15130119008

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 7-16-67

Purpose: To improve [illegible] and yield with [illegible] shale with hot air [illegible]

GENERAL	
Run No.	C105Z-1
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-2
Tons Total Raw Shale Charged, ~~lbs.~~	96.75
Bed Height above Dist., ft	5½'
Type Air Dist.	AD-XII
Bed Below Air Dist., ft	6'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	292
Spent Shale, % of RS	80.8
Liquid Product, lbs/hr	1582.8
Oil Collected, gal/ton RS	23.2
Air, SCF/ton RS (dry)	4840
Total Recycle*, SCF/ton RS(wet)	13300
Dilution, SCF/ton RS (wet)	—
Calc. Vent Gas SCF/ton RS(dry)	6340
Gas Losses, SCF/ton RS(wet)	742
Propane, SCF/ton RS	46.9
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	141
Spent Shale, F	373
Raw Shale, °F	83
Recycle Gas Inlet, °F	262
Dilution Gas Inlet, °F	—
Air Inlet, °F	160
Retort Air Inlet, F	160
Heat of Comb. MBtu/ton RS	459
Heat Lost, MBtu/ton RS	42
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	27.3
Oil, Wt %	10.4
Water, Wt %	1.1
Gas, Wt %	2.4
Mineral CO_2, Wt %	17.1
Ash, Wt %	67.8
Moisture, Wt % (Uncrushed)	1.59
Carbon (Total), Wt %	16.6
Hydrogen (Total), Wt %	1.75
Nominal Size Range, inches	¼"-1"
5 % passing thru	0.263
98 % passing thru	1.05
D_a	0.648
D_v	0.730
Line Burner °F	840

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	1.5
Mineral CO_2, Wt %	13.5
Ash, Wt %	83.9
Carbon (total), Wt %	6.09
Organic Carbon, Wt %	2.41
Hydrogen (total), Wt %	0.29
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	99.0
Density, lb/gal	7.804
Gravity, API	19.5
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	13.2
Oil, lbs/MSCF(dry)**	0.648
Analysis (dry)	
CO_2, Vol %	26.9
O_2, Vol %	0.4
N_2 + Argon, Vol %	60.4
CH_4, Vol %	1.9
CO, Vol %	3.5
H_2, Vol %	5.6
Other, Vol %	1.3
Gross Heating Value(calc),Btu/SCF	120.6
Carbon (Total), lbs/MSCF (dry)	12.8
Hydrogen (Total), lbs/MSCF (dry)	0.86
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	84.9
Oil in Gas**, Vol % RSFA	1.9
Oil in Spent Shale, Vol % RSFA	4.6
Total Oil Meas., Vol % RSFA	91.4
Carbonate Decomposition, %	36.2
Water Recovered, lb/ton RS	108.7
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	RS-100
Overall Balance, %	100.3
Carbon Balance, % - Organic	99.5
Carbon Balance, % - Total	99.6
Hydrogen Balance, % - Organic	98.5
Hydrogen Balance, % - Total	107.9
Water Balance, %	126.8
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.30
ΔP Above Air Dist., in H_2O/ft	0.38
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Off gas temperature [illegible] only 6°F [illegible] [illegible] under control.

*Measured Recycle + Dilution Gas

** Oil Mist + Condensibles to 77 °F

*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed [illegible] DATE July [illegible] 1967

OSRC-10
Revised 7/19/66

//A100
3080. C1052-1 R-1 7-16-67

A. YIELDS

FAY	8.486E 01	DRYGAS	6.344E 03	MISTFA	1.928E 00
H2	3.553E 02	OTHER	8.248E 01	UNRETO	4.682E 00
CH4	1.205E 02	O2	2.538E 01	SSY	8.081E 01
CO	2.281E 02	CO2DEC	3.620E 01	MH2O	1.087E 02
CO2	1.707E 03	OILCOL	2.317E 01		

B. METERED GAS RATES

RECG	1.327E 04	DIL	0.0	WVENTG	7.358E 03
AIR	4.843E 03	TRECG	1.327E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWVG	2.808E 01	HVGT	7.650E 02	MWDG	3.086E 01
GBTU	1.206E 02				

D. COMBUSTION PRODUCTS

CO2C	5.714E 02	COC	2.015E 02	H2OC	3.072E 01
CHR	7.107E 00	COMBCP	1.008E 01		

E. MATERIAL IN

ORGCIN	2.431E 02	RSR	2.920E 02	ORH2IN	3.354E 01
MATIN	2.409E 03				

F. MATERIAL OUT

ORGCVG	5.090E 01	COKEC	2.957E 01	UNRETH	1.130E 00
ORGCOL	1.520E 02	ORH2VG	9.355E 00	COKEH	2.471E 00
UNRETC	9.287E 00	ORH2OL	2.007E 01	ORCOLP	6.255E 01
ORCVGP	2.094E 01	ORCSSP	1.599E 01	HCCVGP	1.086E 01

G. MATERIAL BALANCES

OVALL	1.003E 02	ORH2	9.846E 01	O2BAL	1.056E 02
ASH	0.0	TC	9.961E 01	WATER	1.268E 02
ORGC	9.947E 01	TH2	1.079E 02	GASL	7.417E 02
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	4.577E 05	QH2OC	1.251E 04	QAIR	6.879E 03
QPROP	1.727E 02	QOILC	1.265E 04	QRCYL	5.016E 04
QSUMIN	5.401E 05				

I. HEAT OUT

QMCO2D	2.006E 05	QKEROD	9.723E 04	QH2OV	5.972E 04
QLIQO	3.875E 03	QOFGAS	2.504E 04	QSS	1.065E 05
QGASL	4.618E 03	LBLOSS	0.0	HETLOS	4.245E 04
QSUMOT	5.401E 05				

J. MISCELLANEOUS

ORCSS	2.405E 00	VPOIL	6.476E-01	TGL	3.012E 03
VPH	1.315E 01	WCG	2.167E 01	PROP	4.690E 01

2 to MESSAGE

END OUTPUT

LINE #	PROGRAM ID	USER IDENTIFICATION					
0	2080, 3080	C 1052-1	R-1	7-16-67			
	WRS	OLRS	TRS	B	MRS		RAW SHALE
1	1.1	10.4	83	-1	16125.4		
	FA	GRS	CORS	XA			
2	27.3	2.4	17.1	55.22			
	ASRS	CRS	HRS	BP	TOG		
3	67.8	16.6	1.75	24.48	141		
	CRA	MFA	TA	PA	WA	LBHL	AIR
4	651.3	1.0	160	147	0.14	0	
	CRRG	MFRG	TRG	PRG	CRTG	MFTG	RECYCLE A TOTAL GAS
5	1754.7	1.0	262	73	0.0	0.0	
	CRDG	MFDG	TDG	PDG			DILUTION G
6	0.0	0.0	0	0			
	P	TP	PP	W	N		PROPANE A NUCLEATIN AGENT
7	6.3	0.4	127.1	260.5	0.0		
	WSS	OLSS	GSS	SS			SPENT SHALE
8	0.6	0.6	0.2	0.0			
	COSS	ASSS	CSS	HSS	TSS		
9	13.5	83.9	6.09	0.29	373		
	OILLP	COL	HOL	DOL	WLP		LIQUID PRODUCT
10	1457.6	84.1	11.1	7.801	125.3		
	CRVG	MFVG	TVG	WG	OILM	M	VENT GAS
11	1013.1	1.0	259	0.0	0.0	0	
	CG	H	COOG	OG	NG		
12	12.8	0	76.9	0.4	60.4		
	MEG	COG	HHG	OTG	HG		
13	1.9	3.5	5.6	1.3	0.86		
	CRVP	VPMF	TVP	PVP	P.V.P.C.		VENT PURGE
14	4.8	1.83	77	183	3.0		
	TVPC	VPOIL	VPW	GL			
15	77	76.1	2.8	81.4			
			11.2				

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 7-16-67 Run No. C1052-1
#1 SS Sample

Sample Time: RS 18:15; SS ~~2345~~ ~~1775~~ 1715

FISCHER ASSAY		
(X) RAW SHALE	(X) SPENT SHALE	
27.1	2.8 1.5	Gal/Ton
0.911	~~.901~~	S.G., g/ml
10.3	1.0 0.6	Oil, wt %
1.9	.6 0.6	Water, wt %
85.4	~~75.2~~ 99.0	Sp. Shale, wt %
2.4	.2 0.2	Gas & Loss, wt %
slight	none	COKING TENDENCY

( ) RETORT SHALE MOISTURE
1.59 wt %

(X) RAW SHALE FISCHER ASSAY MOISTURE
0.80 wt %

MINERAL CO_2		
(X) 17.1	(X) 13.4 13.5	wt %
ASH (SHALE)		
(X) 67.6	(X) ~~85.2~~ ~~85.2~~ 83.9	wt %
MOISTURE		
(X) 0.28	(X) ~~.6~~ 0.08 6.09	wt %
CARBON		
(X) 16.6 ~~17.0~~	(X) ~~5.48~~ 5.59 6.09	wt %
HYDROGEN		
(X) 1.75 ~~1.84~~	(X) ~~0.19~~ 0.21 0.29	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_2", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS

DATE COMPLETED ~~JUL 18 1967~~ CHECKED BY KEP

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7-16-67 Run No. C/052-1 55

#1 sample

Sample Time: RS _____; SS 2345

FISCHER ASSAY

( ) RAW SHALE (X) SPENT SHALE

.	0.2	Gal/Ton
.	—	S.G., g/ml
.	0.1	Oil, wt %
.	0.09	Water, wt %
.	0.58	Sp. Shale, wt %
.	99.5	Gas & Loss, wt %
.	.1	COKING TENDENCY
	None	

MINERAL CO_2

( ) . (X) EJ 13.6 wt %

ASH (SHALE)

( ) . (X) DK 82.6 wt %

MOISTURE

( ) . (X) DK 6.10 wt %

CARBON

( ) . (X) EJ 6.59 wt %

HYDROGEN

( ) . (X) 0.36 wt %

BENZENE EXTRACTABLES

( ) . ( ) . wt %

( ) RETORT SHALE MOISTURE

_____ wt %

RAW SHALE FISCHER ASSAY MOISTURE

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_2", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS

DATE COMPLETED JUL 18 1967 CHECKED BY KEP

OSRC-12A
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LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7-16-67 Run No. C1052-1

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	1.0					
GRAVITY, °API	19.5					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 913.0

WATER VOL, ml 820.0

GRAVITY OIL, °API 39.1

VENT GAS

MAJOR COMPONENTS

CO_2	26.9	vol %
O_2	0.4	"
N_2	59.7	"
CH_4	1.9	"
CO	3.5	"
H_2	5.6	"
Ar	0.7	"
Others	1.3	"

C_1 thru C_4, plus n-Pentane

CH_4	.	vol %
C_2H_4-C_2H_6	.	"
C_3H_8	.	"
C_3H_6	.	"
i C_4H_{10}	.	"
n C_4H_{10}	.	"
$\emptyset C_3H_6$	.	"
n C_5H_{12}	.	"

CARBON, 12.8 lbs/MSCFDG

HYDROGEN, 0.86 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUL 18 1967 CHECKED BY REP

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C-1052-1 SAMPLE NO. _____ DATE 7-16-67

UNIT _____ DESCRIPTION _____

APPROX. SHALE SIZE ¼ to 1" SHAKING TIME 10 min. ANALYSIS BY Sowa

TOTAL SAMPLE WT. GROSS 76.0 – TARE 6.6 = NET 69.4

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE. LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50				
	2.00				
	1.50				
	1.05		21.0	19.2	1.8
	0.742		54.3	20.5	33.8
	0.525		37.8	18.5	19.3
	0.371		26.6	19.2	7.4
	0.263	3	23.3	18.4	4.9
	0.185	4	19.9	19.4	.5
	0.131	6	19.5	19.4	.1
	0.093	8	20.8	20.8	0
	0.065	10	19.3	19.2	.1
	PAN		22.2	21.0	1.2
	TOTAL ON SCREENS AND PAN				69.1
	LOSS (BY DIFFERENCE)				.3
	TOTAL SAMPLE WEIGHT				69.4

SCREEN SIZE	Di *	1/Di	% RETAINED	CUM. % RETAINED	% PASSING
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	2		
1.05	(1.067) 1.275	(0.9199) 0.7843	2.60		97.38
0.742	0.896	1.116	48.91		48.47
0.525	0.634	1.577	27.93		20.54
0.371	0.448	2.232	10.71		9.83
0.263	0.317	3.154	7.09		2.74
0.185	0.224	4.464	0.72		2.02
0.131	0.158	6.329	0.14		1.88
0.093	0.112	8.928	0.00	98.10	1.88
0.065			0.14		1.74
PAN			1.74		0.00
LOSS			–	–	–
TOTAL			99.98	–	–
			–	–	–

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

$\sum_{+8m}^{m} Di$	9.71586	$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$	1.51388	$\sum_{+8m}^{m} Xi/Di$	
Da	0.64810	$\sum_{+8m}^{m} Xi\ Di$	
Dv	0.72972		

REMARKS: _____