13017012

GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

Date 6-4-67

Purpose: To determine quality and yield without dilution gas using 1/4-1 inch shale.

GENERAL	
Run No.	TRC 1041
Length, hours	12
Retort Type Number	RC-VII
Oil Recovery System Number	C-1
Total Raw Shale Charged, ~~lbs.~~ Tons	95.89
Bed Height above Dist., ft	5 1/2'
Type Air Dist.	AD-X
Bed Below Air Dist., ft	6'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft^2)	289
Spent Shale, % of RS	80.6
Liquid Product, lbs/hr	1700.6
Oil Collected, gal/ton RS	24.9
Air, SCF/ton RS (dry)	4350
Total Recycle*, SCF/ton RS(wet)	14000
Dilution, SCF/ton RS (wet)	602
Calc. Vent Gas SCF/ton RS(dry)	5780
Gas Losses, SCF/ton RS(wet)	-48
Propane, SCF/ton RS	7.8
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	135
Spent Shale, F	575
Raw Shale, °F	82
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	401
Heat Lost, MBtu/ton RS	-66
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	30.3
Oil, Wt %	11.5
Water, Wt %	1.3
Gas, Wt %	2.3
Mineral CO_2, Wt %	17.3
Ash, Wt %	66.7
Moisture, Wt % (Uncrushed)	Est. 1.0
Carbon (Total), Wt %	17.5
Hydrogen (Total), Wt %	1.92
Nominal Size Range, inches	1/4"-1"
5 % passing thru	0.263
98 % passing thru	1.05
D_a	0.679
D_v	0.778
Line Burner °F Avg.	483

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	1.2
Mineral CO_2, Wt %	14.9
Ash, Wt %	82.8
Carbon (total), Wt %	6.84
Organic Carbon, Wt %	2.77
Hydrogen (total), Wt %	0.32
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	99.64
Density, lb/gal	7.762
Gravity, API	20.3
Ash, Wt %	—
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF(dry)	8.4
Oil, lbs/MSCF(dry)**	0.127
Analysis (dry)	
CO_2, Vol %	26.4
O_2, Vol %	0.5
N_2 + Argon, Vol %	59.5
CH_4, Vol %	2.4
CO, Vol %	3.8
H_2, Vol %	6.3
Other, Vol %	1.1
Gross Heating Value(calc), Btu/SCF	63.7
Carbon (Total), lbs/MSCF (dry)	10.1
Hydrogen (Total), lbs/MSCF (dry)	0.68
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	82.0
Oil in Gas**, Vol % RSFA	0.3
Oil in Spent Shale, Vol % RSFA	2.8
Total Oil Meas., Vol % RSFA	85.1
Carbonate Decomposition, %	30.6
Water Recovered, lb/ton RS	80.8
Ash Balance, % - As Measured	—
Ash Balance, % - Assumed	AS 100
Overall Balance, %	99.5
Carbon Balance, % - Organic	92.5
Carbon Balance, % - Total	94.9
Hydrogen Balance, % - Organic	90.4
Hydrogen Balance, % - Total	96.9
Water Balance, %	116.2
MISCELLANEOUS	
Avg. Retort ΔP, in H_2O/ft	0.41
ΔP Above Air Dist., in H_2O/ft	0.35
NaCl Soln., Wt %	—
NaCl Rate, gal/ton RS	—

Comments: Eastern thermal unit was in unstable condition - decided to make transition from + dilution gas to no dilution. Fischer assay has increased - Unit in fair condition but some skewing of temperatures

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 75 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed Earl E. [illegible] DATE June 20, 1967

OSRC-10
Revised 7/19/66

6/9

//A10J
2050, TRC1041 6-4-67

A. YIELDS

FAY	8.201E 01	DRYGAS	5.721E 03	DISTFA	3.119E-01
H2	3.642E 02	OTHER	6.359E 01	UNPSTO	2.808E 00
CH4	1.337E 02	C2	2.301E 01	SSY	3.056E 01
CO	2.197E 02	CO2DPC	3.052E 01	VH2O	8.076E 01
CO2	1.526E 03	OILCOL	9.485E 01		

B. METERED GAS RATES

RECG	1.337E 04	OIL	6.091E 02	MVENTG	6.847E 03
AIR	4.347E 03	TRECG	1.393E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWWG	2.864E 01	HVGT	3.633E 02	MWDG	3.051E 01
SBTU	6.370E 01				

D. COMBUSTION PRODUCTS

CO2C	5.485E 02	COC	2.007E 02	H2OC	2.989E 01
CHR	9.321E 00	COMBCP	9.261E 00		

E. MATERIAL IN

ORGCIN	2.563E 02	RSR	2.894E 02	ORH2IN	3.555 01
MATIN	2.359E 03				

F. MATERIAL OUT

ORGCVG	3.011E 01	COKEC	3.643E 01	UNRETN	5.491E-01
ORGCOL	1.622E 02	CFH2VG	6.556E 00	COKEH	3.404E 00
UNFETC	8.239E 00	ORHCOL	2.141E 01	ORCOLP	6.329E 01
ORCVGP	1.175E 01	ORCSSP	1.743E 01	HCCVGP	2.455E 00

G. MATERIAL BALANCES

OVALL	9.950E 01	ORH2	9.036E 01	ORBAL	1.030E 02
ASH	0.0	TC	9.489E 01	WATER	1.192E 02
ORGC	9.247E 01	TH2	9.690E 01	GASL	-4.832E 01
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	4.008E 05	QH2OC	1.039E 04	QAIR	5.127E 03
QPROP	2.371E 01	QOILC	1.359E 04	QRCYL	4.392E 04
QSUMIN	4.783E 05				

I. HEAT OUT

QMCO2H	1.715E 05	QMPROD	1.046E 05	QH2OV	5.313E 04
QLIQD	3.755E 03	QOFGAS	2.344E 04	QSS	1.883E 05
QGASL	-5.147E 02	IRLOSS	0.0	HETLOS	-5.557E 04
QSUMOT	4.733E 05				

J. MISCELLANEOUS

CROSS	2.772E 00	HPOIL	1.259E-01	TGL	3.014E 03
VPM	7.378E 00	VOP	1.497E 01	PROP	7.277E 00

END MESSAGE

END OUTPUT

HEAT AND MATERIAL BALANCE FOR PILOT RETORTS – DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	TRC 1041			6-4-67			
		WRS	OLRS	TRS	B	MRS		
1		1.3	11.5	82	-1	15981.7		RAW SHALE
		FA	GRS	CORS	XA			
2		30.3	2.3	17.3	55.22			
		ASRS	CRS	HRS	BP	TOG		
3		66.7	17.5	1.92	24.34	135		
		CRA	MFA	TA	PA	WA	LBHL	
4		580.1	1.0	146	112	0.14	0	AIR
		CRRG	MFRG	TRG	PRG	CRTG	MFTG	
5		1773.3	1.0	250	75	0.0	0.0	RECYCLE A TOTAL GAS
		CRDG	MFDG	TDG	PDG			
6		0.8	129.5	250	23			DILUTION G
		P	TP	PP	W	N		
7		1.2	0.4	129.0	161.4	0.0		PROPANE A NUCLEATIN AGENT
		WSS	OLSS	GSS	SS			
8		0.5	0.4	0.5	0.0			SPENT SHALE
		COSS	ASSS	CSS	HSS	TSS		
9		14.9	82.8	6.24	0.32	575		
		OILLP	COL	HOL	DOL	WLP		
10		1541.2	84.1	11.1	7.762	159.4		LIQUID PRODUCT
		CRVG	MFVG	TVG	WG	OILM	M	
11		1048.8	1.0	250	0.0	0.0	0	VENT GAS
		CG	H	COOG	OG	NG		
12		10.1	0	26.4	0.5	59.5		
		MEG	COG	HHG	OTG	HG		
13		2.4	3.8	6.3	1.1	0.68		
		CRVP	VPMF	TVP	PVP			
14		5.1	1.83	143	179			VENT PURGE
		TVPC	VPOIL	VPW	GL			
15		75	556	6.8	87.0			

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

TRC1041

Date Sampled 6-4-67 Run No. 4440-9

Sample Time: RS 1815; SS _____

FISCHER ASSAY RAW SHALE	FISCHER ASSAY SPENT SHALE	
30.1	1.2	Gal/Ton
.910	—	S.G., g/ml
11.4	0.44	Oil, wt %
1.8	0.5	Water, wt %
84.5	98.6	Sp. Shale, ~~wt~~ %
2.3	0.5	Gas & Loss, wt %
SLIGHT	None	COKING TENDENCY

RETORT SHALE MOISTURE

Est. 1.0 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.54 wt %

	RAW SHALE	SPENT SHALE	
MINERAL CO_2	17.2	14.9	wt %
ASH (SHALE)	66.4	82.8	wt %
MOISTURE	0.38	0.11	wt %
CARBON	17.4	6.84	wt %
HYDROGEN	1.91	0.32	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 JUN 9 1967 CHECKED BY _____

OSRC-12A
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER TKC1041

Date Sampled 6-4-67 Run No. ~~4464-9~~

BKM

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	0.36	X	X	X	X	X
GRAVITY, °API	20.3	X	X	X	X	X

○ OIL ASH, wt %

○ DISTILLATION (See attached sheet - OSRC-24)

BKM

VENT PURGE PRODUCT

OIL WT, g 666.7

WATER VOL, ml 22.0

GRAVITY OIL, °API 42.3

VENT GAS

BKM

MAJOR COMPONENTS

CO_2	26.4	vol %
O_2	0.5	"
N_2	58.8	"
CH_4	2.4	"
CO	3.8	"
H_2	6.3	"
Ar	0.7	"
Others	1.1	"

BKM CARBON, 10.1 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}	.	"

BKM HYDROGEN, 0.62 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUN 6 1967 CHECKED BY RCP

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. ~~C-1040~~ TRC 1041 SAMPLE NO. 9 DATE 6-4-67

UNIT Retort 3 DESCRIPTION TY Lab

APPROX. SHALE SIZE ¼ - 1" SHAKING TIME 10 min ANALYSIS BY Stratton & Smith

TOTAL SAMPLE WT. GROSS 85.1 - TARE 7.2 = NET 77.9

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		27.3	19.2	8.1
	0.742		60.6	20.5	40.1
	0.525		35.6	18.5	17.1
	0.371		25.1	19.3	5.8
	0.263	3	22.6	19.3	4.3
	0.185	4	20.5	19.3	1.2
	0.131	6	19.5	19.3	.2
	0.093	8	20.5	20.4	.1
	0.065	10	19.2	19.2	0
	PAN		21.8	20.9	.9
TOTAL ON SCREENS AND PAN					77.8
LOSS (BY DIFFERENCE)					.1
TOTAL SAMPLE WEIGHT					77.9

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	10.40		89.61
0.742	0.896	1.116	51.48		38.13
0.525	0.634	1.577	21.95		16.18
0.371	0.448	2.232	7.45		8.73
0.263	0.317	3.154	5.51		3.22
0.185	0.224	4.464	1.54		1.68
0.131	0.158	6.329	0.26		1.42
0.093	0.112	8.928	0.13	98.72	1.29
0.065			0.00		1.29
PAN			1.16		0.13
LOSS			0.13		0.00
TOTAL			100.01	—	—
			—	—	—

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

$\sum_{+8m}^{m} Di$	0.76832	$\sum_{+8m}^{m} Xi$	
$1/\sum_{+8m}^{m} Di$	1.45321	$\sum_{+8m}^{m} Xi/Di$	
Da	0.67932	$\sum_{+8m}^{m} Xi\ Di$	
Dv	0.77828		

REMARKS: _____

OSRC-4

004147