1513013 010

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 4-12-67

Purpose: To determine [illegible] at 500 [illegible] 1-2½" [illegible] with 55 [illegible], 36 [illegible] A/D and 3 [illegible] 3 [illegible]

GENERAL	
Run No.	C-1028-3
Length, hours	12
Retort Type Number	RC-II
Oil Recovery System Number	C-2
TONS Total Raw Shale Charged, lbs.	16.35
Bed Height above Dist., ft	12½
Type Air Dist.	AD-VIII
Bed Below Air Dist., ft	7'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	496
Spent Shale, % of RS	82.2
Liquid Product, lbs/hr	2728.7
Oil Collected, gal/ton RS	20.6
Air, SCF/ton RS (dry)	4680
Total Recycle*, SCF/ton RS(wet)	12200
Dilution, SCF/ton RS (wet)	—
Calc.Vent Gas SCF/ton RS(dry)	6190
Gas Losses, SCF/ton RS(wet)	228
Propane, SCF/ton RS	—
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	136
Spent Shale, F	387
Raw Shale, °F	52
Recycle Gas Inlet, °F	245
Dilution Gas Inlet, °F	—
Air Inlet, °F	113
Retort Air Inlet, F	113
Heat of Comb. MBtu/ton RS	439
Heat Lost, MBtu/ton RS	31
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	25.0
Oil, Wt %	9.5
Water, Wt %	1.1
Gas, Wt %	1.9
Mineral CO_2, Wt %	17.7
Ash, Wt %	69.0
Moisture, Wt % (Uncrushed)	1.0 Est.
Carbon (Total), Wt %	15.6
Hydrogen (Total), Wt %	1.63
Nominal Size Range, inches	1"-2½"
5 % passing thru	0.742
98 % passing thru	2.50
Da	1.474
Dv	1.623

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.0
Mineral CO_2, Wt %	14.7
Ash, Wt %	83.9
Carbon (total), Wt %	6.13
Organic Carbon, Wt %	2.12
Hydrogen (total), Wt %	0.20
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	90.4
Density, lb/gal	7.804
Gravity, API	19.5
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	7.0
Oil, lbs/MSCF(dry)**	0.012
Analysis (dry)	
CO_2, Vol %	25.3
O_2, Vol %	0.4
N_2 + Argon, Vol %	60.0
CH_4, Vol %	1.8
CO, Vol %	3.9
H_2, Vol %	5.1
Other, Vol %	3.5
Gross Heating Value(calc),Btu/SCF	109.5
Carbon (Total), lbs/MSCF (dry)	12.5
Hydrogen (Total), lbs/MSCF (dry)	0.83
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	82.4
Oil in Gas**, Vol % RSFA	0.04
Oil in Spent Shale, Vol % RSFA	0.0
Total Oil Meas., Vol % RSFA	82.4
Carbonate Decomposition, %	31.7
Water Recovered, lb/ton RS	89.8
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	AS 100
Overall Balance, %	100.6
Carbon Balance, % - Organic	100.6
Carbon Balance, % - Total	100.4
Hydrogen Balance, % - Organic	94.9
Hydrogen Balance, % - Total	103.9
Water Balance, %	125.0
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.50
ΔP Above Air Dist., in H_2O/ft	0.51
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Operation [illegible]

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 75 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. [illegible] DATE April 21, 1967

OSRC-10

921, RUN NO. C-1028-3 *Started 4/12/67* *4/18/67*

YIELDS

FAY	3.239 01	DRYGAS	6.175 03	MICTFA	3.665-02		
H2	3.140 02	OTHER	2.161 02	UNRTTC	0.000 00	CH4	1.111 02
C2	2.470 01	SSY	2.224 01	CO	2.407 02	CO2DEC	3.169 01
MH2O	8.975 01	CO2	1.562 03	OILCOL	2.059 01		

METERED GAS RATES

RECG	1.223 04	DIL	0.000 00	WVENTG	6.853 03	AIR	4.673 03
TRECG	1.223 04	TGF	0.000 00				

MOL WT & HEATING VALUE OF VENT GAS

MWG	2.944 01	HVGT	6.750 02	MWDG	3.111 01	GBTU	1.093 02

COMBUSTION PRODUCTS

CO2C	5.453 02	COC	2.257 02		
H2CC	2.291 01	CH4	7.532 00	COMBCP	1.134 01

MATERIAL IN

ORGCIN	2.153 02	RSR	4.960 02	ORH2IN	3.013 01	MATIN	2.379 03

MATERIAL OUT

ORGCVG	4.665 01	COKEC	3.471 01	UNRITH	0.000 00		
ORGCOL	1.351 02	ORH2VG	3.374 00	COKEH	2.362 00	UNRETC	0.000 00
ORH2OL	1.724 01	ORCOLP	6.277 01	ORGVGP	2.156 01	ORGSSP	1.516 01
HCCVGP	1.031 01						

MATERIAL BALANCES

OVALL	1.006 02	ORGH2	9.435 01				
CBAL	1.044 02	ASH	0.000 00	TC	1.004 02	WATER	1.050 02
CRGC	1.006 02	TH2	1.039 02	GASL	2.230 02	ASHB	-1.000 00

HEAT IN

QCOKE	4.335 05	QH2CC	1.060 04	QAIR	5.242 03		
QPROP	0.000 00	QOILC	1.125 04	QRCYL	5.005 04	QSUMIN	5.157 05

HEAT OUT

QMCO2D	1.217 05	QKEROD	9.120 04	QH2OV	4.727 04		
QLIQC	4.339 03	QOFGAS	3.480 04	QSS	1.222 05	QGASL	1.659 03
LBLOSS	0.000 00	HETLOS	3.051 04	QSUMOT	5.157 05		

MISCELLANEOUS

ORGSS	2.116 00	VPOIL	1.157-02	TCL	4.733 03	VPM	5.970 00
WOG	1.273 01	PRCP	0.000 00				

MATERIAL AND HEAT BALANCE INPUT SHEET

RIF 92	, RUN NO.	C-1 & 8-3	STARTED	4-12-71	CALC. ON	4-18-6

RAW SHA / BAROMETRI / PRESSU / AND / OFFG / TEMPERATU

1.01	9.05	52	-1	27391.06
H_2O, wt %	Oil, wt %	°F	(1)	Rate, lbs/Hr

25.00	1.09	17.07	55022
Oil, gal/T	Gas+L, wt%	CO_2, wt%	Retort XS, ft²

69.00	15.06	10.63	23.083	136
Ash, wt%	Carbon, wt%	H_2, wt %	Bar. Press, " Hg	Offgas Temp, °F

AIR

108.205	1.00	113	122	0.014	0
Chart Reading	Meter Factor	Temp, °F	Press, "H_2O gauge	Moist, lbs/MSCF	Heat Loss, Btu/Hr

RECYCLE A / TOTAL GAS

28470.6	1.00	245	76	0.00	0.00
Recycle Ch Reads	Meter Factor	Temp, °F	Press, "H_2O gauge	Tot Gas Ch Reads	Meter Factor

DILUTIO / GAS

0.00	0.00	0	0
Dil Gas Ch. Reads	Meter Factor	Temp, °F	Press, "H_2O gauge

PROPANE, WA / & NUCLEATI / AGENT

0.00	0	0	2760.7	0.0
C_3 Rotameter R.	Temp, °F	Press, "H_2O gauge	Water added, lbs/Hr	Nucl. Agent, lb/Hr.

SPENT SHALE

0.05	0.00	0.00	0.00
H_2O, wt%	Oil, wt%	Gas, wt%	Rate, lbs/Hr

14.07	83.09	6.013	0.020	387
CO_2, wt %	Ash, wt%	Carbon, wt%	H_2, wt %	Temp, °F

LIQUID PRODUCT

2201.07	84.01	11.01	7.0804	52700
Dry Oil, lbs/Hr	Carbon, wt%	H_2, wt%	Dens, lbs/gal	Water, lbs/Hr

VENT + DILUTION GAS, VENT PU GAS, AN TOP SEA GAS

160.505	1.00	233	.0 0.0	0.00	0	12.05
Vent + Dil Gas Chart Reading	Meter Factor	Temp, °F	Moist, lbs/MSCF	Mist, lbs/MSCF	(2)	Carbon, lbs/Meter

0	25.03	0.04	60.00	1.08	3.09	5.01
(3)	CO_2, vol %	O_2, vol %	N_2, vol %	CH_4, vol %	CO_2, vol %	H_2, vol %

3.05	0.083	1.605
Others, vol %	H_2, lbs/MSCF	Vi Purge Ch. Reading

1.083	151	1.44	75	8.06	9.01	18.00
Meter Factor	Temp, °F	Press "H_2O gauge	Cond. Gas Out Temp, °F	Dry Oil, gal/Hr	Water lbs/Hr	Top Seal Gas Rate, SCFM

OPTIONS:

(1) Insert "0" to calc. with measured rates; "1" to calc. with spent shale rate and ash analyses; "-1" to calc. with raw shale rate and ash analyses.

(2) Insert "1" to calc. with measured moisture and mist; "0" to calc. from vent purge data.

(3) Insert "0" for Retort No.3 (pressure and temperature have no effect on gas rates); "1" for Retort No. 1&2 (pressure and temperature have effect on gas rates).

LBGilmore
1/17/67

LABORATORY ANALYSIS SHE

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-13-67 Run No. C 1028-3

Sample Time: RS 0:10; SS 11:15

FISCHER ASSAY

RAW SHALE (X)	SPENT SHALE (X)	
24.8	0.0	Gal/Ton
0.911	—	S.G., g/ml
9.4	0.0	Oil, wt %
2.0	0.5	Water, wt %
86.7	99.4	Sp. Shale, wt %
1.9	0.1	Gas & Loss, wt %
slight	None	COKING TENDENCY

RETORT SHALE MOISTURE

1.0 Est. wt %

(X) RAW SHALE FISCHER ASSAY MOISTURE

0.91 wt %

MINERAL CO_2

(X) 17.6	(X) 14.7	wt %

ASH (SHALE)

(X) 68.7	(X) 83.9	wt %

MOISTURE

(X) 0.40	(X) 0.10	wt %

CARBON

(X) 15.5	(X) 6.13	wt %

HYDROGEN

(X) 1.62	(X) 0.20	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 [illegible] 1967 CHECKED BY [illegible]

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-13-67 Run No. C-1023-3 12K

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	9.6					
GRAVITY, °API	19.5					
OIL ASH, wt %						

○ DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 103.0

WATER VOL, ml 86.6

GRAVITY OIL, °API 41.1

VENT GAS

Ⓧ MAJOR COMPONENTS

CO_2	25.3	vol %
O_2	0.4	"
N_2	59.3	"
CH_4	1.8	"
CO	3.9	"
H_2	5.1	"
Ar	0.7	"
Others	3.5	"

○ 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, 12.5 lbs/MSCFDG

HYDROGEN, 0.83 lbs/MSCFDG

COMMENTS

DATE COMPLETED [illegible] CHECKED BY [illegible]

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C-1028-3 SAMPLE NO. 1 DATE 4-1[illegible]-67

UNIT [illegible] 3 DESCRIPTION [illegible]

APPROX. SHALE SIZE [illegible] SHAKING TIME [illegible] ANALYSIS BY [illegible]

TOTAL SAMPLE W/T. GROSS [illegible] – TARE [illegible] = NET [illegible]

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50		18.5	16.6	[illegible]
	2.00		[illegible]	[illegible]	[illegible]
	1.50		[illegible]	[illegible]	[illegible]
	1.05		[illegible]	19.1	[illegible]
	0.742		[illegible]	[illegible]	[illegible]
	0.525		[illegible]	[illegible]	[illegible]
	0.371		[illegible]	[illegible]	[illegible]
	0.263	3	[illegible]	[illegible]	[illegible]
	0.185	4	[illegible]	[illegible]	.0
	0.131	6	[illegible]	[illegible]	.0
	0.093	8	[illegible]	[illegible]	.0
	0.065	10	[illegible]	[illegible]	[illegible]
	PAN		[illegible]	[illegible]	[illegible]
TOTAL ON SCREENS AND PAN					[illegible]
LOSS (BY DIFFERENCE)					[illegible]
TOTAL SAMPLE WEIGHT					[illegible]

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	3.04		96.95
2.00	2.250	0.4444	17.50		84.4[illegible]
1.50	1.750	0.5714	48.40		36.05
1.05	(1.087) 1.275	(0.9199) 0.7843	23.72		12.33
0.742	0.896	1.116	8.97		3.36
0.525	0.634	1.577	1.44		1.92
0.371	0.448	2.232	0.32		1.60
0.263	0.317	3.154	0.32		1.28
0.185	0.224	4.464	0.00		1.28
0.131	0.158	6.329	0.00		1.28
0.093	0.112	8.928	0.00	98.71	1.28
0.065			0.16		1.12
PAN			1.12		0.00
LOSS			—	—	—
TOTAL			99.99	—	—

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

$\sum_{+8m}^{m} D_i$	1.60243	$\sum_{+8m}^{m} X_i$	
$1/\sum_{+8m}^{m} D_i$	0.66977	$\sum_{+8m}^{m} X_i / D_i$	
Da	1.47376	$\sum_{+8m}^{m} X_i D_i$	
Dv	1.62337		

REMARKS: ______

OSRC-4