

GAS SEPARATION
DETAILED RUN SUMMARY SHEET

1513014008

Exploratory Runs

Date 4-24-67

Purpose: *To determine operability and yield with 1/2" - 2 1/2" mesh shale*

Transaction period from 3 1/2 - 2 1/2 to 1/2 - 2 1/2 in shale.

TONS

GENERAL	TR	SPENT SHALE PROPERTIES	
Run No.	C-1032-1	Fischer Assay, Gal/ton	0.3
Length, hours	12	Mineral CO ₂ , Wt %	13.7
Retort Type Number	RC-VI	Ash, Wt %	84.6
Oil Recovery System Number	C-2	Carbon (total), Wt %	5.73
Total Raw Shale Charged, lbs.	164.2	Organic Carbon, Wt %	1.99
Bed Height above Dist., ft	9 1/2'	Hydrogen (total), Wt %	0.14
Type Air Dist.	AD-7X	LIQUID PRODUCT PROPERTIES	
Bed Below Air Dist., ft	7'	Oil, Wt %	94.5
RATES AND QUANTITIES		Density, lb/gal	7.804
Raw Shale, lbs/(hr)(ft ²)	496	Gravity, API	19.5
Spent Shale, % of RS	81.0	Wt %	-
Liquid Product, lbs/hr	2365.3	RETORT GAS PROPERTIES	
Oil Collected, gal/ton RS	19.9	Water Vapor, lbs/MSCF(dry)	8.4
Air, SCF/ton RS (dry)	4720	CO ₂ , lbs/MSCF(dry)**	0.036
Total Recycle*, SCF/ton RS(wet)	17700	Analysis (dry)	
Dilution, SCF/ton RS (wet)	-	CO ₂ , Vol %	27.0
Calc. Vent Gas SCF/ton RS(dry)	6070	O ₂ , Vol %	0.6
Gas Losses, SCF/ton RS(wet)	-278	N ₂ + Argon, Vol %	61.5
Propane, SCF/ton RS	-	CH ₄ , Vol %	1.8
TEMPERATURES AND HEAT BALANCE		CO, Vol %	3.8
Retort Offgas, °F	138	H ₂ , Vol %	5.1
Spent Shale, F	364	Other, Vol %	0.2
Raw Shale, °F	60	Gross Heating Value(calc), Btu/SCF	112.1
Recycle Gas Inlet, °F	217	Carbon (Total), lbs/MSCF (dry)	13.2
Dilution Gas Inlet, °F	-	Hydrogen (Total), lbs/MSCF (dry)	0.83
Air Inlet, °F	135	YIELDS AND BALANCES	
Retort Air Inlet, F	135	Oil Collected, Vol % RSFA	79.0
Heat of Comb. MBtu/ton RS	440	Oil in Gas**, Vol % RSFA	0.1
Heat Lost, MBtu/ton RS	22	Oil in Spent Shale, Vol % RSFA	0.9
RAW SHALE PROPERTIES		Total Oil Meas., Vol % RSFA	80.0
Fischer Assay, gal/ton RS	25.2	Carbonate Decomposition, %	35.9
Oil, Wt %	9.5	Water Recovered, lb/ton RS	73.3
Water, Wt %	1.1	Ash Balance, % - As Measured	-
Gas, Wt %	1.9	Ash Balance, % - Assumed	25-100
Mineral CO ₂ , Wt %	17.3	Overall Balance, %	98.1
Ash, Wt %	68.7	Carbon Balance, % - Organic	93.6
Moisture, Wt % (Uncrushed)	1.0 Est.	Carbon Balance, % - Total	95.5
Carbon (Total), Wt %	15.9	Hydrogen Balance, % - Organic	90.8
Hydrogen (Total), Wt %	1.64	Hydrogen Balance, % - Total	93.3
Nominal Size Range, inches	1/2" - 2 1/2"	Water Balance, %	98.6
5 % passing thru	0.525	MISCELLANEOUS	
98 % passing thru	2.50	Avg. Retort ΔP, in H ₂ O/ft	0.64
Da	1.178	ΔP Above Air Dist., in H ₂ O/ft	0.75
Dv	1.409	NaCl Soln., Wt %	-
		NaCl Rate, gal/ton RS	-

Comments: *Lowered bed height to 9 1/2' during period. No apparent effect on operation.*

*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. Turner DATE May 17, 1967

921, RUN NO. C1032-1

Started 4/24/67

4/28/67
ere

YIELDS

FAY	7.899 01	DRYGAS	6.069 03	MISTFA	1.109-01		
H2	3.095 02	OTHER	1.213 01	UNRETO	8.523-01	CH4	1.092 02
O2	3.641 01	SSY	8.096 01	CO	2.306 02	CO2DEC	3.537 01
NH2O	7.331 01	CO2	1.633 03	OILCOI	1.990 01		

METERED GAS RATES

RECG	1.269 04	DIL	0.000 00	WVENTG	7.420 03	AIR	4.717 03
TRECG	1.269 04	TGF	0.000 00				

MOL WT. & HEATING VALUE OF VENT GAS

MWVG	2.891 01	HVGT	6.808 02	YWDG	3.083 01	GBTU	1.121 02
------	----------	------	----------	------	----------	------	----------

COMBUSTION PRODUCTS

CO2C	5.133 02	COO	2.154 02				
H2OC	3.143 01	CHR	6.587 00	COX5CP	1.041 01		

MATERIAL IN

ORGCIN	2.235 02	RSR	4.957 02	ORH2IN	3.033 01	MATIN	2.382 03
--------	----------	-----	----------	--------	----------	-------	----------

MATERIAL OUT

ORGCVG	4.644 01	COKEC	3.029 01	UNPETH	2.066-01		
ORGCOL	1.306 02	ORH2VG	8.592 00	COKEH	1.516 00	UNRETC	1.923 00
ORH2OL	1.724 01	ORCOLP	5.344 01	ORCVGP	2.077 01	ORCSSP	1.441 01
HCCV3P	1.036 01						

MATERIAL BALANCES

CVALL	9.311 01	ORGH2	9.084 01				
O2BAL	1.000 02	ASH	0.000 00	TC	9.551 01	WATER	9.250 01
ORGC	9.363 01	TH2	9.332 01	GASL	-2.730 02	ASHB	-1.000 00

HEAT IN

QCOYB	4.404 05	QH2OC	6.267 03	QAIR	6.506 03		
QPROP	0.000 00	QOILC	1.087 04	QROYL	4.050 04	QSUMIN	5.047 05

HEAT OUT

QMC02D	2.011 05	QKEROD	8.990 04	QH2OV	4.797 04		
QLI00	4.380 03	QOFGAS	3.213 04	QSS	1.092 05	QGASL	-1.758 03
LBLOSS	0.000 00	QHTLOS	2.174 04	QSUMOT	5.047 05		

MISCELLANEOUS

ORCSS	1.989 00	VPCIL	3.593-02	TCL	4.935 03	VPN	2.400 00
WCG	1.501 01	PROP	0.000 00				

MATERIAL AND HEAT BALANCE INPUT SHEET

RIF 921, RUN NO. C-32-1 STARTED 4-24- CALC. ON 4-28-67

Transition

1.01 9.05 60 -1 27373 .3
 H₂O, wt% Oil, wt% °F (1) Rate, lbs/Hr

25.2 1.9 17.3 55.22
 Oil, gal/T Gas, L, wt% CO₂, wt% Retort XS, ft²

68.05 15.9 1.64 24.20 138
 Ash, wt% Carbon, wt% H₂, wt% Bar. Press, " Hg Offgas Temp, °F

RAW SHALE
 BAROMETRIC
 PRESSURE
 AND
 OFFGAS
 TEMPERATURE

1081.4 1.0 135 80 0.14 0
 Chart Reading Meter Factor Temp, °F Press, "H₂O gauge Moist, lbs/HSCF Heat Loss, Btu/Hr

AIR

2903.7 1.0 217 76 0.0 0.0
 Recycle Ch. Read Meter Factor Temp, °F Press, "H₂O gauge Tot Gas Ch. Read Meter Factor

RECYCLE AIR
 TOTAL GAS

0.0 0.0 0 0
 Dil Gas Ch. Read Meter Factor Temp, °F Press, "H₂O gauge

DILUTION
 GAS

0.0 0 0 276.5 0.0
 C₃ Rotameter R. Temp, °F Press, "H₂O gauge Water added, lbs/Hr Nucl. Agent, lb/Hr

PROPANE, WATER
 & NUCLEATING
 AGENT

0.3 0.1 0.1 0.0
 H₂O, wt% Oil, wt% Gas, wt% Rate, lbs/Hr

SPENT
 SHALE

13.7 84.6 5.73 0.14 364
 CO₂, wt% Ash, wt% Carbon, wt% H₂, wt% Temp, °F

2126.2 84.01 11.01 7.804 239.1
 Dry Oil, lbs/Hr Carbon, wt% H₂, wt% Den, lbs/gal Water, lbs/Hr

LIQUID
 PRODUCT

1708.9 1.0 239 0.0 0.0 0 13.2
 Vent + Dil Gas Chart Reading Meter Factor Temp, °F Moist, lbs/HSCF Mist, lbs/HSCF (2) Carbon, lbs/Hr

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

0 27.0 0.6 61.5 1.8 3.8 5.1
 (3) CO₂, vol% O₂, vol% N₂, vol% CH₄, vol% CO, vol% H₂, vol%

0.2 0.83 3.06
 Others, vol% H₂, lbs/HSCF V. Purge Ch. Reading

1.83 149 121 75 12.3 5.2 20.2
 Meter Factor Temp, °F Press, "H₂O gauge Cond. Gas Out Temp, °F Dry Oil, gm/Hr Water, lbs/Hr Top Seal Gas Rate, SCFH

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).

JRGilmore
 1/17/67

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-24-67

Run No. C 1032-1

Sample Time: RS 1815; SS 2315

FISCHER ASSAY

<input checked="" type="checkbox"/> RAW SHALE	<input checked="" type="checkbox"/> SPENT SHALE	
<u>25.0</u>	<u>0.3</u>	Gal/Ton
<u>0.911</u>	<u>0.901</u>	S.G., g/ml
<u>9.4</u>	<u>0.1</u>	Oil, wt %
<u>1.8</u>	<u>0.3</u>	Water, wt %
<u>85.9</u>	<u>99.5</u>	Sp. Shale, wt %
<u>1.9</u>	<u>0.1</u>	Gas & Loss, wt %
<u>Slight</u>	<u>none</u>	COKING TENDENCY

RETORT SHALE MOISTURE
1.0 Est wt %

RAW SHALE FISCHER ASSAY MOISTURE
0.71 wt %

MINERAL CO₂

17.3 wt % 13.7 wt %

ASH (SHALE)

68.5 wt % 88.6 wt %

MOISTURE

0.23 wt % 0.10 wt %

CARBON

15.9 wt % 5.73 wt %

HYDROGEN

1.64 wt % 0.14 wt %

BENZENE EXTRACTABLES

. wt % . 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 CO₂", "Carbon", and "Hydrogen". The "FA Moisture" is for the sample used for the Fischer Assay.

COMMENTS

DATE COMPLETED APR 27 1967

CHECKED BY Rep

LABORATORY ANALYSIS SHEET

ANVIL POINTS OIL SHALE RESEARCH CENTER

Date Sampled 4-24-67

Run No. C1032-1

LIQUID PRODUCTS

D3 PUMPOUT

T3 PUMPOUT

WATER, wt %

1 2 3 4 1 2
5.5 / / / / /

GRAVITY, °API

9.5 / / / / /

OIL ASH, wt %

DISTILLATION (See attached sheet - OSRC-24)

VENT PURGE PRODUCT

OIL WT, g 1470

WATER VOL, ml 0.0

GRAVITY OIL, °API 42.0

VENT GAS

MAJOR COMPONENTS

CO₂ 27.0 vol %

O₂ 0.6 "

N₂ 60.8 "

CH₄ 1.8 "

CO 3.8 "

H₂ 5.1 "

Ar 0.7 "

Others 0.2 "

C₁ thru C₄, plus n-Pentane

CH₄ _____ vol %

C₂H₄-C₂H₆ _____ "

C₃H₈ _____ "

C₃H₆ _____ "

i C₄H₁₀ _____ "

n C₄H₁₀ _____ "

∅C₃H₆ _____ "

n C₅H₁₂ _____ "

CARBON, 12.2 lbs/MSCFDG

HYDROGEN, 0.83 lbs/MSCFDG

COMMENTS _____

DATE COMPLETED _____

CHECKED BY REP

OSRC-12B

(Revised 5/3/66)

SCREEN ANALYSIS DATA SHEET (TY-LAB)

RUN NO. C-1032 / SAMPLE NO. 1032 / DATE 4-20-66
 UNIT 1032 / DESCRIPTION 1032
 APPROX. SHALE SIZE 10-20 SHAKING TIME 10 ANALYSIS BY 1032
 TOTAL SAMPLE WT. GROSS 73.2 - TARE 6.8 = NET 66.0

003967

SCREEN SIZE		WEIGHTS		NET WT. RETAINED	Di *	1/Di	% RETAINED	CUM. % RETAINED	% PASSING
SCREENS REQD.	OPENING SIZE	GROSS LBS.	TARE LBS.						
	4.25				(3.125)	(0.3200)			100.00
	3.00				(2.625)	(0.3809)			99.09
	2.50	18.2	17.6	.6	2.750	0.3636	0.91		92.10
	2.00	24.8	20.2	4.6	2.250	0.4444	0.99		53.35
	1.50	49.9	23.4	25.5	1.750	0.5714	38.75		28.28
	1.05	35.6	19.1	16.5	(1.087)	(0.9199)	25.07		12.32
	0.742	31.0	20.5	10.5	1.275	0.7843	15.96		4.27
	0.525	23.8	18.5	5.3	0.896	1.116	8.05		2.90
	0.371	20.1	19.2	.9	0.634	1.577	1.37		2.44
	0.263	15.6	15.2	.3	0.448	2.232	0.46		2.29
	0.185	17.5	17.4	.1	0.317	3.154	0.15		2.14
	0.131	15.4	15.3	.1	0.224	4.464	0.15		1.99
	0.093	20.7	20.6	.1	0.158	6.329	0.15	98.01	1.99
	0.065	19.3	19.3	0	0.112	8.928	0		1.99
	PAN	22.3	21.0	1.3			1.98		0
TOTAL ON SCREENS AND PAN				65.8					
LOSS (BY DIFFERENCE)				.2					
TOTAL SAMPLE WEIGHT				66.0					

$\sum_{+8m}^m Di$	1.38131	$\sum_{+8m}^m Xi$	
$1/\sum_{+8m}^m Di$	0.83230	$\sum_{+8m}^m Xi / Di$	
Da	117758	$\sum_{+8m}^m Xi Di$	
Dv	140935		

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

REMARKS: RS