DETAILED RUN SUMMARY SHEET

1513019003

Date 7-13-67

Purpose: To improve operability and yield with [illegible] shale using hot dilution gas.

GENERAL	
Run No.	PTC1051
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-2
Total Raw Shale Charged, ~~lbs.~~ Tons	97.50
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)	294
Spent Shale, % of RS	79.7
Liquid Product, lbs/hr	1739.5
Oil Collected, gal/ton RS	26.0
Air, SCF/ton RS (dry)	5420
Total Recycle*, SCF/ton RS(wet)	13300
Dilution, SCF/ton RS (wet)	2430
Calc.Vent Gas SCF/ton RS(dry)	6860
Gas Losses, SCF/ton RS(wet)	2370
Propane, SCF/ton RS	244
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	142
Spent Shale, F	582
Raw Shale, °F	93
Recycle Gas Inlet, °F	266
Dilution Gas Inlet, °F	219
Air Inlet, °F	165
Retort Air Inlet, F	165
Heat of Comb. MBtu/ton RS	523
Heat Lost, MBtu/ton RS	89
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	29.1
Oil, Wt %	11.1
Water, Wt %	1.1
Gas, Wt %	2.2
Mineral CO_2, Wt %	17.2
Ash, Wt %	66.8
Moisture, Wt % (Uncrushed)	1.04
Carbon (Total), Wt %	17.7
Hydrogen (Total), Wt %	1.87
Nominal Size Range, inches	¼"-1"
5 % passing thru	0.263
98 % passing thru	1.05
D_a	0.634
D_v	0.707
Line Burner °F	830

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.45
Mineral CO_2, Wt %	14.5
Ash, Wt %	83.8
Carbon (total), Wt %	6.29
Organic Carbon, Wt %	2.33
Hydrogen (total), Wt %	0.20
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	99.4
Density, lb/gal	7.752
Gravity, API	20.5
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	17.9
Oil, lbs/MSCF(dry)**	1.102
Analysis (dry)	
CO_2, Vol %	25.0
O_2, Vol %	0.2
N_2 + Argon, Vol %	62.5
CH_4, Vol %	1.9
CO, Vol %	2.8
H_2, Vol %	5.1
Other, Vol %	2.5
Gross Heating Value(calc),Btu/SCF	123.5
Carbon (Total), lbs/MSCF (dry)	12.0
Hydrogen (Total), lbs/MSCF (dry)	0.80
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	89.4
Oil in Gas**, Vol % RSFA	3.4
Oil in Spent Shale, Vol % RSFA	1.1
Total Oil Meas., Vol % RSFA	93.9
Carbonate Decomposition, %	32.8
Water Recovered, lb/ton RS	179.8
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	RS-10[illegible]
Overall Balance, %	103.9
Carbon Balance, % - Organic	100.8
Carbon Balance, % - Total	101.9
Hydrogen Balance, % - Organic	98.8
Hydrogen Balance, % - Total	129.0
Water Balance, %	230.5
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.39
ΔP Above Air Dist., in H_2O/ft	0.42
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Operations satisfactory except for effect on [illegible] gas temperatures (high as 180°F)

*Measured Recycle + Dilution Gas

** Oil Mist + Condensibles to 81 °F

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

Signed [illegible signature] DATE July 28, 1967

OSRC-10

Revised 7/19/66

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//A100
2080. PTC1051 R-1 7-13-67

A. YIELDS
FAY      8.938E 01    DRYGAS   6.856E 03    MISTFA   3.351E 00
H2       3.497E 02    OTHER    1.714E 02    UNRETO   1.077E 00
CH4      1.303E 02    02       1.371E 01    SSY      7.971E 01
CO       1.920E 02    CO2DEC   3.280E 01    MH2O     1.798E 02
CO2      1.714E 03    OILCOL   2.601E 01

B. METERED GAS RATES
RECG     1.089E 04    DIL      2.430E 03    WVENTG   7.067E 03
AIR      5.4EM 03  2PR'G    R332E 04    TGF      0

C. MOL WT & HEATING VALUE OF VENT GAS
MWWG     2.736E 01    HVGT     8.465E 02    MWDG     3.088E 01
GBTU     1.235E 02

D. COMBUSTION PRODUCTS
CO2C     6.807E 02    COC      1.736E 02    H2OC     3.424E 01
CHR      7.048E 00    COMBCP   1.032E 01

E. MATERIAL IN
ORGCIN   2.624E 02    RSR      2.943E 02    ORH2IN   3.546E 01
MATIN    2.439E 03

F. MATERIAL OUT
ORGCVG   5.786E 01    COKEC    3.460E 01    UNRETH   2.919E-01
ORGCOL   1.696E 02    ORH2VG   1.016E 01    COKEH    2.182E 00
UNRETC   2.569E 00    ORH2OL   2.238E 01    ORCOLP   6.462E 01
ORCVGP   2.205E 01    ORCSSP   1.417E 01    HCCVGP   1.173E 01

G. MATERIAL BALANCES
OVALL    1.039E 02    ORH2     9.876E 01    O2BAL    1.235E 02
ASH      0.0          TC       1.019E 02    WATER    2.305E 02
ORGC     1.008E 02    TH2      1.290E 02    GASL     2.374E 03
ASHB    -1.000E 00

H. HEAT IN
QCOMB    5.233E 05    QH2OC    7.145E 04    QAIR     7.200E 03
QPROP    8.475E 01    QOILC    1.411E 04    QRCYL    4.674E 04
QSUMIN   6.629E 05

I. HEAT OUT
QMCO2D   1.828E 05    QKEROD   1.048E 05    QH2OV    4.877E 04
QLIQO    6.740E 03    QOFGAS   2.179E 04    QSS      1.839E 05
QGASL    2.460E 04    LBLOSS   0.0          HETLOS   8.948E 04
QSUMOT   6.629E 05

J. MISCELLANEOUS
ORCSS    2.332E 00    VPOIL    1.102E 00    TGL      2.999E 03
VPM      1.793E 01    WCG      2.738E 01    PROP     2.437E 01

END MESSAGE


END OUTPUT
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LINE #	PROGRAM ID ← USER IDENTIFICATION →						
0	2080,	P7-1051 R-1 7-13-6,					
	WRS	OLRS	TRS	B	MRS		
1	1.1	11.1	93	-1	16249.2		RAW SHALE
	FA	GRS	CORS	XA			
2	29.1	2.2	17.2	55.22			
	ASRS	CRS	HRS	BP	TOG		
3	66.8	17.7	1.87	24.52	142		
	CRA	MFA	TA	PA	WA	LBHL	
4	732.1	1.0	165	143	0.14	0	AIR
	CRRG	MFRG	TRG	PRG	CRTG	MFTG	
5	1428.7	1.0	266	102	0.0	0.0	RECYCLE TOTAL GA
	CRDG	MFDG	TDG	PDG			
6	6.1	61.9	219	101			DILUTION
	P	TP	PP	W	N		
7	3.81	0.4	126.5	170.8	0.0		PROPANE NUCLEATI AGENT
	WSS	OLSS	GSS	SS			
8	0.4	0.15	0.1	0.0			SPENT SHALE
	COSS	ASSS	CSS	HSS	TSS		
9	14.5	83.8	6.29	0.20	582		
	OILLP	COL	HOL	DOL	WLP		
10	1638.2	84.1	11.1	7.752	101.2		LIQUID PRODUCT
	CRVG	MFVG	TVG	WG	OILM	M	
11	1414.2	1.0	272	0.0	0.0	0	
	CG	H	COOG	OG	NG		VENT GAS
12	12.0	0	25.0	0.2	62.5		
	MEG	COG	HHG	OTG	HG		
13	1.9	2.8	5.1	2.5	0.80		
	CRVP	VPMF	TVP	PVP			
14	10.1	0.62	76	17			VENT PURGE
	TVPC	VPOIL	VPW	GL			
15	81	201.3	6.1	103.4			

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 7-14-67 Run No. C1651 PT

Sample Time: RS 0615; SS 0575

FISCHER ASSAY RAW SHALE	FISCHER ASSAY SPENT SHALE	
28.9	0.9 ~~0.9~~ 0.45	Gal/Ton
1.13	—	S.G., g/ml
11.0	0.3 0.15	Oil, wt %
1.8	0.3 0.4	Water, wt %
85.0	99.4 99.4	Sp. Shale, ~~wt~~ %
2.2	0.0 0.1	Gas & Loss, wt %
Slight	None	COKING TENDENCY

Note #2-0.0

RETORT SHALE MOISTURE 1.04 wt %

RAW SHALE FISCHER ASSAY MOISTURE 0.71 wt %

MINERAL CO_2	17.1	14.5 14.5 wt %
ASH (SHALE)	26.6	23.8 23.8 wt %
MOISTURE	0.37	0.06 0.04 wt %
CARBON	17.6	6.36 6.29 wt %
HYDROGEN	1.86	0.23 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 ~~JUL 14 1967~~ CHECKED BY REC

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7-14-67 Run No. C1051-pt SS

Sample Time: RS _____; SS 11:15

FISCHER ASSAY EGB #2 sample

( ) RAW SHALE (X) SPENT SHALE

.	0.0	Gal/Ton
.	.	S.G., g/ml
.	0.0	Oil, wt %
.	0.5	Water, wt %
.	99.3	Sp. Shale, ~~wt~~ %
.	0.2	Gas & Loss, wt %
	None	COKING TENDENCY

( ) RETORT SHALE MOISTURE _____ wt %

( ) RAW SHALE FISCHER ASSAY MOISTURE _____ wt %

MINERAL CO_2 EGB

( ) . (X) 14.4 wt %

ASH (SHALE) EGB

( ) . (X) 83.7 wt %

MOISTURE EGB

( ) . (X) 0.02 wt %

( ) SHALE RICHNESS DISTRIBUTION (See attached graph)

CARBON EGB

( ) . (X) 6.21 wt %

( ) SCREEN ANALYSIS (See back of this sheet)

HYDROGEN EGB

( ) . (X) 0.17 wt %

BENZENE EXTRACTABLES

( ) . ( ) . wt %

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 16 1967 CHECKED BY RCP

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7-14-67 Run No. C 105-1 Pt

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	0.6 ~~2.5~~					
GRAVITY, °API	20.5					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 2416.0

WATER VOL, ml 616.0

GRAVITY OIL, °API 24.5

VENT GAS

MAJOR COMPONENTS

CO_2	25.0	vol %
O_2	0.2	"
N_2	61.8	"
CH_4	1.9	"
CO	2.8	"
H_2	5.1	"
Ar	0.7 ~~2.5~~	"
Others	2.5 ~~2.7~~	"

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}	.	"

CARBON, 12.0 lbs/MSCFDG HYDROGEN, 0.80 lbs/MSCFDG

COMMENTS

JUL 14 1967

DATE COMPLETED CHECKED BY

SCREEN ANALYSIS [ATA SHEET (TY-LAB)

RUN NO. C1051 - PT SAMPLE NO. ______ DATE 7-14-67

UNIT [illegible] DESCRIPTION TY-LAB

APPROX. SHALE SIZE ______ SHAKING TIME ______ ANALYSIS BY ______

TOTAL SAMPLE WT. GROSS 40 – TARE 4 = NET 36.0

SCREEN SIZE			WEIGHTS								
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED	SCREEN SIZE	Di *	1/Di	% RETAINED	CUM. % RETAINED	% PASSING
	4.25					4.25					
	3.00					3.00	(3.125)	(0.3200)			
	2.50					2.50	(2.625) 2.750	(0.3809) 0.3636			
	2.00					2.00	2.250	0.4444			
	1.50					1.50	1.750	0.5714			
	1.05					1.05	(1.087) 1.275	(0.9199) 0.7843			100.00
	0.742		36.7	[illegible]	[illegible]	0.742	0.896	1.116	45.57		54.43
	0.525		30.6	18.5	12.1	0.525	0.634	1.577	34.04		20.39
	0.371		23.1	19.2	3.9	0.371	0.448	2.232	10.97		9.42
	0.263	3	21.1	18.5	2.6	0.263	0.317	3.154	7.31		2.11
	0.185	4	19.7	19.4	.3	0.185	0.224	4.464	0.84		1.27
	0.131	6	19.4	19.4	0	0.131	0.158	6.329	—		1.27
	0.093	8	[illegible]	20.8	0	0.093	0.112	8.928	—	98.73	1.27
	0.065	10	19.2	19.2	0	0.065			—		1.27
	PAN		21.45	21.0	.45	PAN			1.27		0.00
TOTAL ON SCREENS AND PAN					35.55	LOSS			—	—	—
LOSS (BY DIFFERENCE)					~~.45~~	TOTAL			100.00	—	—
TOTAL SAMPLE WEIGHT					~~36.0~~				—	—	—

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

REMARKS: ______

$\sum_{+8m}^{m} D_i$	0.69832	$\sum_{+8m}^{m} X_i$	
$1/\sum_{+8m}^{m} D_i$	1.55828	$\sum_{+8m}^{m} X_i / D_i$	
Da	0.6336	$\sum_{+8m}^{m} X_i D_i$	
Dv	0.7073		

OSRC-4