1513015 006

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 5-18-67

Purpose: To study operability and yield with ¼-1 inch shale using open type A/D and to recycle holder, dilution gas and B-2 [illegible] 5S type [illegible] oil system

GENERAL	
Run No.	R-2 (C-1037-1)
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-1
Total Raw Shale Charged, ~~lbs.~~ Tons	95.32
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	80.0
Liquid Product, lbs/hr	1731.1
Oil Collected, gal/ton RS	26.6
Air, SCF/ton RS (dry)	5860
Total Recycle*, SCF/ton RS(wet)	13700
Dilution, SCF/ton RS (wet)	2570
Calc. Vent Gas SCF/ton RS(dry)	7430
Gas Losses, SCF/ton RS(wet)	87
Propane, SCF/ton RS	23.2
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	139
Spent Shale, F	696
Raw Shale, °F	70
Recycle Gas Inlet, °F	250
Dilution Gas Inlet, °F	250
Air Inlet, °F	146
Retort Air Inlet, F	146
Heat of Comb. MBtu/ton RS	542
Heat Lost, MBtu/ton RS	-25
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	28.1
Oil, Wt %	10.7
Water, Wt %	0.9
Gas, Wt %	2.2
Mineral CO_2, Wt %	17.1
Ash, Wt %	68.3
Moisture, Wt % (Uncrushed)	0.83 Est.
Carbon (Total), Wt %	16.4
Hydrogen (Total), Wt %	1.70
Nominal Size Range, inches	¼"-1"
5 % passing thru	0.263
98 % passing thru	1.05
D_a	0.606
D_v	0.714
Line Burner °F	880

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.9
Mineral CO_2, Wt %	12.5
Ash, Wt %	85.4
Carbon (total), Wt %	6.34
Organic Carbon, Wt %	2.93
Hydrogen (total), Wt %	0.25
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	99.2
Density, lb/gal	7.793
Gravity, API	19.7
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	16.3
Oil, lbs/MSCF(dry)**	0.301
Analysis (dry)	
CO_2, Vol %	28.0
O_2, Vol %	0.6
N_2 + Argon, Vol %	62.4
CH_4, Vol %	1.4
CO, Vol %	2.9
H_2, Vol %	4.7
Other, Vol %	0.0
Gross Heating Value(calc), Btu/SCF	55.3
Carbon (Total), lbs/MSCF (dry)	11.0
Hydrogen (Total), lbs/MSCF (dry)	0.46
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	94.6
Oil in Gas**, Vol % RSFA	0.1
Oil in Spent Shale, Vol % RSFA	2.2
Total Oil Meas., Vol % RSFA	96.9
Carbonate Decomposition, %	41.5
Water Recovered, lb/ton RS	126.7
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	RS 100
Overall Balance, %	102.7
Carbon Balance, % - Organic	111.6
Carbon Balance, % - Total	109.7
Hydrogen Balance, % - Organic	100.7
Hydrogen Balance, % - Total	122.4
Water Balance, %	198.5
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.54
ΔP Above Air Dist., in H_2O/ft	0.45
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Balance started 17 hours after line burner was fired. Unit probably not equilibrated. Rolls on manual control

*Measured Recycle + Dilution Gas

** Oil Mist + Condensibles to 80 °F

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

Signed [signature] DATE 6/8/67

OSRC-10

Revised 7/19/66

6/16/

//A100
2080,C1037-1 R-3-5-18-87

A. YIELDS

FAY	9.460E 01	DRYGAS	7.425E 03	MISTFA	1.356E-01
H2	3.490E 02	OTHER	0.0	UNRETO	2.242E 00
CH4	1.089E 02	O2	4.455E 01	SSY	7.988E 01
CO	2.153E 02	CO2DEC	4.154E 01	MH2O	1.267E 02
CO2	2.079E 03	OILCOL	2.653E 01		

B. METERED GAS RATES

RECG	1.108E 04	OIL	2.565E 03	WVENTG	8.391E 03
AIR	5.855E 03	TRECG	1.395E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWWG	2.893E 01	HVGT	4.106E 02	MWDG	3.111E 01
GBTU	5.531E 01				

D. COMBUSTION PRODUCTS

CO2C	7.937E 02	COC	1.969E 02	H2OC	2.826E 01
CHR	9.903E 00	COMBCP	1.396E 01		

E. MATERIAL IN

ORGCIN	2.368E 02	RSR	2.877E 02	ORH2IN	3.243E 01
MATIN	2.469E 03				

F. MATERIAL OUT

ORGCVG	4.513E 01	COKBC	4.157E 01	UNRETH	5.357E-01
ORGCOL	1.742E 02	ORH2VG	6.516E 00	COKSH	2.517E 00
UNRETC	5.155E 00	ORH2OL	2.300E 01	ORCOLP	7.356E 01
ORCVGP	1.823E 01	OPCSSP	1.977E 01	HCCVGP	4.971E 00

G. MATERIAL BALANCES

CVALL	1.027E 02	CRH2	1.007E 02	C2BAL	1.147E 02
ASH	0.0	TC	1.097E 02	WATER	1.935E 02
ORGC	1.116E 02	TH2	1.224E 02	CASL	8.571E 01
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	5.420E 05	QH2OC	1.032E 04	QAIR	8.194E 03
QPROP	8.261E 01	QOILC	1.450E 04	QRCYL	5.034E 04
QSUMIN	6.255E 05				

I. HEAT OUT

QNCOCO	2.301E 05	QKEPOD	1.000E 05	QH2OV	3.945E 04
QLIQO	5.216E 03	QOFGAS	3.224E 04	QSS	2.424E 05
QGASL	1.138E 03	LBLOSS	0.0	METLOS	-2.509E 04
QSUMOT	6.255E 05				

J. MISCELLANEOUS

ORCSS	2.928E 00	VPOIL	3.014E-01	TGL	3.232E 03
VPY	1.632E 01	VCB	1.665E 01	PROP	2.315E 01

END MESSAGE

END OUTPUT

HEAT AND MATERIAL BALANCE FOR PILOT RETORTS – DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	C-1037-1R-2 5-18-67						
	WRS	OLRS	TRS	B	MRS			
1	0.9	10.7	70	-1	15887.0			RAW SHALE
	FA	GRS	CORS	XA				
2	28.1	2.2	17.1	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	68.3	16.4	1.70	24.39	139			
	CRA	MFA	TA	PA	WA	LBHL		AIR
4	775.9	1.0	146	131	0.14	0		
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		RECYCLE AI TOTAL GAS
5	1466.2	1.0	250	75	0.0	0.0		
	CRDG	MFDG	TDG	PDG				DILUTION G
6	3.2	129.5	250	73				
	P	TP	PP	W	N			PROPANE AI NUCLEATIN AGENT
7	3.53	0.4	127.8	133.0	0.0			
	WSS	OLSS	GSS	SS				SPENT SHALE
8	0.5	0.3	0.2	0.0				
	COSS	ASSS	CSS	HSS	TSS			
9	12.5	85.4	6.34	0.25	696			
	OILLP	COL	HOL	DOL	WLP			LIQUID PRODUCT
10	1645.6	84.1	11.1	7.793	85.5			
	CRVG	MFVG	TVG	WG	OILM	M		VENT GAS
11	1570.2	1.0	250	9.5	0.04	1		
	CG	H	COOG	OG	NG			
12	11.0	0	28.0	0.6	62.4			
	MEG	COG	HHG	OTG	HG			
13	1.4	2.9	4.7	0.0	0.46			
	CRVP	VPMF	TVP	PVP				VENT PURGE
14	0.7	1.83	124	72				
	TVPC	VPOIL	VPW	GL				
15	80	43.8	4.5	18.1				

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 5-19-67 Run No. C 1037-X1

Sample Time: RS 0615; SS ____

FISCHER ASSAY

(X) RAW SHALE	(X) SPENT SHALE	
27.9	~~0.8~~ 0.9	Gal/Ton
0.911	—	S.G., g/ml
10.6	0.3	Oil, wt %
1.5	0.5	Water, wt %
85.8	99.0	Sp. Shale, ~~wt~~ %
2.2	0.2	Gas & Loss, wt %
Olive Gray	None	COKING TENDENCY

( ) RETORT SHALE MOISTURE

Fst 0.83 wt %

ES C1037-2

(X) RAW SHALE FISCHER ASSAY MOISTURE

0.64 wt %

ES EHA (X) MINERAL CO_2 11.1 (X) 12.5 wt %

ES (X) ASH (SHALE) 68.2 (X) 35.4 wt %

ES (X) MOISTURE 0.13 (X) 0.21 wt %

( ) SHALE RICHNESS DISTRIBUTION (See attached graph)

(X) CARBON 16.4 (X) 6.34 wt %

( ) SCREEN ANALYSIS (See back of this sheet)

(X) HYDROGEN ~~1.67~~ 1.70 (X) 0.25 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 MAY 25 1967 CHECKED BY ~~MAY 25 1967~~ PEP

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-19-67 Run No. C-1037-1

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	0.8					
GRAVITY, °API	19.7					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 526.0

WATER VOL, ml 254.5

GRAVITY OIL, °API 41.2

VENT GAS

MAJOR COMPONENTS

CO_2	28.0	vol %
O_2	0.6	"
N_2	61.6	"
CH_4	1.4	"
CO	2.9	"
H_2	4.7	"
Ar	0.8	"
Others	0.0	"

CARBON, ~~11.98~~ 11.0 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, 0.46 lbs/MSCFDG

COMMENTS

DATE COMPLETED MAY 22 1967 CHECKED BY KEP

OSRC-12B

SCREEN ANALYSIS DAT SHEET (TY-LAB)

RUN NO. C-1037 - 1 SAMPLE NO. _____ DATE 5-19-67

UNIT F 3 DESCRIPTION TYLAB. 1/2 TOTAL TYLAB

APPROX. SHALE SIZE 2-1 SHAKING TIME 10 MIN. N. ANALYSIS BY [illegible]

TOTAL SAMPLE WT. GROSS 43.6 - TARE 14.7 = NET 68.9

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		23.3	19.2	4.1
	0.742		49.9	20.[illegible]	29.[illegible]
	0.525		35.7	18.5	17.[illegible]
	0.371		28.3	19.3	9.0
	0.263	3	25.1	18.3	6.8
	0.185	4	21.1	19.[illegible]	1.7
	0.131	6	19.3	19.[illegible]	.2
	0.093	8	20.5	20.[illegible]	.0
	0.065	10	19.2	19.[illegible]	.[illegible]
	PAN		22.3	21.0	1.3
TOTAL ON SCREENS AND PAN					67.1
LOSS (BY DIFFERENCE)					[illegible]
TOTAL SAMPLE WEIGHT					68.9

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	6.07		93.93
0.742	0.896	1.116	43.49		50.44
0.525	0.634	1.577	25.44		25.00
0.371	0.448	2.232	10.35		14.65
0.263	0.317	3.154	10.06		4.59
0.185	0.224	4.464	2.51		2.08
0.131	0.158	6.329	0.30		1.78
0.093	0.112	8.928	0.00	98.22	1.78
0.065			0.00		1.78
PAN			1.78		0.00
LOSS			—	—	—
TOTAL			100.00	—	—
			—	—	—

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

$\sum_{+8m}^{m} Di$	0.70130	$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$	1.62171	$\sum_{+8m}^{m} Xi / Di$	
Da	0.60565	$\sum_{+8m}^{m} Xi\ Di$	
Dv	0.71400		

REMARKS: _____

OSRC-4
REV. 9/66