1513018032

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 7-3-67

Purpose: To determine operability and yield with ¼-2½ inch shale at 500 mass rate and with hot air (w/o dilution gas.)

GENERAL		**SPENT SHALE PROPERTIES**	
Run No.	R-2 C1099-7	Fischer Assay, Gal/ton	0.2
Length, hours	12	Mineral CO_2, Wt %	15.9
Retort Type Number	RC VII	Ash, Wt %	81.9
Oil Recovery System Number	C-2	Carbon (total), Wt %	6.76
Total Raw Shale Charged, ~~lbs.~~ Tons	164.93	Organic Carbon, Wt %	2.42
Bed Height above Dist., ft	9½	Hydrogen (total), Wt %	0.23
Type Air Dist.	ADII	**LIQUID PRODUCT PROPERTIES**	
Bed Below Air Dist., ft	6	Oil, Wt %	94.0
RATES AND QUANTITIES		Density, lb/gal	7.793
Raw Shale, lbs/(hr)(ft^2)	498	Gravity, API	19.7
Spent Shale, % of RS	83.4	Ash, Wt %	—
Liquid Product, lbs/hr	2690.5	**PRODUCT GAS PROPERTIES**	
Oil Collected, gal/ton RS	23.2	Water Vapor, lbs/MSCF(dry)	5.7
Air, SCF/ton RS (dry)	4690	Oil, lbs/MSCF(dry)**	0.164
Total Recycle*, SCF/ton RS(wet)	12150	**Analysis (dry)**	
Dilution, SCF/ton RS (wet)	—	CO_2, Vol %	23.0
Calc.Vent Gas SCF/ton RS(dry)	6269	O_2, Vol %	0.0
Gas Losses, SCF/ton RS(wet)	510	N_2 + Argon, Vol %	59.2
Propane, SCF/ton RS	27.3	CH_4, Vol %	2.4
TEMPERATURES AND HEAT BALANCE		CO, Vol %	4.2
Retort Offgas, °F	142	H_2, Vol %	6.4
Spent Shale, F	527	Other, Vol %	4.8
Raw Shale, °F	87	Gross Heating Value(calc),Btu/SCF	156
Recycle Gas Inlet, °F	260	Carbon (Total), lbs/MSCF (dry)	13.4
Dilution Gas Inlet, °F	—	Hydrogen (Total), lbs/MSCF (dry)	1.17
Air Inlet, °F	122	**YIELDS AND BALANCES**	
Retort Air Inlet, F	122	Oil Collected, Vol % RSFA	84.0
Heat of Comb. MBtu/ton RS	436	Oil in Gas**, Vol % RSFA	0.5
Heat Lost, MBtu/ton RS	32	Oil in Spent Shale, Vol % RSFA	1.6
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	86.1
Fischer Assay, gal/ton RS	27.6	Carbonate Decomposition, %	22.9
Oil, Wt %	10.5	Water Recovered, lb/ton RS	57.4
Water, Wt %	0.8	Ash Balance, % - As Measured	—
Gas, Wt %	2.5	Ash Balance, % - Assumed	R.S 100
Mineral CO_2, Wt %	17.3	Overall Balance, %	100.9
Ash, Wt %	68.3	Carbon Balance, % - Organic	101.2
Moisture, Wt % (Uncrushed)	1.03	Carbon Balance, % - Total	102.4
Carbon (Total), Wt %	17.2	Hydrogen Balance, % - Organic	93.9
Hydrogen (Total), Wt %	1.79	Hydrogen Balance, % - Total	97.4
Nominal Size Range, inches	¼"-2½"	Water Balance, %	105.7
5 % passing thru	0.371	**MISCELLANEOUS**	
98 % passing thru	2.50	Avg. Retort ΔP, in H_2O/ft	0.77
D_a	0.994	ΔP Above Air Dist., in H_2O/ft	0.89
D_v	1.326	NaCl Soln., Wt %	—
Line Burner °F	850	NaCl Rate, gal/ton RS	—

Comments: Operation good except for minor adjustments in recycle gas to keep observed temperatures at reasonable level.

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 82 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. [illegible] DATE July 18, 1967

OSRC-10
Revised 7/19/66

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//A100
2080, C1049-7 R-2 7-3-67

A. YIELDS
FAY      8.400E 01    DRYGAS   6.269E 03    MISTFA   4.776E-01
H2       4.012E 02    OTHER    3.009E 02    UNRETO   7.942E-01
CH4      1.505E 02    02       0.0          SSY      8.339E 01
CO       2.633E 02    CO2DEC   2.291E 01    MH2O     5.738E 01
CO2      1.442E 03    OILCOL   2.318E 01

B. METERED GAS RATES
RECG     1.215E 04    DIL      0.0          WVENTG   6.508E 03
AIR      4.690E 03    TRECG    1.215E 04    TGF      0.0

C. MOL WT & HEATING VALUE OF VENT GAS
MWWG     2.921E 01    HVGT     9.747E 02    MWDG     3.055E 01
GBTU     1.555E 02

D. COMBUSTION PRODUCTS
CO2C     6.907E 02    COC      2.416E 02    H2OC     1.682E 01
CHR      1.566E 01    COMBCP   1.170E 01

E. MATERIAL IN
ORGCIN   2.527E 02    RSR      4.978E 02    ORH2IN   3.459E 01
MATIN    2.384E 03

F. MATERIAL OUT
ORGCVG   6.338E 01    COKEC    3.836E 01    UNRETH   2.128E-01
ORGCOL   1.519E 02    ORH2VG   9.334E 00    COKEH    2.876E 00
UNRETC   1.986E 00    ORH2OL   2.006E 01    ORCOLP   6.014E 01
ORCVGP   2.508E 01    ORCSSP   1.597E 01    HCCVGP   1.339E 01

G. MATERIAL BALANCES
OVALL    1.009E 02    ORH2     9.389E 01    O2BAL    1.011E 02
ASH      0.0          TC       1.024E 02    WATER    1.057E 02
ORGC     1.012E 02    TH2      9.738E 01    GASL     5.104E 02
ASHB    -1.000E 00

H. HEAT IN
QCOMB    4.355E 05    QH2OC    8.606E 03    QAIR     3.022E 03
QPROP    4.460E 01    QOILC    1.265E 04    QRCYL    4.569E 04
QSUMIN   5.055E 05

I. HEAT OUT
QMCO2D   1.277E 05    QKEROD   1.027E 05    QH2OV    4.083E 04
QLIQO    3.687E 03    QOFGAS   2.238E 04    QSS      1.718E 05
QGASL    5.106E 03    LBLOSS   0.0          HETLOS   3.132E 04
QSUMOT   5.055E 05

J. MISCELLANEOUS
ORCSS    2.419E 00    VPOIL    1.638E-01    TGL      4.644E 03
VPM      5.684E 00    WCG      1.068E 01    PROP     2.726E 01

END MESSAGE


END OUTPUT
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LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	C1049-7 R-2 7-3-67						
	WRS	OLRS	TRS	B	MRS			
1	0.8	10.5	87	-1	27488.9			RAW SHALE
	FA	GRS	CORS	XA				
2	27.6	2.5	17.2	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	68.3	17.2	1.79	24.42	142			
	CRA	MFA	TA	PA	WA	LBHL		AIR
4	1674.8	1.0	122	115	0.14	0		
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		RECYCLE AI TOTAL GAS
5	2792.4	1.0	26.0	69	0.0	0.0		
	CRDG	MFDG	TDG	PDG				DILUTION G.
6	0.0	0.0	0	0				
	P	TP	PP	W	N			PROPANE AI NUCLEATIN AGENT
7	7.19	0.4	127.9	286.1	0.0			
	WSS	OLSS	GSS	SS				SPENT SHALE
8	0.4	0.1	0.1	0.0				
	COSS	ASSS	CSS	HSS	TSS			
9	15.9	81.9	6.76	0.23	527			
	OILLP	COL	HOL	DOL	WLP			LIQUID PRODUCT
10	2483.3	84.1	11.1	7.793	207.2			
	CRVG	MFVG	TVG	WG	OILM	M		VENT GAS
11	1534.2	1.0	255	0.0	0.0	0		
	CG	H	COOG	OG	NG			
12	13.4	0	23.0	0.0	59.2			
	MEG	COG	HHG	OTG	HG			
13	2.4	4.2	6.4	4.8	1.17			
	CRVP	VPMF	TVP	PVP				VENT PURGE
14	5.5	2.21	166	25				
	TVPC	VPOIL	VPW	GL				
15	82	73.9	3.4	71.4				

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 7-4-67 Run No. C1C49-7

Sample Time: RS 0715; SS _____

	RAW SHALE	SPENT SHALE	
FISCHER ASSAY	27.3	0.2	Gal/Ton
	.916	.—	S.G., g/ml
	10.4	0.1	Oil, wt %
	1.8	0.4	Water, wt %
	85.3	99.4	Sp. Shale, wt %
	2.5	0.1	Gas & Loss, wt %
	slight	NONE	COKING TENDENCY
MINERAL CO_2	17.2	15.9	wt %
ASH (SHALE)	~~67.4~~ 67.8	81.9	wt %
MOISTURE	0.14	0.06	wt %
CARBON	~~19.4~~ 19.1	6.76	wt %
HYDROGEN	~~1.84~~ 1.78	0.23	wt %
BENZENE EXTRACTABLES	.	.	wt %

RETORT SHALE MOISTURE _____ wt %

RAW SHALE FISCHER ASSAY MOISTURE 0.75 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 10 1967 CHECKED BY REP

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 7-4-67 Run No. C 1049-7

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	6.0					
GRAVITY, °API	19.7					
OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 887.0

WATER VOL, ml 24.0

GRAVITY OIL, °API 42.6

VENT GAS

MAJOR COMPONENTS

CO_2	23.0	vol %
O_2	0.0	"
N_2	58.5	"
CH_4	2.4	"
CO	4.2	"
H_2	6.4	"
Ar	0.7	"
Others	4.8	"

CARBON, ~~14.4~~ 13.4 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}	.	"
$\emptyset C_3H_6$	.	"
n C_5H_{12}	.	"

HYDROGEN, 1.17 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUL 5 1967 CHECKED BY FCP

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C1049-7 SAMPLE NO. Ty Lab DATE 7-4-67

UNIT Run 3 DESCRIPTION

APPROX. SHALE SIZE ½ to 2½ SHAKING TIME 13 min ANALYSIS BY Smith + Lowry

TOTAL SAMPLE WT. GROSS 74.8 – TARE 5.9 =NET 68.9

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50		17.1	16.8	.3
	2.00		28.2	20.2	8.0
	1.50		43.7	23.7	20.0
	1.05		34.8	19.2	15.6
	0.742		30.5	20.5	10.0
	0.525		26.0	18.6	7.4
	0.371		22.5	19.2	3.3
	0.263	3	21.1	18.5	2.6
	0.185	4	19.8	19.4	.4
	0.131	6	19.5	19.4	.1
	0.093	8	20.5	20.5	.0
	0.065	10	19.3	19.2	.1
	PAN		21.9	21.0	.9
TOTAL ON SCREENS AND PAN					68.7
LOSS (BY DIFFERENCE)					.2
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	0.99		99.56
2.00	2.250	0.4444	11.64		87.92
1.50	1.750	0.5714	29.11		58.81
1.05	(1.087) 1.275	(0.9199) 0.7843	22.71		36.10
0.742	0.896	1.116	14.56		21.54
0.525	0.634	1.577	10.77		10.77
0.371	0.448	2.232	4.80		5.97
0.263	0.317	3.154	3.78		2.19
0.185	0.224	4.464	0.58		1.61
0.131	0.158	6.329	0.15		1.46
0.093	0.112	8.928	0	98.54	1.46
0.065			0.15		1.39
PAN			1.31		0
LOSS					
TOTAL					

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

$\Sigma^{m}_{+8m} Di$		$\Sigma^{m}_{+8m} Xi$	
$1/\Sigma^{m}_{+8m} Di$		$\Sigma^{m}_{+8m} Xi / Di$	99.851
Da	0.9935	$\Sigma^{m}_{+8m} Xi\ Di$	1.306190
Dv	1.3255		

REMARKS:

OSRC-4