1513018020

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 6-28-67

Purpose: To determine operability and yield with ¼ – 2½ inch shale at 400 mass rate with hot air addition. (Without dilution gas)

GENERAL	
Run No.	R-1 TRC1048
Length, hours	12
Retort Type Number	RC VII
Oil Recovery System Number	O-2
Total Raw Shale Charged, ~~lbs.~~ Tons	119.08
Bed Height above Dist., ft	9½
Type Air Dist.	ADXI
Bed Below Air Dist., ft	6
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	359
Spent Shale, % of RS	82.0
Liquid Product, lbs/hr	2079.7
Oil Collected, gal/ton RS	24.7
Air, SCF/ton RS (dry)	4470
Total Recycle*, SCF/ton RS(wet)	13220
Dilution, SCF/ton RS (wet)	—
Calc. Vent Gas SCF/ton RS(dry)	5928
Gas Losses, SCF/ton RS(wet)	566
Propane, SCF/ton RS	21.0
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	138
Spent Shale, F	483
Raw Shale, °F	86
Recycle Gas Inlet, °F	264
Dilution Gas Inlet, °F	—
Air Inlet, °F	150
Retort Air Inlet, F	150
Heat of Comb. MBtu/ton RS	411
Heat Lost, MBtu/ton RS	25
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	30.2
Oil, Wt %	11.5
Water, Wt %	0.8
Gas, Wt %	2.4
Mineral CO_2, Wt %	18.4
Ash, Wt %	66.1
Moisture, Wt % (Uncrushed)	1.0 Est.
Carbon (Total), Wt %	18.4
Hydrogen (Total), Wt %	1.84
Nominal Size Range, inches	¼" – 2½"
5 % passing thru	—
98 % passing thru	—
Da	—
Dv	—
Line Burner °F = 880	

Bad Sample

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.6
Mineral CO_2, Wt %	17.4
Ash, Wt %	80.6
Carbon (total), Wt %	7.21
Organic Carbon, Wt %	2.46
Hydrogen (total), Wt %	0.20
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	95.7
Density, lb/gal	7.747
Gravity, API	20.6
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	5.2
Oil, lbs/MSCF(dry)**	0.1
Analysis (dry)	
CO_2, Vol %	23.8
O_2, Vol %	0.3
N_2 + Argon, Vol %	59.7
CH_4, Vol %	2.7
CO, Vol %	4.0
H_2, Vol %	7.0
Other, Vol %	2.5
Gross Heating Value(calc), Btu/SCF	119
Carbon (Total), lbs/MSCF (dry)	11.8
Hydrogen (Total), lbs/MSCF (dry)	1.01
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	81.9
Oil in Gas**, Vol % RSFA	0.3
Oil in Spent Shale, Vol % RSFA	1.4
Total Oil Meas., Vol % RSFA	83.6
Carbonate Decomposition, %	22.5
Water Recovered, lb/ton RS	55.4
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	R.S. 100
Overall Balance, %	99.4
Carbon Balance, % - Organic	92.6
Carbon Balance, % - Total	95.6
Hydrogen Balance, % - Organic	89.9
Hydrogen Balance, % - Total	93.0
Water Balance, %	101.6
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.51
ΔP Above Air Dist., in H_2O/ft	0.50
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Transition event to 400 mass rate in 5 steps.

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 83 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. Turner DATE July 17, 1967

OSRC-10
Revised 7/19/66

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//A100
2080. C1046PT R-1 6-28-67

A. YIELDS
FAY      8.191E 01    DRYGAS   5.928E 03    MISTFA   2.819E-01
H2       4.150E 02    OTHER    1.462E 02    UNRETO   1.439E 00
CH4      1.601E 02    02       1.779E 01    SSY      8.201E 01
CO       2.371E 02    CO2DEC   2.245E 01    MH20     5.537E 01
C02      1.411E 03    OILCOL   2.474E 01

B. METERED GAS RATES
RECG     1.322E 04    DIL      0.0          WVENTG   6.010E 03
AIR      4.473E 03    TRECG    1.322E 04    TGF      0.0

C. MOL WT & HEATING VALUE OF VENT GAS
MWWG     2.891E 01    HVGT     7.047E 02    MWDG     3.010E 01
GBTU     1.189E 02

D. COMBUSTION PRODUCTS
C02C     6.307E 02    COC      2.166E 02    H20C     1.767E 01
CHR      1.354E 01    COMBCP   9.965E 00

E. MATERIAL IN
ORGCIN   2.695E 02    RSR      3.594E 02    ORH2IN   3.546E 01
MATIN    2.366E 03

F. MATERIAL OUT
ORGCVG   4.798E 01    COKEC    3.644E 01    UNRETH   4.186E-01
ORGCOL   1.612E 02    ORH2VG   8.042E 00    COKEH    2.127E 00
UNRETC   3.907E 00    ORH2OL   2.127E 01    ORCOLP   5.980E 01
ORCVGP   1.780E 01    ORCSSP   1.497E 01    HCCVGP   7.837E 00

G. MATERIAL BALANCES
OVALL    9.943E 01    ORH2     8.935E 01    02BAL    1.005E 02
ASH      0.0          TC       9.561E 01    WATER    1.016E 02
ORGC     9.257E 01    TH2      9.302E 01    GASL     5.663E 02
ASHB    -1.000E 00

H. HEAT IN
QCOMB    4.105E 05    QH20C    8.463E 03    QAIR     5.278E 03
QPROP    6.398E 01    QOILC    1.341E 04    QRCYL    4.971E 04
QSUMIN   4.875E 05

I. HEAT OUT
QMC02D   1.338E 05    QKEROD   1.078E 05    QH20V    4.024E 04
QLIQO    3.682E 03    QOFGAS   2.129E 04    QSS      1.507E 05
QGASL    4.907E 03    LBLOSS   0.0          HETLOS   2.507E 04
QSUMOT   4.875E 05

J. MISCELLANEOUS
ORCSS    2.460E 00    VPOIL    1.113E-01    TGL      3.456E 03
VPM      5.193E 00    WCG      9.846E 00    PROP     2.101E 01

END MESSAGE
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HEAT AND MATERIAL BALANCE FOR PILOT RETORTS – DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	C1048 PT R-1 6/28/67						
	WRS	OLRS	TRS	B	MRS			
1	0.8	11.4	86	-1	19897.0			
	FA	GRS	CORS	XA				RAW SHALE
2	30.2	2.4	18.4	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	66.1	18.9	1.84	24.35	138			
	CRA	MFA	TA	PA	WA	LBHL		AIR
4	791.1	1.0	150	130	0.19	0		
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		RECYCLE A TOTAL GAS
5	2186.1	1.0	264	69	0.0	0.0		
	CRDG	MFDG	TDG	PDG				DILUTION G
6	0.0	0.0	0	0				
	P	TP	PP	W	N			PROPANE A NUCLEATIN AGENT
7	4.0	6.4	128.8	200.5	0.0			
	WSS	OLSS	GSS	SS				SPENT SHALE
8	0.4	0.2	0.2	0.0				
	COSS	ASSS	CSS	HSS	TSS			
9	17.4	80.6	7.21	0.20	483			
	OILLP	COL	HOL	DOL	WLP			LIQUID PRODUCT
10	190.7	84.1	11.1	7.747	178.9			
	CRVG	MFVG	TVG	WG	OILM	M		VENT GAS
11	1023.8	1.0	256	0.0	0.0	0		
	CG	H	COOG	OG	NG			
12	11.8	0	23.8	0.3	59.7			
	MEG	COG	HHG	OTG	HG			
13	2.7	4.0	7.0	2.5	1.01			
	CRVP	VPMF	TVP	PVP				VENT PURGE
14	4.4	2.17	159	43				
	TVPC	VPOIL	VPW	GL				
15	83	95.7	2.7	56.8				

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 6-28-67 Run No. C 1048-PT

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	4.3					
GRAVITY, °API	20.6					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 548.6

WATER VOL, ml 108.0

GRAVITY OIL, °API 41.8

VENT GAS

MAJOR COMPONENTS

CO_2	23.8	vol %
O_2	0.3	"
N_2	59.0	"
CH_4	2.7	"
CO	4.0	"
H_2	7.0	"
Ar	0.7	"
Others	2.5	"

CARBON, 11.8 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, 1.01 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUL 3 1967 CHECKED BY FSP

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-28-67 Run No. C1048 PT

Sample Time: RS 1815; SS _____

FISCHER ASSAY EA

RAW SHALE	SPENT SHALE	
29.9	0.6	Gal/Ton
.912	—	S.G., g/ml
11.4	0.2	Oil, wt %
1.8	0.4	Water, wt %
84.4	99.2	Sp. Shale, wt %
2.4	0.2	Gas & Loss, wt %
Slight	none	COKING TENDENCY

RETORT SHALE MOISTURE

Est 1.0 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.88 wt %

	RAW SHALE	SPENT SHALE	
MINERAL CO_2 EA	8.2	17.4	wt %
ASH (SHALE) DK	65.5	80.6	wt %
MOISTURE DK	0.30	0.06	wt %
CARBON EA DK	18.2	17.21 ~~5.51~~	wt %
HYDROGEN EA DK	1.82	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 8 1967 CHECKED BY _____

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. 01048 PT SAMPLE NO. _____ DATE 6-28-69

UNIT RETORT #3 DESCRIPTION TYLAB

APPROX. SHALE SIZE 2½-¼ SHAKING TIME 5 MIN ANALYSIS BY [illegible]

TOTAL SAMPLE WT. GROSS 31.3 − TARE 3.3 = NET 28.0

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50		17.8	16.7	1.1
	2.00		23.4	20.2	3.2
	1.50		34.8	19.2	15.6
	1.05		23.5	23.5	.0
	0.742		23.8	20.5	3.3
	0.525		20.9	18.5	2.4
	0.371		20.2	19.3	.9
	0.263	3	19.2	18.4	.8
	0.185	4	19.6	19.4	.2
	0.131	6	19.5	19.4	.1
	0.093	8	20.4	20.4	.0
	0.065	10	19.3	19.2	.1
	PAN		21.3	21.0	.3
TOTAL ON SCREENS AND PAN					28.0
LOSS (BY DIFFERENCE)					0
TOTAL SAMPLE WEIGHT					28.0

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			
0.742	0.896	1.116			
0.525	0.634	1.577			
0.371	0.448	2.232			
0.263	0.317	3.154			
0.185	0.224	4.464			
0.131	0.158	6.329			
0.093	0.112	8.928			
0.065					
PAN					
LOSS					
TOTAL					

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

$\Sigma_{+8m}^{m} Di$		$\Sigma_{+8m}^{m} Xi$	
$1/\Sigma_{+8m}^{m} Di$		$\Sigma_{+8m}^{m} Xi / Di$	
Da		$\Sigma_{+8m}^{m} Xi\ Di$	
Dv			

REMARKS: _____