

GAS SEPARATION AND REPARTING  
DETAILED RUN SUMMARY SHEET

1523022009

Date 8-31-67

Purpose: Liquid disengagement experiment.

GENERAL		SPENT SHALE PROPERTIES	
Run No.	C1058-2	Fischer Assay, Gal/ton	6.9
Length, hours	12	Mineral CO <sub>2</sub> , Wt %	15.1
Retort Type Number	RC- <del>XIII</del>	Ash, Wt %	78.7
Oil Recovery System Number	C-5	Carbon (total), Wt %	9.45
<b>TONS</b> Total Raw Shale Charged, lbs.	163.46	Organic Carbon, Wt %	5.33
Bed Height above Dist., ft	9 1/2'	Hydrogen (total), Wt %	0.58
Type Air Dist.	AD- <del>XIII</del>	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	6'	Oil, Wt %	77.2
RATES AND QUANTITIES		Density, lb/gal	7.737
Raw Shale, lbs/(hr)(ft <sup>2</sup> )	493	Gravity, API	20.8
Spent Shale, % of RS	83.4	Ash, Wt %	-
Liquid Product, lbs/hr	1971.5	PRODUCT GAS PROPERTIES	
Oil Collected, gal/ton RS	18.6	Water Vapor, lbs/MSCF (dry)	12.9
Air, SCF/ton RS (dry)	5040	Oil, lbs/MSCF (dry)**	0.160
Total Recycle*, SCF/ton RS (wet)	13200	Analysis (dry)	
Dilution, SCF/ton RS (wet)	-	CO <sub>2</sub> , Vol %	24.0
Calc. Vent Gas SCF/ton RS (dry)	6400	O <sub>2</sub> , Vol %	0.3
Gas Losses, SCF/ton RS (wet)	530	N <sub>2</sub> + Argon, Vol %	62.3
Propane, SCF/ton RS	-	CH <sub>4</sub> , Vol %	2.0
TEMPERATURES AND HEAT BALANCE		CO, Vol %	5.8
Retort Offgas, °F	152	H <sub>2</sub> , Vol %	5.6
Spent Shale, F	430	Other, Vol %	0.0
Raw Shale, °F	76	Gross Heating Value (calc), Btu/SCF	114.9
Recycle Gas Inlet, °F	236	Carbon (Total), lbs/MSCF (dry)	12.2
Dilution Gas Inlet, °F	-	Hydrogen (Total), lbs/MSCF (dry)	0.89
Air Inlet, °F	152	YIELDS AND BALANCES	
Retort Air Inlet, F	152	Oil Collected, Vol % RSFA	64.9
Heat of Comb. MBtu/ton RS	484	Oil in Gas**, Vol % RSFA	0.5
Heat Lost, MBtu/ton RS	41	Oil in Spent Shale, Vol % RSFA	19.9
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	85.3
Fischer Assay, gal/ton RS	28.6	Carbonate Decomposition, %	34.1
Oil, Wt %	10.9	Water Recovered, lb/ton RS	98.7
Water, Wt %	1.0	Ash Balance, % - As Measured	-
Gas, Wt %	2.2	Ash Balance, % - Assumed	RS-100
Mineral CO <sub>2</sub> , Wt %	19.1	Overall Balance, %	97.9
Ash, Wt %	65.6	Carbon Balance, % - Organic	99.7
Moisture, Wt % (Uncrushed)	Est. 1.0	Carbon Balance, % - Total	99.8
Carbon (Total), Wt %	17.9	Hydrogen Balance, % - Organic	106.2
Hydrogen (Total), Wt %	1.77	Hydrogen Balance, % - Total	112.6
Nominal Size Range, inches	1/4" - 1"	Water Balance, %	109.9
5 % passing thru	0.263	MISCELLANEOUS	
98 % passing thru	1.05	Avg. Retort ΔP, in H <sub>2</sub> O/ft	1.51
D <sub>a</sub>	0.620	ΔP Above Air Dist., in H <sub>2</sub> O/ft	2.14
D <sub>v</sub>	0.712	Pressure Above Deck "H <sub>2</sub> O. PI-8	1.2
		Pressure Below Deck "H <sub>2</sub> O. PI-10	10.8

Comments: Low retorting efficiency, gas channeling was a problem, and retort was found to be chattered at end of test.

\*Measured Recycle + Dilution Gas

\*\* Oil Mist + Condensibles to 81 OF

\*\*\* Rates are for moisture-free raw shale. All shale analyses are on a moisture-free basis.

Signed R.J. Clappitt

DATE 9-7-67

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2080, C1058-2 8-31 7

*Handwritten signature*

A. YIELDS

FAY	6.488E 01	DRYGAS	6.397E 03	MISTFA	4.631E-01
H2	3.582E 02	OTHER	0.0	UNRETO	1.988E 01
CH4	1.279E 02	O2	1.919E 01	SSY	8.335E 01
CO	3.710E 02	CO2DEC	3.410E 01	MH2O	9.873E 01
CO2	1.535E 03	OILCOL	1.856E 01		

B. METERED GAS RATES

RECG	1.322E 04	DIL	0.0	WVENTG	7.603E 03
AIR	5.036E 03	TRECG	1.322E 04	TGF	0.0

C. MOL WT & HEATING VALUE OF VENT GAS

MWWG	2.757E 01	HVGT	7.353E 02	MWDG	3.016E 01
GBTU	1.149E 02				

D. COMBUSTION PRODUCTS

CO2C	3.516E 02	COC	3.526E 02	H2OC	4.890E 01
CHR	4.067E 00	COMBCP	8.798E 00		

E. MATERIAL IN

ORGCIN	2.537E 02	RSR	4.934E 02	ORH2IN	3.316E 01
MATIN	2.406E 03				

F. MATERIAL OUT

ORCGVG	4.337E 01	COKEC	4.886E 01	UNRETH	4.977E 00
ORGCOL	1.207E 02	ORH2VG	1.129E 01	COKEH	3.011E 00
UNRETC	3.995E 01	ORH2OL	1.594E 01	ORCOLP	4.759E 01
ORCVGP	1.709E 01	ORCSSP	3.501E 01	HCCVGP	8.297E 00

G. MATERIAL BALANCES

OVALL	9.991E 01	ORH2	1.062E 02	O2BAL	1.023E 02
ASH	0.0	TC	9.977E 01	WATER	1.099E 02
ORGC	9.969E 01	TH2	1.126E 02	GASL	5.300E 02
ASHB	-1.000E 00				

H. HEAT IN

QCOMB	4.837E 05	QH2OC	1.935E 04	QAIR	6.308E 03
QPROP	0.0	QOILC	1.005E 04	QRCYL	4.311E 04
QSUMIN	5.625E 05				

I. HEAT OUT

QMC02D	2.110E 05	QKEROD	8.346E 04	QH2OV	4.540E 04
QLIQO	4.045E 03	QOFGAS	3.195E 04	QSS	1.418E 05
QGASL	3.917E 03	LBLOSS	0.0	HETLOS	4.089E 04
QSUMOT	5.625E 05				

J. MISCELLANEOUS

ORCSS	5.328E 00	VPOIL	1.602E-01	TGL	5.137E 03
VPM	1.291E 01	WCG	2.135E 01	PROP	0.0

END MESSAGE

END OUTPUT

LINE # PROGRAM ID ← USER IDENTIFICATION →

0 2080, C1058-2 8-31-67

1	WRS 1.0 H <sub>2</sub> O, WT % FA	OLRS 10.9 OIL, WT % GRS	TR5 76 TEMP., °F CORS	B -1 XA	MRS 27243.1 RATE, lb/HR	RAW SHALE	
2	28.6 OIL, GAL/TON ASRS	2.2 GAS & LOSS, WT % CRS	19.1 CO <sub>2</sub> , WT % HRS	55.22 RETORT XS, FT <sup>2</sup> BP	TOG 152 OFFGAS TEMP., °F		
3	65.6 ASH, WT %	17.9 CARBON, WT %	1.77 H <sub>2</sub> , WT %	24.40 BARO. PRESS., IN Hg			
4	CRA 1144.3 CHART READING, SCFM	MFA 1.0 METER FACTOR	TA 144 TEMP., °F	PA 124 PRESS., IN H <sub>2</sub> O	WA 0.14 H <sub>2</sub> O, lb/MSCF	AIR	
5	CRRG 2927.0 RECYCLE CHART READING, SCFM	MFRG 1.0 METER FACTOR	TRG 236 TEMP., °F	PRG 64 PRESS., IN H <sub>2</sub> O	CRTG 0.0 TOTAL GAS CHART READING	MFTG 0.0 METER FACTOR	RECYCLE TOTAL GAS
6	CRDG 0.0 CHART READING	MFDG 0.0 METER FACTOR	TDG 0 TEMP., °F	PDG 0 PRESS., IN H <sub>2</sub> O			DILUTION
7	P 0.0 SCFM	TP 0 TEMP., °F	PP 0 PRESS., IN H <sub>2</sub> O	W 275.2 H <sub>2</sub> O ADDED, lb/HR	N 0.0 NUCL. AGENT, lb/HR		PROPANE NUCLEATING AGENT
8	WSS 0.9 H <sub>2</sub> O, WT % COSS	OLSS 2.6 OIL, WT % ASSS	GSS 0.6 GAS, WT % CSS	SS 0.0 RATE, lb/HR HSS	TSS 430 TEMP., °F	SPENT SHALE	
9	15.1 CO <sub>2</sub> , WT %	78.7 ASH, WT %	9.45 CARBON, WT %	0.58 H <sub>2</sub> , WT %			
10	OILLP 1955.7 DRY OIL, lb/HR	COL 84.1 CARBON, WT %	HOL 11.1 H <sub>2</sub> , WT %	DOL 7.737 DENSITY, lb/GAL	WLP 15.8 H <sub>2</sub> O, lb/HR		LIQUID PRODUCT
11	CRVG 1716.7 CHART READING, SCFM CG	MVVG 1.0 METER FACTOR H	TVG 233 TEMP., °F COOG	WG 0.0 H <sub>2</sub> O, lb/MSCF OG	OILM 0.0 OIL MIST, lb/MSCF NG	M 0	VENT GAS
12	12.2 CARBON, lb/MSCF MEG	0 COG	24.0 CO <sub>2</sub> , VOL % HHG	0.3 O <sub>2</sub> , VOL % OTG	62.3 N <sub>2</sub> , VOL % HG		
13	2.0 CH <sub>4</sub> , VOL %	5.8 CO, VOL %	5.6 H <sub>2</sub> , VOL %	0.0 OTHERS, VOL %	0.89 H <sub>2</sub> , lb/MSCF		
14	CRVP 10.1 CHART READING VPC	VPMF 1.83 METER FACTOR VPOIL	TVP 70 TEMP., °F VPW	PVP 322 PRESS., IN H <sub>2</sub> O GL	PVPC 27 CONDENSER PRESS., IN H <sub>2</sub> O		VENT PURGE
15	81 CONDENSER GAS EFFLUENT TEMP., °F	120.0 DRY OIL, lb/HR	17.2 H <sub>2</sub> O, lb/HR	68.7 TOP SEAL GAS RATE, SCFM			

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 Moisture and Mist, Externally,  
Or "0" to Calculate from Vent Purge Raw 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 8-31-67

Run No. C1058-2

Sample Time: RS 1945; SS 1730

FISCHER ASSAY

RAW SHALE       SPENT SHALE

<u>28.3</u>	<u>6.9</u>	Gal/Ton
<u>.915</u>	<u>-</u>	S.G., g/ml
<u>10.8</u>	<u>2.6</u>	Oil, wt %
<u>1.9</u>	<u>0.9</u>	Water, wt %
<u>85.1</u>	<u>95.9</u>	Sp. Shale, wt %
<u>2.2</u>	<u>0.6</u>	Gas & Loss, wt %
<u>Slight</u>	<u>none</u>	COKING TENDENCY

MINERAL CO<sub>2</sub>

19.0       15.1      wt %

ASH (SHALE)

65.4       78.7      wt %

MOISTURE

0.32       0.25      wt %

CARBON

17.8       9.45      wt %

HYDROGEN

1.76       0.58      wt %

BENZENE EXTRACTABLES

.       2.0      wt %

RETORT SHALE MOISTURE

Est. 1.0 wt %

RAW SHALE FISCHER ASSAY MOISTURE

0.92 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 SEP - SEP 5 1967

CHECKED BY

REP  
OSRC-12A  
Revised 6/20/66

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 8-31-67

Run No. C1058-2  
(2100 hr)

LIQUID PRODUCTS

R  
R

	D3 PUMPOUT				T3 PUMPOUT	
	1	2	3	4	1	2
<input checked="" type="checkbox"/> WATER, wt %	<u>0.8</u>					
<input checked="" type="checkbox"/> GRAVITY, °API	<u>20.3</u>					
<input type="checkbox"/> OIL ASH, wt %						

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

*ml*

OIL WT, g 1440.0  
WATER VOL, ml 20.54.0  
GRAVITY OIL, °API 39.4

120.0  
12) 1440.0  
12  
24  
24

VENT GAS

MAJOR COMPONENTS

CO<sub>2</sub> 84.0 vol %  
O<sub>2</sub> 0.3 "  
N<sub>2</sub> 61.5 "  
CH<sub>4</sub> 2.0 "  
CO 5.8 "  
H<sub>2</sub> 5.6 "  
Ar 0.8 "  
Others 0.0 "

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, 12.2 lbs/MSCFDG

HYDROGEN, 0.89 lbs/MSCFDG

COMMENTS \_\_\_\_\_

DATE COMPLETED SEP 5 1967

CHECKED BY RCP

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

# SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C/058-2 SAMPLE NO. 1 DATE 8/31/67  
 UNIT REPORT #3 DESCRIPTION TY LAB THE LAST ONE  
 APPROX. SHALE SIZE 1/4 TO 1" SHAKING TIME 10 MIN. ANALYSIS BY R.A. STRODE  
 TOTAL SAMPLE WT. GROSS 117.8 - TARE 43.4 = NET 74.4

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		19.40	19.15	.25
	0.742		57.20	20.50	36.70
	0.525		40.55	17.50	21.95
	0.371		23.90	18.70	5.20
	0.263	3	27.10	19.40	8.70
	0.185	4	19.75	19.40	.35
	0.131	6	19.50	19.30	.20
	0.093	8	20.80	20.70	.10
	0.065	10	19.30	19.20	.10
	PAN		21.70	21.0	.70
TOTAL ON SCREENS AND PAN					14.25
LOSS (BY DIFFERENCE)					4.15
TOTAL SAMPLE WEIGHT					74.40

SCREEN SIZE	D <sub>i</sub> *	1/D <sub>i</sub>	% 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	0.34		99.65
0.742	0.896	1.116	49.33		50.32
0.525	0.634	1.577	29.50		20.82
0.371	0.448	2.232	6.99		13.83
0.263	0.317	3.154	11.69		2.14
0.185	0.224	4.464	0.47		1.67
0.131	0.158	6.329	0.27		1.40
0.093	0.112	8.928	0.13	98.72	1.27
0.065			0.13		1.14
PAN			0.94		6.20
LOSS			0.20		0.00
TOTAL			99.99	-	-

004539

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

REMARKS: ✓

$\sum_{+8m}^m D_i$	0.70272	$\sum_{+8m}^m X_i$	
$1/\sum_{+8m}^m D_i$	1.59326	$\sum_{+8m}^m X_i / D_i$	
D <sub>a</sub>	0.61961	$\sum_{+8m}^m X_i D_i$	
D <sub>v</sub>	0.71183		