

**GAS COMBUSTION RETORTING  
DETAILED RUN SUMMARY SHEET**

1513013011

Date 4-13-67

Purpose: To determine granulometry and yield at 500 Mas. rate using 1-2" shale with 55 liner, 36 height 1/8" and cover 3 air - moisture standards.

GENERAL	
Run No.	C-1078-4
Length, hours	12
Retort Type Number	RC-75
Oil Recovery System Number	C-2
Total Raw Shale Charged, lbs.	164.1
Bed Height above Dist., ft	12 1/2'
Type Air Dist.	A.O.V.I.E.
Bed Below Air Dist., ft	7'
RATES AND QUANTITIES	
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	495
Spent Shale, % of RS	82.0
Liquid Product, lbs/hr	7521.3
Oil Collected, gal/ton RS	21.2
Air, SCF/ton RS (dry)	4720
Total Recycle*, SCF/ton RS (wet)	12900
Dilution, SCF/ton RS (wet)	-
Calc. Vent. Gas SCF/ton RS (dry)	6170
Gas Losses, SCF/ton RS (wet)	-224
Propane, SCF/ton RS	-
TEMPERATURES AND HEAT BALANCE	
Retort Offgas, °F	139
Spent Shale, F	386
Raw Shale, °F	54
Recycle Gas Inlet, °F	250
Dilution Gas Inlet, °F	-
Air Inlet, °F	131
Retort Air Inlet, F	131
Heat of Comb. MBtu/ton RS	442
Heat Lost, MBtu/ton RS	26
RAW SHALE PROPERTIES	
Fischer Assay, gal/ton RS	24.5
Oil, Wt %	9.4
Water, Wt %	1.1
Gas, Wt %	1.9
Mineral CO <sub>2</sub> , Wt %	17.7
Ash, Wt %	69.1
Moisture, Wt % (Uncrushed)	1.0 Est.
Carbon (Total), Wt %	15.5
Hydrogen (Total), Wt %	1.57
Nominal Size Range, inches	1"-2 1/2"
5 % passing thru	NO
98 % passing thru	-
D <sub>80</sub>	7.165
D <sub>50</sub>	-

SPENT SHALE PROPERTIES	
Fischer Assay, Gal/ton	0.0
Mineral CO <sub>2</sub> , Wt %	14.2
Ash, Wt %	84.3
Carbon (total), Wt %	6.02
Organic Carbon, Wt %	2.14
Hydrogen (total), Wt %	0.21
LIQUID PRODUCT PROPERTIES	
Oil, Wt %	95.4
Density, lb/gal	7.723
Gravity, API	19.7
Ash, Wt %	-
PRODUCT GAS PROPERTIES	
Water Vapor, lbs/MSCF (dry)	7.7
Oil, lbs/MSCF (dry)**	0.041
Analysis (dry)	
CO <sub>2</sub> , Vol %	26.3
O <sub>2</sub> , Vol %	0.6
N <sub>2</sub> + Argon, Vol %	61.0
CH <sub>4</sub> , Vol %	1.9
CO, Vol %	2.7
H <sub>2</sub> , Vol %	5.4
Other, Vol %	1.1
Gross Heating Value (calc), Btu/SCF	103.9
Carbon (Total), lbs/MSCF (dry)	12.6
Hydrogen (Total), lbs/MSCF (dry)	0.78
YIELDS AND BALANCES	
Oil Collected, Vol % RSFA	86.7
Oil in Gas**, Vol % RSFA	0.1
Oil in Spent Shale, Vol % RSFA	0.0
Total Oil Meas., Vol % RSFA	86.8
Carbonate Decomposition, %	34.2
Water Recovered, lb/ton RS	69.3
Ash Balance, % - As Measured	-
Ash Balance, % - Assumed	85-100
Overall Balance, %	97.3
Carbon Balance, % - Organic	102.4
Carbon Balance, % - Total	101.7
Hydrogen Balance, % - Organic	101.8
Hydrogen Balance, % - Total	101.9
Water Balance, %	92.6
MISCELLANEOUS	
Avg. Retort ΔP, in H <sub>2</sub> O/ft	0.51
ΔP Above Air Dist., in H <sub>2</sub> O/ft	0.54
NaCl Soln., Wt %	-
NaCl Rate, gal/ton RS	-

Comments: *Moisture balance error. Recycle rate was measured from 12/500 to 13/500. Some gas lost during process.*

\*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 E. E. Jones DATE April 21, 1967 OSRC-10 Revised 7/19/66

YIELDS

PAY	8.670 01	DRYGAS	6.124 03	MISTFA	1.303-01		
HP	3.338 02	CFHEP	6.730 01	UNRETC	0.000 00	CH4	1.153 02
CI	3.674 01	SBY	8.198 01	CO	2.835 02	CO2DHC	8.423 01
HW20	6.938 01	CCP	1.510 03	OILCOI	2.124 01		

METERED GAS RATES

RECH	1.237 04	DIL	0.000 00	VENTE	7.330 03	AIP	4.721 03
TRECS	1.237 04	ICF	0.000 00				

WOL HT & HEATING VALUE OF VENT GAS

WVCO	2.911 01	WVGT	6.353 02	WVDE	3.078 01	WVTH	1.039 02
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COMBUSTION PRODUCTS

CO2C	5.150 02	COO	2.114 02				
H2OC	3.199 01	CH2	6.420 00	COVCOF	1.030 01		

MATERIAL IN

CRGCIN	2.133 02	CSR	4.251 02	CFHPTN	2.497 01	WATIN	2.382 03
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MATERIAL OUT

CRGCOF	4.481 01	CKKIC	3.518 01	UNRETN	0.000 00		
CRGCOI	1.392 02	CRHCOV	3.391 00	CKKFA	1.702 00	UNRETC	0.000 00
CRHCOI	1.577 01	CRCOIF	5.325 01	CRCOVF	2.077 01	CRGASP	1.646 01
RCOVP	2.253 00						

MATERIAL BALANCES

CVALL	9.923 01	CRGMC	1.612 02				
COFAL	9.899 01	ASH	0.000 00	FC	1.017 02	WATER	2.257 01
CRCC	1.024 02	THP	1.612 00	CRSL	-2.135 02	CH2	-1.300 00

HEAT IN

COOFC	4.415 05	HWCOO	3.459 03	CRIP	6.621 03		
CRPOP	0.000 00	COILC	1.158 04	CRVCL	5.210 04	WATIN	5.604 03

HEAT OUT

CRCOFD	1.903 05	CRFRON	9.040 04	CRPOV	4.797 04		
CLIRO	5.004 03	COFBAS	3.546 04	CRS	1.213 05	CGASL	-1.953 03
LBLOSS	0.000 00	HTLOSS	2.533 04	CRUYCT	5.204 05		

MISCELLANEOUS

CRGSC	2.143 00	VFCIL	4.070-02	TGL	5.302 03	VPX	7.163 00
WCS	1.309 01	PROP	0.000 00				

MATERIAL AND HEAT BALANCE INPUT SHEET

RIF92 | , RUN NO. | C-1-8-4 | STARTED | 4-13-6 | CALC. ON | 4-18-67

101 | 904 | 54 | -1 | 2734308  
 H<sub>2</sub>O, wt% | Oil, wt% | °F | (1) | Rate, lbs/hr

2405 | 109 | 1707 | 55022  
 Oil, gal/T | Gas, L, wt% | CO<sub>2</sub>, wt% | Retort XS, ft<sup>2</sup>

6901 | 1505 | 1057 | 23097 | 139  
 Ash, wt% | Carbon, wt% | H<sub>2</sub>, wt% | Bar. Press, " Hg | Offgas Temp, °F

RAW SHALE  
 BAROMETR.  
 PRESSURE  
 AND  
 OFFGAS  
 TEMPERATURE

1086.2 | 100 | 131 | 118 | 0.014 | 0  
 Chart Reading | Meter Factor | Temp, °F | Press, "H<sub>2</sub>O gauge | Moist, lbs/msec | Heat Loss, Btu/hr

AIR

2966.0 | 100 | 250 | 71 | 0.00 | 0.00  
 Recycle Ch. Read | Meter Factor | Temp, °F | Press, "H<sub>2</sub>O gauge | Tot Gas Ch. Read | Meter Factor

RECYCLE AIR  
 TOTAL GAS

0.0 | 0.0 | 0 | 0  
 Dil Gas Chart Read | Meter Factor | Temp, °F | Press, "H<sub>2</sub>O gauge

DILUTION  
 GAS

0.00 | 0 | 0 | 276.2 | 0.00  
 C<sub>3</sub> Rotameter R. | Temp, °F | Press, "H<sub>2</sub>O gauge | Water addit, lbs/hr | Nucl. Agent, lb/hr

PROPANE, WATER  
 & NUCLEATING  
 AGENT

004 | 000 | 000 | 0.00  
 H<sub>2</sub>O, wt% | Oil, wt% | Gas, wt% | Rate, lbs/hr

SPENT  
 SHALE

14.2 | 84.3 | 60.2 | 0.2 | 386  
 CO<sub>2</sub>, wt% | Ash, wt% | Carbon, wt% | H<sub>2</sub>, wt% | Temp, °F

2263.2 | 84.01 | 11.01 | 70793 | 258.01  
 Dry Oil, lbs/hr | Carbon, wt% | H<sub>2</sub>, wt% | Den, lbs/gal | Water, lbs/hr

L. LIQUID  
 PRODUCT

1695.8 | 100 | 240 | 0.00 | 0.00 | 0 | 12.05  
 Vent + Dil Gas Chart Reading | Meter Factor | Temp, °F | Moist, lbs/msec | Mist, lbs/msec<sup>2</sup> (2) | Carbon, lbs/msec

VENT +  
 DILUTION  
 GAS,  
 VENT PURGE  
 GAS, AND  
 TOP SEAL  
 GAS

0 | 26.3 | 0.6 | 61.00 | 1.9 | 3.7 | 5.4  
 (3) CO<sub>2</sub>, vol% | O<sub>2</sub>, vol% | N<sub>2</sub>, vol% | CH<sub>4</sub>, vol% | CO, vol% | H<sub>2</sub>, vol%

101 | 0078 | 1601  
 Other, vol% | H<sub>2</sub>, lbs/msec<sup>2</sup> | V. Purge Ch. Reading

1083 | 176 | 152 | 75 | 2908 | 903 | 12024  
 Meter Factor | Temp, °F | Press, "H<sub>2</sub>O gauge | Cond. Gas | Dry Oil, gm/hr | Water, lbs/hr | Top Seal Gas Rate, scfm

OPTIONS:

- (1) Insert "0" to calc. with measured rates; "1" to calc. with spent shale rate and ash analyses; "-1" to calc. with raw shale rate and ash analyses.
- (2) Insert "1" to calc. with measured moisture and mist; "0" to calc. from vent purge data.
- (3) Insert "0" for Retort No. 3 (pressure and temperature have no effect on gas rates); "1" for Retort No. 1&2 (pressure and temperature have effect on gas rates).

LB Gilmore  
 1/17/67

LABORATORY ANALYSIS SHEET

843

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-13-67

Run No. C10297  
C10284

Sample Time: RS 1.815; SS 2.815

FISCHER ASSAY

RETORT SHALE MOISTURE  
1.0 <sup>EST.</sup> wt %

RAW SHALE <sup>R</sup>  SPENT SHALE

24.3 0.0 Gal/Ton

0.912 — S.G., g/ml

9.3 0.0 Oil, wt %

2.0 0.4 Water, wt %

86.8 99.5 Sp. Shale, wt %

1.9 0.1 Gas & Loss, wt %

slight None COKING TENDENCY

<sup>R</sup>  RAW SHALE FISCHER ASSAY MOISTURE

0.87 wt %

MINERAL CO<sub>2</sub>

<sup>R</sup>  17.6 <sup>R</sup>  14.2 wt %

ASH (SHALE)

<sup>R</sup>  12.8 <sup>R</sup>  24.3 wt %

MOISTURE

<sup>R</sup>  0.45 <sup>R</sup>  0.11 wt %

CARBON

<sup>R</sup>  15.4 <sup>R</sup>  6.02 wt %

HYDROGEN

<sup>R</sup>  1.56 <sup>R</sup>  0.21 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<sub>2</sub>", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS \_\_\_\_\_

DATE COMPLETED \_\_\_\_\_

CHECKED BY RFP

OSRC-12A

Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

C1028-4

Date Sampled 4-13-67

Run No. C-10297  
(2100)

LIQUID PRODUCTS

D3 PUMPOUT

T3 PUMPOUT

	1	2	3	4	1	2
<input checked="" type="checkbox"/> WATER, wt %	4.6	/	/	/	/	/
<input checked="" type="checkbox"/> GRAVITY, °API	19.7	/	/	/	/	/
<input type="checkbox"/> OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

no sample

OIL WT, g \_\_\_\_\_  
 WATER VOL, ml \_\_\_\_\_  
 GRAVITY OIL, °API \_\_\_\_\_

VENT GAS

MAJOR COMPONENTS

CO<sub>2</sub> 26.3 vol %  
 O<sub>2</sub> 0.6 "  
 N<sub>2</sub> 60.3 "  
 CH<sub>4</sub> 1.9 "  
 CO 3.7 "  
 H<sub>2</sub> 5.4 "  
 Ar 0.7 "  
 Others 1.1 "

C<sub>1</sub> thru C<sub>4</sub>, plus n-Pentane

CH<sub>4</sub> \_\_\_\_\_ vol %  
 C<sub>2</sub>H<sub>4</sub>-C<sub>2</sub>H<sub>6</sub> \_\_\_\_\_ "  
 C<sub>3</sub>H<sub>8</sub> \_\_\_\_\_ "  
 C<sub>3</sub>H<sub>6</sub> \_\_\_\_\_ "  
 i C<sub>4</sub>H<sub>10</sub> \_\_\_\_\_ "  
 n C<sub>4</sub>H<sub>10</sub> \_\_\_\_\_ "  
 ∅C<sub>3</sub>H<sub>6</sub> \_\_\_\_\_ "  
 n C<sub>5</sub>H<sub>12</sub> \_\_\_\_\_ "

CARBON, 12.6 lbs/MSCFDG

HYDROGEN, 0.78 lbs/MSCFDG

COMMENTS \_\_\_\_\_

DATE COMPLETED 4-17-67

CHECKED BY RPB