Attachment to WCR.

Orange Roughy-1

W866

ACS

LABORATORIES

PTY. LTD.

[redacted]

CORE ANALYSIS REPORT

of

ORANGE ROUGHY 1

for

ESSO AUSTRALIA LTD

by

ACS LABORATORIES PTY LTD

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CHAPTER 1

INTRODUCTION

1. INTRODUCTION

This report presents the results of, and details of the procedures employed from a Core Analysis study of the seventeen (17) 1½" diameter plugs from Orange Roughy 1.

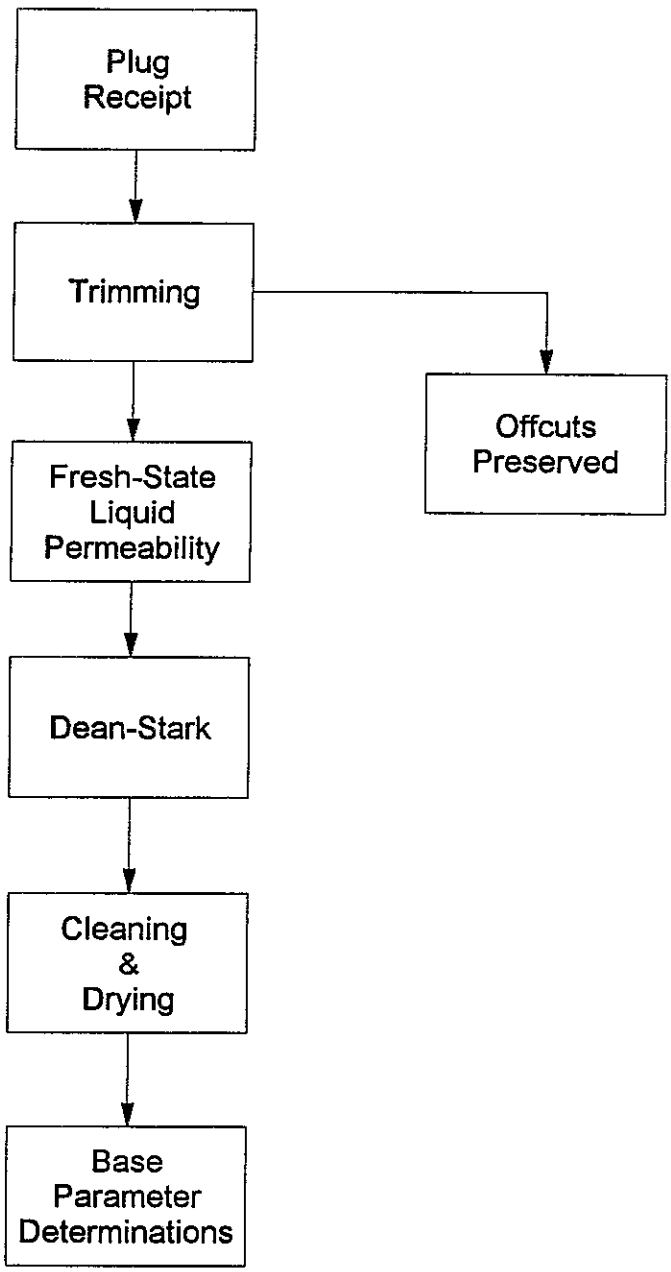
Following discussions between ACS and Esso personnel, a test program was developed and later confirmed by facsimile.

Chapter 2 of this report presents a brief overview of the entire study. Chapter 3 encompasses details of the procedures employed. Chapter 4 presents the results obtained from the study in tabular, and where appropriate, graphical format.

CHAPTER 2

TEST SCHEDULE CHART

TEST SCHEDULE CHART



CHAPTER 3

TEST AND CALCULATION PROCEDURES

3. TEST AND CALCULATION PROCEDURES

3.1 Sample Receipt

On 26th June 1995 the 17 core plugs were received at ACS Laboratories in Brisbane. On 27 June 1995 instruction was received regarding the samples.

3.2 Sample Trimming

The 17 plugs were trimmed to a right cylinder of standard length. Samples were appropriately labeled for later identification and wrapped to prevent loss of pore fluids. The offcuts were also wrapped and refrigerated to preserve their integrity for possible petrological work.

3.2 Fresh-State Liquid Permeability

To determine liquid permeability at overburden pressures the samples were placed in rubber sleeves. This assembly was loaded into a hydrostatic cell and overburden pressure of 4000 psi was applied. Brine was then pumped through the sample whilst monitoring the upstream pressure. The permeability was determined using Darcy's Law through knowledge of the upstream pressure, fluid flow rates, viscosity of the fluid, and the sample's dimensions.

3.4 Residual Fluid Saturations - (Dean- Stark)

By re-fluxing the sample using a solvent such as toluene, the water was collected in a modified tube using the Dean-Stark principal. The oil saturation values were calculated using mass balance and volumetric data.

3.5 Sample Cleaning and Drying

Any residual pore fluids were removed using a Soxhlet extraction apparatus with a 3:1 chloroform/methanol azeotropic mixture. Re-fluxing continued until tests for oil (fluorescence under UV light) and salt (silver nitrate precipitation) showed negative. The cleaned samples were dried in a humidity oven at 50°C and 50% relative humidity to a constant weight. Cooling to room temperature occurred in an airtight container.

3.6 Base Parameter Determinations

On completion of cleaning and drying all samples were weighed and dimensions recorded before analysis.

- **Sample Weighing**

  Dry samples were weighed on an electronic balance to the nearest milligram.

- **Sample Dimensions**

  The length and diameter of each sample was measured with digital callipers, to the nearest micron.

- **Permeability to Air - Ambient**

  Once cleaned and dried, as described above, air permeability was determined on the plug samples. The samples were firstly placed in a Hassler cell with a confining pressure of 250 psi. The confining pressured was used to prevent bypassing of air around the samples when the measurement was made. To determine permeability a known air pressure was applied to the upstream face of each sample creating a flow of air through the core plug. Permeabilities for the samples were calculated using Darcy's Law through knowledge of the upstream pressure, flow rate, viscosity of air and the samples' dimensions.

- **Helium Injection Porosity - Ambient**

  The porosity of the clean and dry core plugs was determined as follows. The plugs were first placed in a sealed matrix cup. Helium held at 100 psi reference pressure was then introduced to the cup. From the resultant pressure change the unknown grain volume was calculated using Boyle's Law.

  The bulk volume was determined by mercury immersion. The difference between the grain volume and the bulk volume is the pore volume and from this the 'effective' porosity was calculated as the volume percentage of pores with respect to the bulk volume.

- **Porosity and Permeability - Overburden Pressure**

  To determine the porosity and air permeability of the core plugs at overburden pressure, the samples were placed in a thick walled rubber sleeve. This assembly was loaded into a hydrostatic cell and the pore volume determined at 'ambient' pressure. An overburden pressure of 4000 psi was then applied to the samples and the pore volume reduction caused by this increase in pressure determined. These data are used to derive porosity at the applied overburden pressure. Air permeability at overburden pressure was then measured in the hydrostatic cell, as described previously.

CHAPTER 4

TEST RESULTS

BRINE PERMEABILITY
(FRESH STATE)

Company Esso Australia Ltd

Well Orange Roughy 1

Overburden 4000 psi

Sample Number	Depth meters	Permeability to Brine milliDarcy's	Oil Saturation Sor (percent)
1	2313.60	0.01	0.0
2	2315.45	0.24	0.0
3	2316.45	0.93	0.9
4	2317.45	0.23	0.0
5	2318.45	3.2	0.0
6	2319.45	12	6.1
7	2320.45	216	0.0
8	2321.53	40	0.0
9	2322.45	10	0.0
10	2323.45	6.2	0.0
11	2324.45	< 0.01	0.0
12	2325.45	0.10	0.8
13	2326.45	0.01	0.0
14	2327.45	< 0.01	0.0
15	2328.45	0.04	0.0
16	2329.45	0.09	0.0
17	2330.45	27	0.0

POROSITY AND AIR PERMEABILITY

Company Esso Australia Ltd

Well Orange Roughy 1

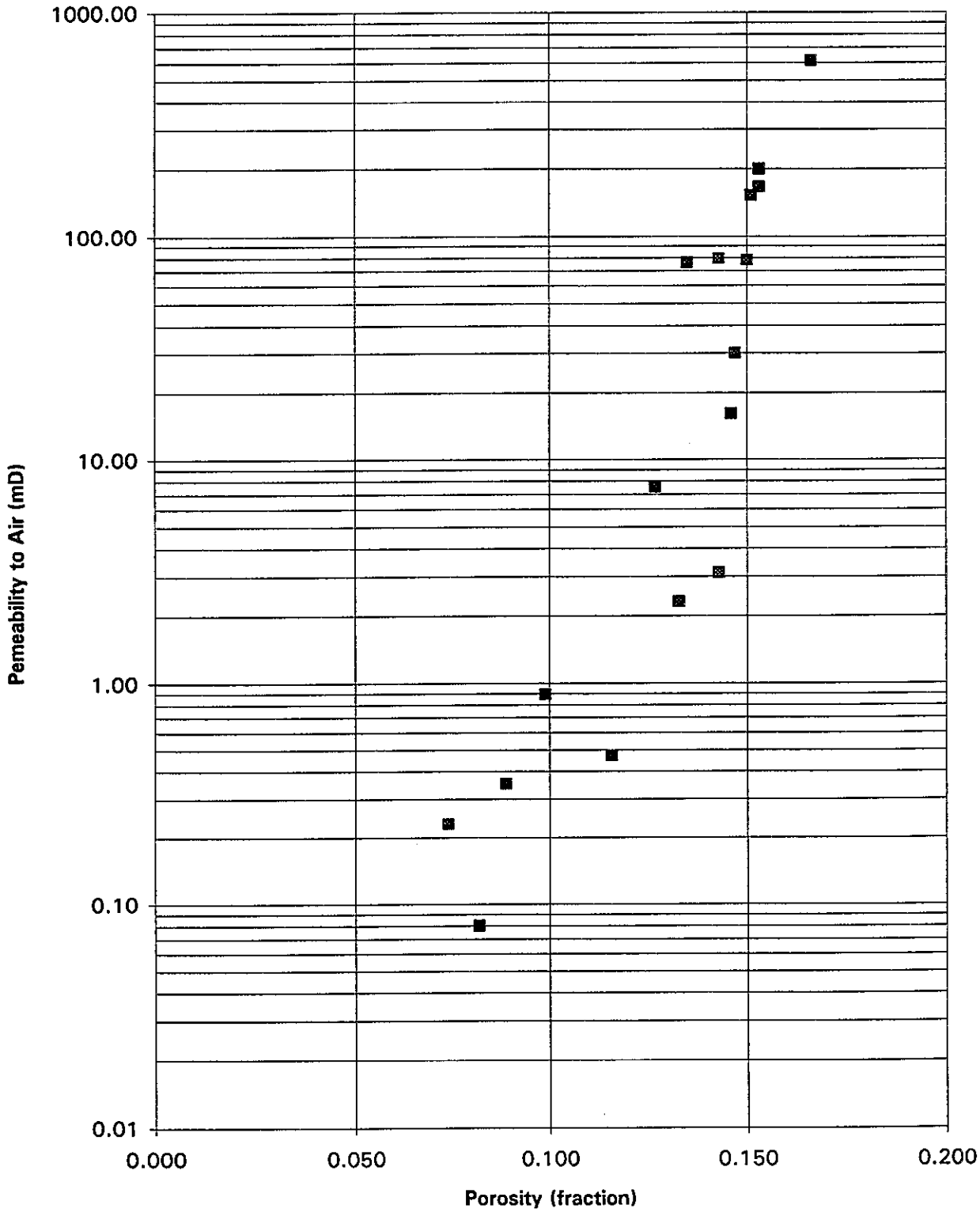
Ambient

Sample Number	Depth meters	Permeability to Air milliDarcy's	Porosity percent	Grain Density (gms/cm^3)
1	2313.60	0.23	8.1	2.70
2	2315.45	16	14.7	2.71
3	1316.45	30	14.8	2.71
4	1317.45	7.5	12.8	2.69
5	2318.45	78	15.1	2.68
6	2319.45	166	15.5	2.68
7	2320.45	611	16.2	2.66
8	2321.53	199	15.2	2.66
9	2322.45	152	15.1	2.67
10	2323.45	76	12.2	2.64
11	2324.45	0.35	9.3	2.69
12	2325.45	3.1	15.1	2.68
13	2326.45	0.47	14.5	2.76
14	2327.45	0.08	9.7	2.73
15	2328.45	0.89	10.6	2.67
16	2329.45	2.3	13.6	2.65
17	2330.45	79	14.5	2.66

Porosity vs Permeability to Air

Company: Esso Australia Ltd
Well: Orange Roughy 1

Ambient



POROSITY AND AIR PERMEABILITY

Company Esso Australia Ltd

Well Orange Roughy 1

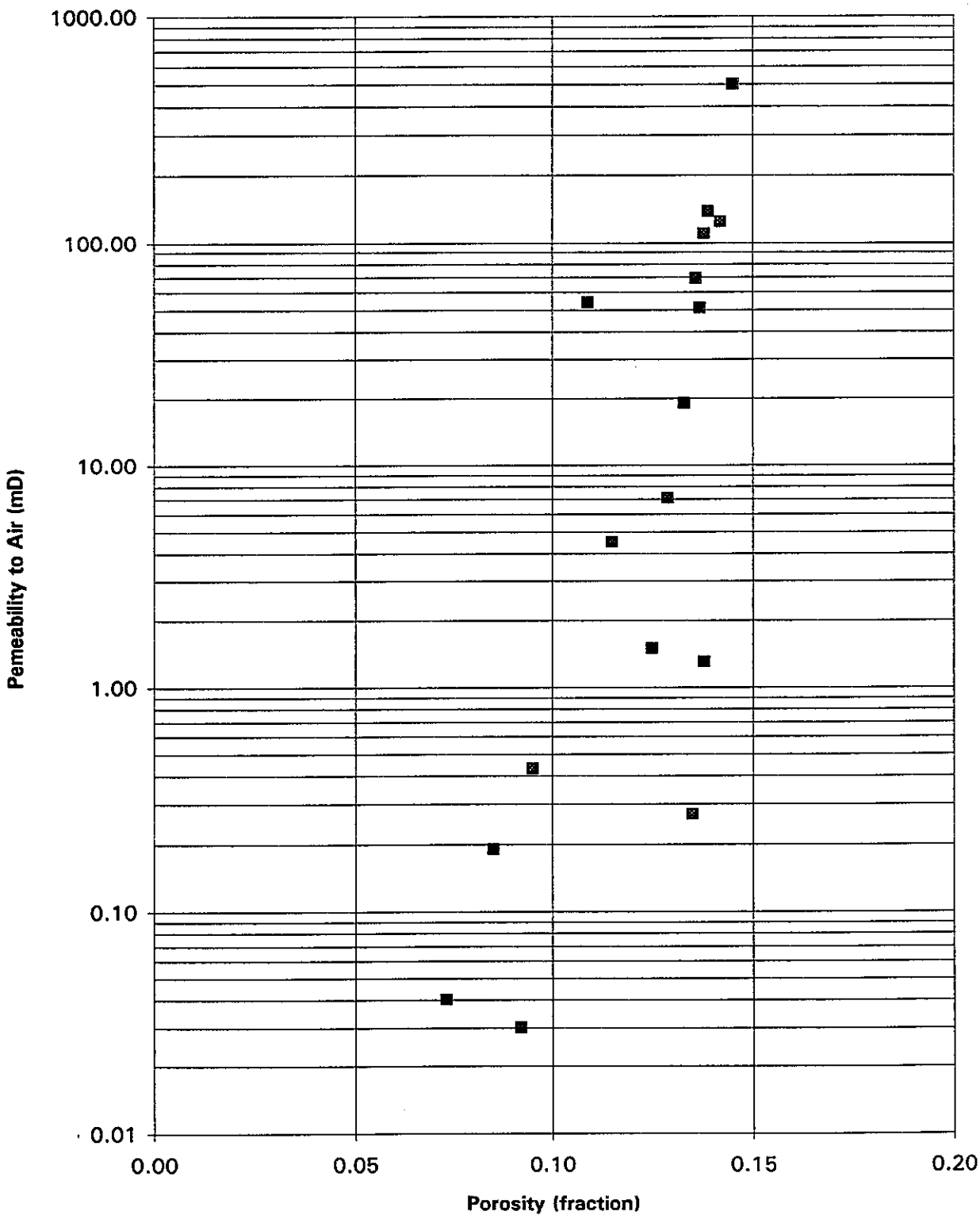
Overburden 4000 psi

Sample Number	Depth meters	Permeability to Air milliDarcy's	Porosity percent	Grain Density (gms/cm^3)
1	2313.60	0.04	7.3	2.70
2	2315.45	7.1	12.9	2.71
3	1316.45	19	13.3	2.71
4	1317.45	4.5	11.5	2.69
5	2318.45	51	13.7	2.68
6	2319.45	124	14.2	2.68
7	2320.45	500	14.5	2.66
8	2321.53	138	13.9	2.66
9	2322.45	110	13.8	2.67
10	2323.45	54	10.9	2.64
11	2324.45	0.19	8.5	2.69
12	2325.45	1.3	13.8	2.68
13	2326.45	0.27	13.5	2.76
14	2327.45	0.03	9.2	2.73
15	2328.45	0.43	9.5	2.67
16	2329.45	1.5	12.5	2.65
17	2330.45	69	13.6	2.66

Porosity vs Permeability to Air

Company: Esso Australia Ltd
Well: Orange Roughy 1

Overburden: 4000 psi



APPENDIX

FLUIDS

BRINE:

Composition	38000 ppm NaCl equivalent
Density	1.008 g/cm^3
Viscosity	1.081 cp