6/26/67		
1	WRS	OLRS	TRS	B	MRS	
	0.6	11.7	95	-1	16601.0	
2	FA	GRS	CORS	XA		
	30.7	2.6	18.1	55.22		
3	ASRS	CRS	HRS	BP	TOG	
	65.8	18.8	1.95	24.30	140	
4	CRA	MFA	TA	PA	WA	LBHL
	584.0	1.0	150	124	0.14	0
5	CRRG	MFRG	TRG	PRG	CRTG	MFTG
	1900.9	1.0	275	73	0.0	0.0
6	CRDG	MFDG	TDG	PDG		
	0.0	0.0	0	0		
7	P	TP	PP	W	N	
	3.77	0.4	129.5	194.8	0.0	
8	WSS	OLSS	GSS	SS		
	0.3	0.2	0.1	0.0		
9	COSS	ASSS	CSS	HSS	TSS	
	17.2	80.7	7.45	0.21	512	
10	DILLP	COL	HOL	DOL	WLP	
	1651.1	84.1	11.1	7.747	170.2	
11	CRVG	MVVG	TVG	WG	OILM	M
	815.9	1.0	266	0.0	0.0	0
12	CG	H	COOG	OG	NG	
	12.9	0	24.2	0.0	58.7	
13	MEG	COG	HHG	DTG	HG	
	2.6	4.2	6.1	4.2	1.06	
14	CRVP	VPMF	TVP	PVP		
	2.6	2.18	164	44		
15	TVPC	VPOIL	VPW	GL		
	83	56.9	2.2	86.0		



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 Mlst,
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 6-26-67

Run No. C 1047-5

Sample Time: RS 1815; SS 2315

FISCHER ASSAY

ASA

RETORT SHALE MOISTURE

RAW SHALE SPENT SHALE

ELB 1.16 wt %

<u>30.3</u>	<u>0.6</u>	Gal/Ton
<u>.913</u>	<u>.901</u>	S.G., g/ml
<u>11.6</u>	<u>0.2</u>	Oil, wt %
<u>1.7</u>	<u>0.3</u>	Water, wt %
<u>84.1</u>	<u>99.4</u>	Sp. Shale, wt %
<u>2.6</u>	<u>0.1</u>	Gas & Loss, wt %
<u>Slight</u>	<u>none</u>	COKING TENDENCY

RAW SHALE FISCHER ASSAY MOISTURE

0.86 wt %

MINERAL CO₂

ELB

EDK, ELB

17.9 17.2 wt %

ASH (SHALE)

ELB

ELB

65.2 80.7 wt %

MOISTURE

ELB

ELB

0.38 0.04 wt %

SHALE RICHNESS DISTRIBUTION
(See attached graph)

CARBON

ELB

18.6 7.45 wt %
9.4

SCREEN ANALYSIS
(See back of this sheet)

HYDROGEN

ELB

1.93 0.21 wt %
0.21

BENZENE EXTRACTABLES

. . wt %

All results are "as received" unless noted. "Moisture" designates the moisture content of the -48 mesh material used for "Ash", "Mineral CO₂", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS

DATE COMPLETED JUL 29 1967

CHECKED BY

Ref

OSRC-12A

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-26-67

Run No. C. 1047-5

LIQUID PRODUCTS

D3 PUMPOUT

T3 PUMPOUT

J.H.

WATER, wt %

1	2	3	4
<u>2.0</u>	/	/	/

1	2

GRAVITY, °API

<u>20.6</u>	/	/	/
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OIL ASH, wt %

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

J.H. &

OIL WT, g 683.0

WATER VOL, ml 60.0

GRAVITY OIL, °API 41.8

VENT GAS

J.H.

MAJOR COMPONENTS

CO ₂	<u>24.2</u>	vol %
O ₂	<u>0.0</u>	"
N ₂	<u>58.0</u>	"
CH ₄	<u>2.6</u>	"
CO	<u>4.2</u>	"
H ₂	<u>6.1</u>	"
Ar	<u>0.7</u>	"

C₁ thru C₄, plus n-Pentane

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

J.H.
 CARBON, 12.9 lbs/MSCFDG
8.26

E.B.
 HYDROGEN, 1.06 lbs/MSCFDG
0.60

COMMENTS _____

DATE COMPLETED JUN 28 1967

CHECKED BY R.E.

SCREEN ANALYSIS DATA SHEET (TY-LAB)

20.4

RUN NO. C1047-5 SAMPLE NO. T. L. L. DATE 6-26-67
 UNIT Retort 3 DESCRIPTION _____
 APPROX. SHALE SIZE 1/2 2 1/2 SHAKING TIME 10 min ANALYSIS BY Jones
 TOTAL SAMPLE WT. GROSS 84.7 - TARE 6.6 = NET 78.1

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		29.6	16.6	13.0	2.50	(2.625) 2.750	(0.3809) 0.3636	16.65		83.36
	2.00		37.9	20.2	17.7	2.00	2.250	0.4444	22.66		60.70
	1.50		34.1	23.4	10.7	1.50	1.750	0.5714	13.70		47.00
	1.05		33.5	19.2	14.3	1.05	(1.087) 1.275	(0.9199) 0.7843	18.31		28.69
	0.742		29.2	20.5	8.7	0.742	0.896	1.116	11.14		17.55
	0.525		25.5	18.5	7.0	0.525	0.634	1.577	8.96		8.59
	0.371		22.5	19.2	3.3	0.371	0.448	2.232	4.23		4.36
	0.263	3	20.6	18.5	2.1	0.263	0.317	3.154	2.69		1.67
	0.185	4	19.8	19.4	.4	0.185	0.224	4.464	0.51		1.16
	0.131	6	19.5	19.4	.1	0.131	0.158	6.329	0.13		1.03
	0.093	8	20.5	20.4	.1	0.093	0.112	8.928	0.13	99.11	0.90
	0.065	10	19.2	19.2	0	0.065			0.00		0.90
	PAN		21.7	21.0	.7	PAN			0.90		0.00
TOTAL ON SCREENS AND PAN					78.1	LOSS			-	-	-
LOSS (BY DIFFERENCE)					-	TOTAL			100.01	-	-
TOTAL SAMPLE WEIGHT					-				-	-	-

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

$\sum_{+8m}^m D_i$	1.60571	$\sum_{+8m}^m X_i$	
$1/\sum_{+8m}^m D_i$	0.87349	$\sum_{+8m}^m X_i / D_i$	
D _a	1.13464	$\sum_{+8m}^m X_i D_i$	
D _v	1.62012		

REMARKS: _____