1513017011

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 6-3-67

Purpose: To determine operability and yield with less dilution gas using 1/4"-1" shale.

GENERAL	
Run No.	C1040-8
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-1
Total Raw Shale Charged, ~~lbs.~~ Tons	95.4
Bed Height above Dist., ft	5½'
Type Air Dist.	AD-X
Bed Below Air Dist., ft	6'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	288
Spent Shale, % of RS	79.7
Liquid Product, lbs/hr	1745.0
Oil Collected, gal/ton RS	25.5
Air, SCF/ton RS (dry)	4980
Total Recycle*, SCF/ton RS(wet)	14100
Dilution, SCF/ton RS (wet)	1430
Calc. Vent Gas SCF/ton RS(dry)	6600
Gas Losses, SCF/ton RS(wet)	1171
Propane, SCF/ton RS	19.0
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	135
Spent Shale, F	662
Raw Shale, °F	77
Recycle Gas Inlet, °F	250
Dilution Gas Inlet, °F	250
Air Inlet, °F	143
Retort Air Inlet, F	143
Heat of Comb. MBtu/ton RS	466
Heat Lost, MBtu/ton RS	-63
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	29.0
Oil, Wt %	11.0
Water, Wt %	1.1
Gas, Wt %	1.8
Mineral CO_2, Wt %	17.1
Ash, Wt %	67.0
Moisture, Wt % (Uncrushed)	1.25
Carbon (Total), Wt %	17.5
Hydrogen (Total), Wt %	2.5
Nominal Size Range, inches	1/4"-1"
5 % passing thru	0.263
98 % passing thru	1.05
D_a	0.601
D_v	0.721
Line Burner °F	800

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.3
Mineral CO_2, Wt %	14.2
Ash, Wt %	84.1
Carbon (total), Wt %	6.16
Organic Carbon, Wt %	2.28
Hydrogen (total), Wt %	0.25
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	99.5
Density, lb/gal	7.793
Gravity, API	19.7
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	9.0
Oil, lbs/MSCF(dry)**	0.074
Analysis (dry)	
CO_2, Vol %	26.8
O_2, Vol %	0.1
N_2 + Argon, Vol %	59.7
CH_4, Vol %	1.8
CO, Vol %	3.4
H_2, Vol %	4.8
Other, Vol %	3.4
Gross Heating Value(calc),Btu/SCF	67.3
Carbon (Total), lbs/MSCF (dry)	10.6
Hydrogen (Total), lbs/MSCF (dry)	0.66
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	88.1
Oil in Gas**, Vol % RSFA	0.2
Oil in Spent Shale, Vol % RSFA	0.7
Total Oil Meas., Vol % RSFA	89.0
Carbonate Decomposition, %	33.8
Water Recovered, lb/ton RS	99.3
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	RS 100
Overall Balance, %	100.9
Carbon Balance, % - Organic	93.9
Carbon Balance, % - Total	96.5
Hydrogen Balance, % - Organic	66.5
Hydrogen Balance, % - Total	78.1
Water Balance, %	145.4
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.45
ΔP Above Air Dist., in H_2O/ft	0.38
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Rough levels on LR-3 shutting off RS feed belts. Temperatures erratic. Fischer assay on RS should be increased to 29 for material balance. Adjusting [illegible] ratio in attempt to control unit. Retort in [illegible] condition.

*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. Turner DATE June 20, 1967

OSRC-10
Revised 7/19/66

//A100
2030, C1040-3 6-3-67

A. YIELDS

FAY	3.808E 01	DRYGAS	6.595E 03	MISFA	2.151E-01
H2	3.165E 02	OTHER	2.242E 02	UNRETO	7.242E-01
CH4	1.137E 02	O2	6.595E 00	SSY	7.967E 01
CO	2.042E 02	CO2DCO	3.384E 01	MH2O	9.933E 01
CO2	1.767E 03	OILCOL	2.554E 01		

B. METERED GAS RATES

RECG	1.265E 04	OIL	1.431E 03	WVENTG	6.675E 03
AIR	4.976E 03	TRECG	1.403E 04	TSF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWVG	2.927E 01	HVGT	4.435E 02	MWDG	3.141E 01
GBTU	6.725E 01				

D. COMBUSTION PRODUCTS

CO2C	7.234E 02	COC	2.101E 02	H2OC	2.030E 01
CH2	1.299E 01	COYROP	1.145E 01		

E. MATERIAL IN

ORGCIN	2.534E 02	RSR	2.879E 02	ORH2IN	4.794E 01
MATIN	2.409E 03				

F. MATERIAL OUT

ORGCVG	3.875E 01	COKEC	3.448E 01	UNRETH	2.033E-01
ORGCOL	1.674E 02	ORH2VG	5.692E 00	COKEH	2.388E 00
UNRETC	1.398E 00	ORH2OL	2.210E 01	ORCOLP	6.478E 01
ORCVGP	1.490E 01	ORCSSP	1.408E 01	HCCVGP	3.542E 00

G. MATERIAL BALANCES

OVALL	1.009E 02	ORH2	6.647E 01	C2BAL	1.075E 02
ASH	0.0	TC	9.646E 01	WATER	1.454E 02
ORGC	9.335E 01	TH2	7.306E 01	GASL	1.171E 03
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	4.663E 05	QH2OC	1.023E 04	QAIR	6.049E 03
QPROP	5.902E 01	QOILC	1.393E 04	QRCYL	5.213E 04
QSUMIN	5.487E 05				

I. HEAT OUT

QHCO2D	1.875E 05	QKEROD	1.011E 05	QH2OV	5.294E 04
QLIQO	4.224E 03	QOFGAS	2.669E 04	QSS	2.234E 05
QGASL	1.535E 04	LBLOSS	0.0	HEILOS	-6.950E 04
QSUMOT	5.487E 05				

J. MISCELLANEOUS

QRCSS	2.253E 00	VPOIL	7.370E-02	IGL	2.977E 03
VPH	9.013E 00	HCC	1.594E 01	PROP	1.201E 01

END MESSAGE

END OUTPUT

HEAT AND MATERIAL BALANCE FOR PILOT RETORTS – DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION	
0	2080,	C1040-8	6-3-67

1	WRS: 1.1	OLRS: 11.0	TRS: 77	B: -1	MRS: 15899.9		RAW SHALE
2	FA: 29.0	GRS: 1.8	CORS: 17.1	XA: 55.22			
3	ASRS: 67.0	CRS: 17.5	HRS: 2.5	BP: 24.36	TOG: 135		
4	CRA: 660.3	MFA: 1.0	TA: 143	PA: 98	WA: 0.14	LBHL: 0	← AIR
5	CRRG: 1685.0	MFRG: 1.0	TRG: 250	PRG: 76	CRTG: 0.0	MFTG: 0.0	← RECYCLE AI TOTAL GAS
6	CRDG: 1.8	MFDG: 129.5	TDG: 250	PDG: 71			← DILUTION G
7	P: 2.9	TP: 0.4	PP: 128.7	W: 201.3	N: 0.0		← PROPANE AI NUCLEATIN AGENT
8	WSS: 0.5	OLSS: 0.1	GSS: 0.1	SS: 0.0			SPENT SHALE
9	COSS: 14.2	ASSS: 84.1	CSS: 6.16	HSS: 0.25	TSS: 662		
10	OILLP: 1582.5	COL: 84.1	HOL: 11.1	DOL: 7.793	WLP: 162.5		← LIQUID PRODUCT
11	CRVG: 1171.4	MFVG: 1.0	TVG: 250	WG: 0.0	OILM: 0.0	M: 0	VENT GAS
12	CG: 10.6	H: 0	COOG: 26.8	OG: 0.1	NG: 59.7		
13	MEG: 1.8	COG: 3.4	HHG: 4.8	OTG: 3.4	HG: 0.66		
14	CRVP: 5.7	VPMF: 1.83	TVP: 131	PVP: 179			VENT PURGE
15	TVPC: 75	VPOIL: 34.0	VPW: 7.8	GL: 103.7			

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 6-4-67 Run No. C1040-8

Sample Time: RS 0615; SS _____

FISCHER ASSAY

RAW SHALE	SPENT SHALE	
28.7	0.3	Gal/Ton
0.911	.—	S.G., g/ml
10.9	0.1	Oil, wt %
2.0	0.5	Water, wt %
85.3	99.3	Sp. Shale, wt %
1.8	0.1	Gas & Loss, wt %
light	none	COKING TENDENCY

RETORT SHALE MOISTURE

1.25 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.90 wt %

	RAW SHALE	SPENT SHALE	
MINERAL CO_2	17.0	14.2	wt %
ASH (SHALE)	66.8	84.1	wt %
MOISTURE	0.37	0.09	wt %
CARBON	17.4	6.16	wt %
HYDROGEN	2.50	0.25	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 JUN 9 1967 CHECKED BY _____

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-4-67 Run No. C 1040-8

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	0.50					
GRAVITY, °API	19.7					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 408.0

WATER VOL, ml 0.0

GRAVITY OIL, °API 42.4

VENT GAS

MAJOR COMPONENTS

CO_2	26.8	vol %
O_2	0.1	"
N_2	59.0	"
CH_4	1.8	"
CO	3.4	"
H_2	4.8	"
Ar	0.7	"
Others	3.4	"

CARBON, 10.6 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}	.	"
ϕC_3H_6	.	"
n C_5H_{12}	.	"

HYDROGEN, 0.66 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUN 5 1967 CHECKED BY

SCREEN ANALYSIS D[illegible]TA SHEET (TY-LAB)

RUN NO. C-10-10-8 SAMPLE NO. ______ DATE [illegible]

UNIT [illegible] DESCRIPTION [illegible]

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

TOTAL SAMPLE WT. GROSS 90.8 − TARE 2.4 = NET 88.4

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		26.8	19.2	7.6
	0.742		57.8	20.5	37.3
	0.525		38.4	18.5	19.9
	0.371		27.9	19.2	8.7
	0.263	3	27.2	18.4	8.8
	0.185	4	22.2	19.4	2.8
	0.131	6	19.7	19.3	.4
	0.093	8	20.5	20.5	.0
	0.065	10	19.3	19.2	.1
	PAN		22.4	21.0	1.4
TOTAL ON SCREENS AND PAN					87.9
LOSS (BY DIFFERENCE)					.5
TOTAL SAMPLE WEIGHT					88.4

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			
1.05	(1.087) 1.275	(0.9199) 0.7843	8.74		91.25
0.742	0.896	1.116	42.87		48.38
0.525	0.634	1.577	22.87		25.51
0.371	0.448	2.232	10.00		15.51
0.263	0.317	3.154	10.11		5.40
0.185	0.224	4.464	3.22		2.18
0.131	0.158	6.329	0.46		1.72
0.093	0.112	8.928	0.00	98.27	1.72
0.065			0.11		1.61
PAN			1.61		0.00
LOSS			—	—	—
TOTAL			99.99	—	—
			—	—	—

0041141

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

$\Sigma_{+8m}^{m} D_i$	0.70890	$\Sigma_{+8m}^{m} X_i$	
$1/\Sigma_{+8m}^{m} D_i$	1.63441	$\Sigma_{+8m}^{m} X_i / D_i$	
Da	0.60125	$\Sigma_{+8m}^{m} X_i D_i$	
Dv	0.72138		

REMARKS: ______

OSRC-4