15130176 02

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 5-27-67

Purpose: To determine operability and yield with hot dilution gas using ¼-1 inch shale - Mobil Task Force recommendation.

GENERAL		SPENT SHALE PROPERTIES	
Run No.	C1039-2	Fischer Assay, Gal/ton	0.4
Length, hours	12	Mineral CO_2, Wt %	11.8
Retort Type Number	RC-VII	Ash, Wt %	87.3
Oil Recovery System Number	C-1	Carbon (total), Wt %	4.98
Total Raw Shale Charged, ~~lbs.~~ Tons	96.92	Organic Carbon, Wt %	1.78
Bed Height above Dist., ft	5½'	Hydrogen (total), Wt %	0.16
Type Air Dist.	AD-X	**LIQUID PRODUCT PROPERTIES**	
Bed Below Air Dist., ft	6'	Oil, Wt %	99.2
RATES AND QUANTITIES		Density, lb/gal	7.793
Raw Shale, lbs/(hr)(ft^2)	293	Gravity, API	19.7
Spent Shale, % of RS	77.8	Ash, Wt %	—
Liquid Product, lbs/hr	1591.9	**PRODUCT GAS PROPERTIES**	
Oil Collected, gal/ton RS	22.2	Water Vapor, lbs/MSCF(dry)	1.2
Air, SCF/ton RS (dry)	5640	Oil, lbs/MSCF(dry)**	0.050
Total Recycle*, SCF/ton RS(wet)	13500	Analysis (dry)	
Dilution, SCF/ton RS (wet)	2590	CO_2, Vol %	27.1
Calc. Vent Gas SCF/ton RS(dry)	6950	O_2, Vol %	0.6
Gas Losses, SCF/ton RS(wet)	960	N_2 + Argon, Vol %	64.2
Propane, SCF/ton RS	26.5	CH_4, Vol %	1.3
TEMPERATURES AND HEAT BALANCE		CO, Vol %	2.6
Retort Offgas, °F	137	H_2, Vol %	4.1
Spent Shale, F	808	Other, Vol %	0.1
Raw Shale, °F	68	Gross Heating Value(calc), Btu/SCF	74.1
Recycle Gas Inlet, °F	250	Carbon (Total), lbs/MSCF (dry)	11.4
Dilution Gas Inlet, °F	250	Hydrogen (Total), lbs/MSCF (dry)	0.60
Air Inlet, °F	136	**YIELDS AND BALANCES**	
Retort Air Inlet, F	136	Oil Collected, Vol % RSFA	79.0
Heat of Comb. MBtu/ton RS	556	Oil in Gas**, Vol % RSFA	0.2
Heat Lost, MBtu/ton RS	-106	Oil in Spent Shale, Vol % RSFA	0.7
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	79.9
Fischer Assay, gal/ton RS	28.1	Carbonate Decomposition, %	46.0
Oil, Wt %	10.7	Water Recovered, lb/ton RS	135.7
Water, Wt %	1.2	Ash Balance, % - As Measured	—
Gas, Wt %	2.1	Ash Balance, % - Assumed	RS-100
Mineral CO_2, Wt %	17.0	Overall Balance, %	98.8
Ash, Wt %	67.9	Carbon Balance, % - Organic	84.7
Moisture, Wt % (Uncrushed)	1.20	Carbon Balance, % - Total	90.2
Carbon (Total), Wt %	16.9	Hydrogen Balance, % - Organic	92.3
Hydrogen (Total), Wt %	1.81	Hydrogen Balance, % - Total	103.9
Nominal Size Range, inches	¼"-1"	Water Balance, %	129.3
5 % passing thru	0.065 *	**MISCELLANEOUS**	
98 % passing thru	1.05	Avg. Retort ΔP, in H_2O/ft	0.48
Da	0.598	ΔP Above Air Dist., in H_2O/ft	0.40
Dv	0.718	NaCl Soln., Wt %	—
Line Burner °F	837	NaCl Rate, gal/ton RS	—

Comments: Air header temperature fluctuating due to burning of dilution in heaters. Trouble with RS and SS samples. Other than mechanical troubles, operation looked good.

*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.

* Very Wet shale

Signed Earl E. Turner DATE June 20, 1967

OSRC-10
Revised 7/19/66

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//A100
2080, C1039-2 5-27-67

A. YIELDS
FAY      7.900E 01    DRYGAS   6.948E 03    MISTFA   1.575E-01
H2       2.849E 02    OTHER    6.948E 00    UNRETO   7.259E-01
CH4      9.032E 01    O2       4.169E 01    SSY      7.773E 01
CO       1.806E 02    CO2DEC   4.601E 01    MH2O     1.357E 02
CO2      1.883E 03    OILCOL   2.220E 01

B. METERED GAS RATES
RECG     1.090E 04    DIL      2.586E 03    WVENTG   7.669E 03
AIR      5.637E 03    TRECG    1.348E 04    TGF      0.0

C. MOL WT & HEATING VALUE OF VENT GAS
MWVG     2.860E 01    HVGT     5.146E 02    MWDG     3.116E 01
GBTU     7.406E 01

D. COMBUSTION PRODUCTS
CO2C     4.774E 02    COC      1.633E 02    H2OC     5.584E 01
CHR      3.241E 00    COMBCP   8.199E 00

E. MATERIAL IN
ORGCIN   2.477E 02    RSR      2.925E 02    ORH2IN   3.403E 01
MATIN    2.460E 03

F. MATERIAL OUT
ORGCVG   3.693E 01    COKEC    2.550E 01    UNRETH   1.985E-01
ORGCOL   1.455E 02    ORH2VG   1.047E 01    COKEH    1.594E 00
UNRETC   1.853E 00    ORH2OL   1.920E 01    ORCOLP   5.974E 01
ORCVGP   1.487E 01    ORCSSP   1.104E 01    HCCVGP   5.663E 00

G. MATERIAL BALANCES
OVALL    9.877E 01    ORH2     9.232E 01    O2BAL    1.072E 02
ASH      0.0          TC       9.015E 01    WATER    1.293E 02
ORGC     8.465E 01    TH2      1.039E 02    GASL     9.603E 02
ASHB    -1.000E 00

H. HEAT IN
QCOMB    5.563E 05    QH2OC    8.027E 03    QAIR     7.053E 03
QPROP    8.379E 01    QOILC    1.211E 04    QRCYL    5.024E 04
QSUMIN   6.358E 05

I. HEAT OUT
QMCO2D   2.534E 05    QKERCO   1.012E 05    QH2OV    5.452E 04
QLIQO    4.341E 03    QOFGAS   3.119E 04    QSS      2.803E 05
QGASL    1.491E 04    LBLOSS   0.0          HETLOS  -1.061E 05
QSUMOT   6.338E 05

J. MISCELLANEOUS
ORCSS    1.759E 00    VPOIL    4.954E-02    TGL      3.094E 03
VPM      1.151E 01    WCG      1.949E 01    PROP     2.645E 01

END MESSAGE


END OUTPUT
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HEAT AND MATERIAL BALANCE FOR PILOT RETORTS - DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	C1039-2	5-27-67					
	WRS	OLRS	TRS	B	MRS			
1	1.2	10.7	68	-1	16153.8			RAW SHALE
	FA	GRS	CORS	XA				
2	28.1	2.1	17.0	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	67.9	16.9	1.81	24.10	137			
	CRA	MFA	TA	PA	WA	LBHL		AIR
4	764.1	1.0	136	133	0.14	0		
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		RECYCLE A TOTAL GAS
5	1466.1	1.0	250	79	0.0	0.0		
	CRDG	MFDG	TDG	PDG				DILUTION G
6	3.6	119.4	250	68				
	P	TP	PP	W	N			PROPANE A NUCLEATIN AGENT
7	4.1	0.4	132.2	196.2	0.0			
	WSS	OLSS	GSS	SS				SPENT SHALE
8	0.4	0.1	0.1	0.0				
	COSS	ASSS	CSS	HSS	TSS			
9	11.8	87.3	4.98	0.16	808			
	OILLP	COL	HOL	DOL	WLP			LIQUID PRODUCT
10	1397.3	84.1	11.1	7.793	194.6			
	CRVG	MFVG	TVG	WG	OILM	M		VENT GAS
11	1459.1	1.0	250	0.0	0.0	0		
	CG	H	COOG	OG	NG			
12	11.4	0	27.1	0.6	64.2			
	MEG	COG	HHG	OTG	HG			
13	1.3	2.6	4.1	0.1	0.60			
	CRVP	VPMF	TVP	PVP				VENT PURGE
14	3.7	1.83	121	80				
	TVPC	VPOIL	VPW	GL				
15	80	16.7	7.0	17.3				

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 5-28-67 Run No. C1039-2

Sample Time: RS 4:15; SS ____

FISCHER ASSAY

RAW SHALE	SPENT SHALE	
27.8	6.4	Gal/Ton
.914	.-	S.G., g/ml
10.6	0.1	Oil, wt %
2.1	0.4	Water, wt %
85.2	99.4	Sp. Shale, ~~wt~~ %
2.1	0.1	Gas & Loss, wt %
slight	none	COKING TENDENCY

MINERAL CO_2		
16.9	11.8	wt %
ASH (SHALE)		
67.7	~~82.4~~ 87.3	wt %
MOISTURE		
0.32	0.1	wt %
CARBON		
16.8	4.98	wt %
HYDROGEN		
1.80	0.16	wt %
BENZENE EXTRACTABLES		
.	.	wt %

RETORT SHALE MOISTURE

1.20 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.91 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 MAY 31 1967 CHECKED BY

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 5-28-67 Run No. C1039-3

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
⊗ WATER, wt %	0.3					
⊗ GRAVITY, °API	19.7					
○ OIL ASH, wt %						

○ DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

gs

⊗ OIL WT, g 200

⊗ WATER VOL, ml 200

⊗ GRAVITY OIL, °API 39.7

VENT GAS

ET ⊗ MAJOR COMPONENTS

			○ C_1 thru C_4, plus n-Pentane		
CO_2	27.1	vol %	CH_4	.	vol %
O_2	0.6	"	C_2H_4-C_2H_6	.	"
N_2	63.4	"	C_3H_8	.	"
CH_4	1.3	"	C_3H_6	.	"
CO	2.6	"	i C_4H_{10}	.	"
H_2	4.1	"	n C_4H_{10}	.	"
Ar	0.8	"	ϕC_3H_6	.	"
Others	0.1	"	n C_5H_{12}	.	"

EHA ⊗ CARBON, 11.4 lbs/MSCFDG

EHA ⊗ HYDROGEN, 0.60 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUN 1 1967 CHECKED BY REP

OSRC-12B
(Revised 5/3/66)

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C1039-2 SAMPLE NO. LL1 DATE 5/28/67

UNIT RETORT #3 DESCRIPTION TY LAB

APPROX. SHALE SIZE ½ to 1 SHAKING TIME 10 min ANALYSIS BY Studing R. Olson

TOTAL SAMPLE WT. GROSS 118.8 − TARE 29.4 = NET 89.4

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		24.7	19.2	5.5
	0.742		57.9	20.5	37.4
	0.525		39.0	18.5	20.5
	0.371		27.7	19.3	8.4
	0.263	3	25.5	18.3	7.2
	0.185	4	22.3	19.4	2.9
	0.131	6	20.0	19.4	.6
	0.093	8	20.6	20.5	.1
	0.065	10	19.4	19.2	.2
	PAN		27.2	21.0	6.2
TOTAL ON SCREENS AND PAN					89.0
LOSS (BY DIFFERENCE)					+.4
TOTAL SAMPLE WEIGHT					89.4

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	6.15		93.84
0.742	0.896	1.116	41.83		52.01
0.525	0.634	1.577	22.93		29.08
0.371	0.448	2.232	9.40		19.68
0.263	0.317	3.154	8.05		11.63
0.185	0.224	4.464	3.24		8.39
0.131	0.158	6.329	0.67		7.72
0.093	0.112	8.928	0.11	92.38	7.61
0.065			0.22		7.39
PAN			6.94		0.45
LOSS			+0.45		0.00
TOTAL			99.99	—	—
			—	—	—

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

$\Sigma^{m}_{+8m} Di$	0.66309	$\Sigma^{m}_{+8m} Xi$	
$1/\Sigma^{m}_{+8m} Di$	1.54557	$\Sigma^{m}_{+8m} Xi / Di$	
Da	0.59770	$\Sigma^{m}_{+8m} Xi\ Di$	
Dv	0.71778		

REMARKS:

OSRC-4