GAS COMBUSTION RETORTING
DETAILED RUN SUMMARY SHEET

151301809

Date 6-22-67

Purpose: To determine operability and yield with ... using hot dilution gas and approaching maximum ... rate.

GENERAL		SPENT SHALE PROPERTIES	
Run No.	R-1 TRC1046-7	Fischer Assay, Gal/ton	0.0
Length, hours	12	Mineral CO_2, Wt %	15.3
Retort Type Number	RC VII	Ash, Wt %	82.4
Oil Recovery System Number	C-1	Carbon (total), Wt %	6.62
Tons Total Raw Shale Charged, ~~lbs.~~	99.21	Organic Carbon, Wt %	2.44
Bed Height above Dist., ft	9½	Hydrogen (total), Wt %	0.21
Type Air Dist.	ADXI	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	6	Oil, Wt %	90.8
RATES AND QUANTITIES		Density, lb/gal	7.747
Raw Shale, lbs/(hr)(ft^2)	299	Gravity, API	20.6
Spent Shale, % of RS	82.2	Ash, Wt %	—
Liquid Product, lbs/hr	1669.5	PRODUCT GAS PROPERTIES	
Oil Collected, gal/ton RS	23.6	Water Vapor, lbs/MSCF(dry)	5.8
Air, SCF/ton RS (dry)	5006	Oil, lbs/MSCF(dry)**	0.128
Total Recycle*, SCF/ton RS(wet)	13100	Analysis (dry)	
Dilution, SCF/ton RS (wet)	1850	CO_2, Vol %	23.9
Calc. Vent Gas SCF/ton RS(dry)	6400	O_2, Vol %	0.5
Gas Losses, SCF/ton RS(wet)	960	N_2 + Argon, Vol %	61.8
Propane, SCF/ton RS	23.0	CH_4, Vol %	2.0
TEMPERATURES AND HEAT BALANCE		CO, Vol %	2.7
Retort Offgas, °F	141	H_2, Vol %	5.5
Spent Shale, °F	562	Other, Vol %	3.6
Raw Shale, °F	89	Gross Heating Value(calc),Btu/SCF	108.7
Recycle Gas Inlet, °F	276	Carbon (Total), lbs/MSCF (dry)	11.8
Dilution Gas Inlet, °F	280	Hydrogen (Total), lbs/MSCF (dry)	0.82
Air Inlet, °F	152	YIELDS AND BALANCES	
Retort Air Inlet, F	152	Oil Collected, Vol % RSFA	84.6
Heat of Comb. MBtu/ton RS	479	Oil in Gas**, Vol % RSFA	0.4
Heat Lost, MBtu/ton RS	25	Oil in Spent Shale, Vol % RSFA	0.0
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	85.0
Fischer Assay, gal/ton RS	27.9	Carbonate Decomposition, %	75.0
Oil, Wt %	10.7	Water Recovered, lb/ton RS	69.0
Water, Wt %	1.0	Ash Balance, % - As Measured	—
Gas, Wt %	2.3	Ash Balance, % - Assumed	R.S.100
Mineral CO_2, Wt %	17.7	Overall Balance, %	100.1
Ash, Wt %	67.7	Carbon Balance, % - Organic	99.4
Moisture, Wt % (Uncrushed)	1.0 Est.	Carbon Balance, % - Total	100.9
Carbon (Total), Wt %	16.9	Hydrogen Balance, % - Organic	98.1
Hydrogen (Total), Wt %	1.73	Hydrogen Balance, % - Total	98.4
Nominal Size Range, inches	½"-2½"	Water Balance, %	91.4
5 % passing thru	0.371	MISCELLANEOUS	
98 % passing thru	2.50	Avg. Retort ΔP, in H_2O/ft	0.35
Da	1.073	ΔP Above Air Dist., in H_2O/ft	0.33
Dv	1.439	NaCl Soln., Wt %	—
Line Burner °F	660	NaCl Rate, gal/ton RS	—

Comments: Transition period in which the recycle gas was reduced with a corresponding change in the air rate. Five minute power failure about midway the balance period.

*Measured Recycle + Dilution Gas
** Oil Mist + Condensibles to 86 °F
*** Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed E. D. [signature] DATE July 17 1967

OSRC-10
Revised 7/19/66

//A100
2080. TRC1046-7 R-1 6-22-67

A. YIELDS

FAY	8.459E 01	DRYGAS	6.404E 03	MISTFA	3.792E-01
H2	3.522E 02	OTHER	2.305E 02	UNRETO	0.0
CH4	1.281E 02	02	3.202E 01	SSY	8.216E 01
CO	1.729E 02	CO2DEC	2.898E 01	MH2O	6.895E 01
CO2	1.531E 03	OILCOL	2.360E 01		

B. METERED GAS RATES

RECG	1.173E 04	DIL	1.853E 03	WVENTG	6.221E 03
AIR	5.002E 03	TRECG	1.359E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWWG	2.941E 01	HVGT	6.964E 02	MWDG	3.079E 01
GBTU	1.087E 02				

D. COMBUSTION PRODUCTS

CO2C	5.818E 02	COC	1.534E 02	H2OC	3.457E 01
CHR	6.007E 00	COMBCP	9.570E 00		

E. MATERIAL IN

ORGCIN	2.435E 02	RSR	2.994E 02	ORH2IN	3.285E 01
MATIN	2.407E 03				

F. MATERIAL OUT

ORGCVG	4.828E 01	COKEC	4.015E 01	UNRETH	0.0
ORGCOL	1.538E 02	ORH2VG	9.217E 00	COKEH	2.715E 00
UNRETC	0.0	ORH2OL	2.029E 01	ORCOLP	6.314E 01
ORCVGP	1.982E 01	ORCSSP	1.646E 01	HCCVGP	1.025E 01

G. MATERIAL BALANCES

OVALL	1.001E 02	ORH2	9.810E 01	O2BAL	9.884E 01
ASH	0.0	TC	1.009E 02	WATER	9.135E 01
ORGC	9.944E 01	TH2	9.835E 01	GASL	9.600E 02
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	4.786E 05	QH2OC	8.479E 03	QAIR	5.812E 03
QPROP	6.922E 01	QOILC	1.280E 04	QRCYL	5.471E 04
QSUMIN	5.605E 05				

I. HEAT OUT

QMCO2D	1.662E 05	QKEROD	1.040E 05	QH2OV	4.539E 04
QLIQO	3.531E 03	QOFGAS	2.257E 04	QSS	1.837E 05
QGASL	1.009E 04	LBLOSS	0.0	HETLOS	2.497E 04
QSUMOT	5.605E 05				

J. MISCELLANEOUS

ORCSS	2.443E 00	VPOIL	1.280E-01	TGL	2.965E 03
VPM	5.769E 00	WCG	1.082E 01	PROP	2.301E 01

END MESSAGE

END OUTPUT

HEAT AND MATERIAL BALANCE FOR PILOT RETORTS – DATA SHEET

LINE #	PROGRAM ID	USER IDENTIFICATION						
0	2080,	TRC1046-7 R-1 6-22-67						
	WRS	OLRS	TRS	B	MRS			
1	1.0	10.7	89	-1	16534.2			
	FA	GRS	CORS	XA				RAW SHALE
2	27.9	2.3	17.7	55.22				
	ASRS	CRS	HRS	BP	TOG			
3	67.7	16.9	1.73	24.35	141			
	CRA	MFA	TA	PA	WA	LBHL		
4	690.4	1.0	152	133	0.14	0		AIR
	CRRG	MFRG	TRG	PRG	CRTG	MFTG		
5	1629.8	1.0	276	73	0.0	0.0		RECYCLE AI TOTAL GAS
	CRDG	MFDG	TDG	PDG				
6	5.6	56.4	280	75				DILUTION GA
	P	TP	PP	W	N			
7	3.65	0.4	128.8	167.0	0.0			PROPANE AI NUCLEATIN AGENT
	WSS	OLSS	GSS	SS				
8	0.4	0.0	0.0	0.0				SPENT SHALE
	COSS	ASSS	CSS	HSS	TSS			
9	15.3	82.4	6.62	0.21	562			
	OILLP	COL	HOL	DOL	WLP			
10	1511.5	84.1	11.1	7.747	158.0			LIQUID PRODUCT
	CRVG	MFVG	TVG	WG	OILM	M		
11	1184.6	1.0	280	0.0	0.0	0		
	CG	H	COOG	OG	NG			VENT GAS
12	11.8	0	23.9	0.5	61.8			
	MEG	COG	HHG	OTG	HG			
13	2.0	2.7	5.5	3.6	0.82			
	CRVP	VPMF	TVP	PVP				
14	4.3	2.16	161	42				VENT PURGE
	TVPC	VPOIL	VPW	GL				
15	86	51.0	2.9	83.7				

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.

Mesh	Wt. Grams	Wt. %
8	224.0	30.2
14	222.5	30.0
28	116.5	15.7
35	38.8	5.2
48	24.9	3.4
65	22.6	3.0
100	19.3	2.6
150	16.0	2.2
Pan	57.5	7.7
TOTAL	742.1	100%

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-22-67 Run No. ~~XX~~ C-1646-7

Sample Time: RS 18:25; SS ____

FISCHER ASSAY RAW SHALE (ET)	FISCHER ASSAY SPENT SHALE (EHG)	
27.7	0.9	Gal/Ton
0.911	—	S.G., g/ml
10.6	0.9	Oil, wt %
1.9	0.4	Water, wt %
85.2	99.4	Sp. Shale, ~~wt~~ %
2.3	0.2	Gas & Loss, wt %
slight	none	COKING TENDENCY

( ) RETORT SHALE MOISTURE

Est. 1.0 wt %

(X) (ET) RAW SHALE FISCHER ASSAY MOISTURE

0.88 wt %

MINERAL CO_2 (ET)	MINERAL CO_2 (EGB)	
(X) 17.6	(X) 15.3	wt %

ASH (SHALE) (ET)	ASH (SHALE) (EGB)	
(X) 67.4	(X) 82.4	wt %

MOISTURE (ET)	MOISTURE (EGB)	
(X) 0.46	(X) 0.10	wt %

CARBON (ET)	CARBON (EGB)	
(X) 16.8	( ) 6.62	wt %

HYDROGEN (ET)	HYDROGEN (EGB)	
(X) 1.72	( ) 0.21	wt %

BENZENE EXTRACTABLES		
( ) .	( ) .	wt %

( ) SHALE RICHNESS DISTRIBUTION (See attached graph)

BKM-EHG (X) 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 26 1967 CHECKED BY ____

OSRC-12A

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 6-22-67 Run No. ~~EC 1046-7~~ (2100)

LIQUID PRODUCTS

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
WATER, wt %	9.2					
GRAVITY, °API	20.6					
OIL ASH, wt %						

○ DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 612.0

WATER VOL, ml 51.0

GRAVITY OIL, °API 40.7

VENT GAS

⊗ MAJOR COMPONENTS

CO_2	23.9	vol %
O_2	0.5	"
N_2	61.1	"
CH_4	2.0	"
CO	2.7	"
H_2	5.5	"
Ar	0.7	"
Others	3.6	"

○ 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}	.	"

⊗ CARBON, 11.8 lbs/MSCFDG ⊗ HYDROGEN, 0.82 lbs/MSCFDG

COMMENTS

DATE COMPLETED JUN 24 1967 CHECKED BY

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. TRC 1046-4 SAMPLE NO. _____ DATE 6/22/67

UNIT Reactor #3 DESCRIPTION Ty Lobe

APPROX. SHALE SIZE ¼ - 2½ SHAKING TIME 1815 ANALYSIS BY Sours + Bowery

TOTAL SAMPLE WT. GROSS 83.5 − TARE 6.6 = NET 76.9

SCREEN SIZE			WEIGHTS		
SCREENS REQD.	OPENING SIZE	MESH	GROSS LBS.	TARE LBS.	NET WT. RETAINED
	4.25				
	3.00				
	2.50*		19.2	16.7	2.5
	2.00		33.4	20.2	13.2
	1.50		44.4	23.4	21.0
	1.05		36.1	19.2	16.9
	0.742		29.5	20.5	9.0
	0.525		25.8	18.5	7.3
	0.371		22.7	19.2	3.5
	0.263	3	20.8	18.4	2.4
	0.185	4	19.7	19.4	.3
	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		21.8	21.0	.7
TOTAL ON SCREENS AND PAN					77.0
LOSS (BY DIFFERENCE)					+1
TOTAL SAMPLE WEIGHT					77.1

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	x 3.26		96.75
2.00	2.250	0.4444	17.13		79.62
1.50	1.750	0.5714	27.27		52.35
1.05	(1.087) 1.275	(0.9199) 0.7843	21.94		30.41
0.742	0.896	1.116	11.68		18.73
0.525	0.634	1.577	9.48		9.25
0.371	0.448	2.232	4.54		4.71
0.263	0.317	3.154	3.15		1.56
0.185	0.224	4.464	0.39		1.17
0.131	0.158	6.329	0.13		1.04
0.093	0.112	8.928	0	98.96	1.04
0.065			0.13		0.91
PAN			0.91		0
LOSS			—		
TOTAL			100.00		

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

$\Sigma^{m}_{+8m} Di$	1.42386	$\Sigma^{m}_{+8m} Xi$	
$1/\Sigma^{m}_{+8m} Di$	0.92257	$\Sigma^{m}_{+8m} Xi / Di$	
Da	1.07265	$\Sigma^{m}_{+8m} Xi\ Di$	
Dv	1.43882		

REMARKS: _____

OSRC-4