1513013017

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 4-16-67

Purpose: To determine operability of retort at 500 [illegible] using 1-2½" shale with SS liner, 36 [illegible] and [illegible]

GENERAL	
Run No.	C-1028-16
Length, hours	12
Retort Type Number	RC-IV
Oil Recovery System Number	C-2
Total Raw Shale Charged, lbs. (Tons)	16.35
Bed Height above Dist., ft	12½'
Type Air Dist.	[illegible]
Bed Below Air Dist., ft	7'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	490
Spent Shale, % of RS	82.9
Liquid Product, lbs/hr	226.7
Oil Collected, gal/ton RS	18.9
Air, SCF/ton RS (dry)	4590
Total Recycle*, SCF/ton RS(wet)	13000
Dilution, SCF/ton RS (wet)	—
Calc. Vent Gas SCF/ton RS(dry)	5590
Gas Losses, SCF/ton RS(wet)	-464
Propane, SCF/ton RS	—
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	139
Spent Shale, F	397
Raw Shale, °F	58
Recycle Gas Inlet, °F	233
Dilution Gas Inlet, °F	—
Air Inlet, °F	140
Retort Air Inlet, F	140
Heat of Comb, MBtu/ton RS	477
Heat Lost, MBtu/ton RS	22
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	23.8
Oil, Wt %	9.1
Water, Wt %	1.1
Gas, Wt %	1.9
Mineral CO_2, Wt %	17.5
Ash, Wt %	69.8
Moisture, Wt % (Uncrushed)	[illegible]
Carbon (Total), Wt %	15.2
Hydrogen (Total), Wt %	1.57
Nominal Size Range, inches	1"-2½"
5 % passing thru	0.742
98 % passing thru	2.50
Da	1.477
Dv	1.698

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.0
Mineral CO_2, Wt %	14.4
Ash, Wt %	84.2
Carbon (total), Wt %	5.81
Organic Carbon, Wt %	1.88
Hydrogen (total), Wt %	0.17
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	97.7
Density, lb/gal	7.793
Gravity, API	19.7
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	7.9
Oil, lbs/MSCF(dry)**	0.048
Analysis (dry)	
CO_2, Vol %	27.2
O_2, Vol %	0.4
N_2 + Argon, Vol %	61.5
CH_4, Vol %	1.9
CO, Vol %	3.6
H_2, Vol %	5.1
Other, Vol %	0.3
Gross Heating Value(calc), Btu/SCF	[illegible]
Carbon (Total), lbs/MSCF (dry)	[illegible]
Hydrogen (Total), lbs/MSCF (dry)	[illegible]
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	79.3
Oil in Gas**, Vol % RSFA	0.2
Oil in Spent Shale, Vol % RSFA	0.0
Total Oil Meas., Vol % RSFA	79.5
Carbonate Decomposition, %	31.8
Water Recovered, lb/ton RS	[illegible]
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	[illegible]
Overall Balance, %	99.2
Carbon Balance, % - Organic	95.7
Carbon Balance, % - Total	[illegible]
Hydrogen Balance, % - Organic	99.4
Hydrogen Balance, % - Total	95.3
Water Balance, %	109.8
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.46
ΔP Above Air Dist., in H_2O/ft	0.51
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: RS [illegible] Rotten [illegible] No. 3 [illegible], air [illegible] gas [illegible] during SS [illegible] Retort [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 [signature] DATE April 21 1967

OSRC-10

921, RUN NO. C-10[illegible]-10 Checked 4/8/6[illegible]

YIELDS

RAY	7.927 01	DRYGAS	5.799 03	MISITA	1.517-01		
HP	3.005 02	OTHER	1.757 01	UNRETC	0.000 00	CH4	1.112 02
C2	2.359 01	SGY	7.739 01	CO	2.191 02	COPDTC	3.175 01
NH2O	7.310 01	CO2	1.600 03	OILCOL	1.026 01		

METERED GAS RATES

PTGR	1.297 04	DIL	0.000 00	WVENTG	7.393 03	AIR	4.579 03
TRCOG	1.297 04	TOF	0.000 00				

MOL WT & HEATING VALUE OF VENT GAS

MWG	2.995 01	HVGT	5.931 02	MWDG	3.0[illegible] 01	GBTU	1.006 02

COMBUSTION PRODUCTS

CO2C	5.937 02	COC	1.960 02		
H2OC	2.370 01	CHP	9.490 00	COMPCP	1.202 [illegible]1

MATERIAL IN

ORGCIN	2.034 03	RCD	4.900 02	ORH2IN	2.393 01	MATIN	2.371 03

MATERIAL OUT

ORGCVG	4.354 01	COKEC	3.114 01	UNRCTH	0.000 00		
ORGCOL	1.236 02	ORH2VG	7.461 00	COKEH	2.075 00	UNRSTC	0.000 00
CRH2OL	1.632 01	ORGCLP	5.951 01	OTOVGP	2.050 01	ORGASG	1.494 01
HCCVGP	8.366 00						

MATERIAL BALANCES

OVALL	9.919 01	ORGH2	8.931 01				
CBAL	1.015 02	ASH	0.000 00	TC	9.663 01	WATER	1.095 02
ORGC	9.515 01	TH2	9.526 01	GASL	-4.043 00	ASHR	-1.000 00

HEAT IN

QCOAL	4.235 05	QH2OC	3.555 03	QAIR	5.907 03		
QPROP	0.000 00	QOILS	1.029 04	QRCYL	4.644 04	QSUMIN	4.937 05

HEAT OUT

QRCORD	1.802 05	DKPROD	3.700 04	QH2OV	4.797 04		
QLIQC	4.301 03	QOFGAS	3.375 04	QSS	1.256 05	QGASL	-3.295 03
LBLOSS	0.000 00	HETLOS	2.915 04	QSUMOT	4.937 05		

MISCELLANEOUS

CROSS	1.878 00	VPOIL	4.731-02	TGL	4.973 03	VFM	7.300 00
WCG	1.409 01	PROP	0.000 00				

MATERIAL AND HEAT BALANCE INPUT SHEET

RIF 92	, RUN NO.	C-1028-10	STARTED	4-16-67	CALC. ON	

RAW SHALE, BAROMETRIC PRESSURE AND OFFGAS TEMPERATURE

H_2O, wt %	Oil, wt %	°F	(1)	Rate, lbs/Hr
1.01	9.01	58	-1	27058.04

Oil, gal/T	Gas+L, wt%	CO_2, wt%	Retort XS, ft³
23.08	1.09	17.05	55022

Ash, wt%	Carbon, wt%	H_2, wt%	Bar. Press, " Hg	Offgas Temp, °F
69.08	15.02	1.057	24.026	139

AIR

Chart Reading	Meter Factor	Temp, °F	Press, "H_2O gauge	Moist, lbs/mscf	Heat Loss, Btu/Hr
1036.04	1.00	140	1.07	0.074	0

RECYCLE AND TOTAL GAS

Recycle Ch Read	Meter Factor	Temp, °F	Press, "H_2O gauge	Tot Gas Ch Read	Meter Factor
29370.3	1.00	233	71	0.00	0.00

DILUTION GAS

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

PROPANE, WATER & NUCLEATING AGENT

C_3 Rotameter R.	Temp, °F	Press, "H_2O Gauge	Water added, lbs/Hr	Nucl. Agent, lb/Hr.
0.00	0	0	273.03	0.00

SPENT SHALE

H_2O, wt%	Oil, wt%	Gas, wt%	Rate, lbs/Hr
0.04	0.00	0.00	0.00

CO_2, wt%	Ash, wt%	Carbon, wt%	H_2, wt%	Temp, °F
14.04	84.02	5.81	0.17	397

LIQUID PRODUCT

Dry Oil, lbs/Hr	Carbon, wt%	H_2, wt%	Den, lbs/gal	Water, lbs/Hr
1969.21	84.01	11.01	7.793	277.05

VENT + DILUTION GAS, VENT PURGE GAS, AND TOP SEAL GAS

Vent + Dil Gas Chart Reading	Meter Factor	Temp, °F	Moist, lbs/Mscf	Mist, lbs/Mscf	(2)	Carbon, lbs/Mscf
1664.05	1.00	240	0.00	0.00	0	12.05

(3)	CO_2, vol%	O_2, vol%	N_2, vol%	CH_4, vol%	CO, vol%	H_2, vol%
0	27.02	0.04	61.05	1.09	3.06	5.01

Others, vol%	N_2, lbs/Mscf	V. Purge Ch. Reading
0.03	0.081	1503

Meter Factor	Temp, °F	Press, "H_2O Gauge	Cond. Gas Out Temp, °F	Dry Oil, gm/Hr	Water, lbs/Hr	Top Seal Gas Rate, SCFM
1.083	163	166	75	3500	10.04	11.06

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).

LRGilmore
1/17/67

OSEC-9

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-16-67 Run No. C1628-10

Sample Time: RS 13:15; SS 23:15

FISCHER ASSAY

RAW SHALE	SPENT SHALE	
23.6	0.0	Gal/Ton
.911	0.0	S.G., g/ml
9.00	0.00	Oil, wt %
1.9	0.4	Water, wt %
87.2	99.3	Sp. Shale, wt %
1.9	0.3	Gas & Loss, wt %
Light	Low	COKING TENDENCY

RETORT SHALE MOISTURE

1.0 Est wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.77 wt %

	RAW SHALE	SPENT SHALE	
MINERAL CO_2	17.5	14.4 ~~17.7~~	wt %
ASH (SHALE)	69.6	84.2	wt %
MOISTURE	0.24	0.11	wt %
CARBON	15.2	5.81	wt %
HYDROGEN	1.57	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_2", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS

DATE COMPLETED APR 19 1967 CHECKED BY

OSRC-12A
Revised 6/30/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-16-67 Run No. C1023-10

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
⊗ WATER, wt %	2.3					
⊗ GRAVITY, °API	19.7					
○ OIL ASH, wt %						

○ DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

⊗

OIL WT, g 420

WATER VOL, ml 237

GRAVITY OIL, °API 41.5

VENT GAS

⊗ MAJOR COMPONENTS

CO_2	27.3	vol %
O_2	0.4	"
N_2	60.8	"
CH_4	1.9	"
CO	3.6	"
H_2	5.1	"
Ar	0.7	"
Others	0.3	"

⊗ CARBON, 12.5 lbs/MSCFDG

○ 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}	.	"
øC_3H_6	.	"
n C_5H_{12}	.	"

⊗ HYDROGEN, 0.21 lbs/MSCFDG

COMMENTS

DATE COMPLETED [illegible] CHECKED BY [illegible]

OSRC-12B

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C102 -1/C SAMPLE NO. 1 DATE 4/15/87

UNIT RETORT #3 DESCRIPTION TY LAB

APPROX. SHALE SIZE 1"x4" SHAKING TIME 10 min ANALYSIS BY [illegible]

TOTAL SAMPLE WT. GROSS 68.6 - TARE 5.3 = NET 63.3

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50		20.9	16.7	4.2
	2.00		32.7	20.2	12.5
	1.50		45.8	23.4	25.4
	1.05		32.3	19.2	13.1
	0.742		25.4	20.5	4.9
	0.525		20.0	18.5	1.5
	0.371		19.6	19.2	.4
	0.263	3	18.5	18.3	.2
	0.185	4	19.5	19.4	.1
	0.131	6	19.4	19.3	.1
	0.093	8	20.5	20.5	.0
	0.065	10	19.4	19.3	.1
	PAN		21.9	21.2	.7
	TOTAL ON SCREENS AND PAN				63.2
	LOSS (BY DIFFERENCE)				-.1
	TOTAL SAMPLE WEIGHT				63.3

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	6.64		93.38
2.00	2.250	0.4444	19.75		73.6
1.50	1.750	0.5714	40.13		33.50
1.05	(1.087) 1.275	(0.9199) 0.7843	20.69		12.81
0.742	0.896	1.116	7.74		5.07
0.525	0.634	1.577	2.37		2.70
0.371	0.448	2.232	0.63		2.07
0.263	0.317	3.154	0.32		1.75
0.185	0.224	4.464	0.16		1.59
0.131	0.158	6.329	0.16		1.43
0.093	0.112	8.928	0.00	98.59	1.43
0.065			0.16		1.27
PAN			1.11		0.16
LOSS			0.16	-	0.00
TOTAL			100.02	-	-

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

$\sum_{+8m}^{m} Di$	1.67357	$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$	0.66981	$\sum_{+8m}^{m} Xi/Di$	
Da	1.47190	$\sum_{+8m}^{m} Xi\ Di$	
Dv	1.69750		

REMARKS: _____

OSRC-4