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OIL and GAS DIVISION

EXXON PRODUCTION RESEARCH COMPANY

Research Application



**GIPPSLAND BASIN. PYNDUS, MUZACZ & KIBLER.
HYDROCARBON REPORT
MACKEREL - A12**

Hydrocarbon Report
Wellhead Oil, Mackerel A-12 Well
Esso Australia Limited

G. T. Pyndus
W. F. Muzacz
T. W. Kibler

Production Operations Division

April 1981

EPR.35PS.81

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PRODUCTION OPERATIONS DIVISION
J. F. WOLFE
MANAGER

OIL and GAS DIVISION

April 16, 1981

Mr. R.S.W. Neil
Esso Australia Ltd.
G.P.O. Box 4047
Sydney, N.S.W. 2001
Australia

Dear Mr. Neil:

EPR.35PS.81 - Hydrocarbon Report
Mackerel A-12 Wellhead Oil Sample
Esso Australia Ltd.

The attached report presents the results of a PVT analysis made on a wellhead sample from the subject well. This work was requested in your telex of September 10, 1980. A differential liberation was made along with the PVT determination, and a flash liberation was included to furnish a check on the compositional analysis.

Very truly yours,

J. F. Wolfe

By S. W. Hopke
S. W. Hopke

GTP:sw
Attachment

EXAMINATION OF WELLHEAD OIL SAMPLES

Source: Esso Australia Ltd., Mackerel A-12, Wellhead Oil Sample

Date Taken:

Sampling Data

Sampling point	Wellhead
Wellhead Pressure, psig	630
Wellhead temperature, °F	96

Reservoir Data

Depth midpoint of perforation, feet subsea	7789
Pressure, psig	3340
Temperature at 7700 feet subsea, °F	220

Saturation Pressures

<u>psig</u>	<u>°F</u>
145	60
160	72
193	100
245	140
293	180
340	220

Properties of Samples

Pressure-Volume Relations	Table I
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TABLE I

Pressure-Volume Relations of Wellhead Oil Sample

Source: Esso Australia Ltd., Mackerel A-12, Wellhead Oil Sample
 Date Taken:
 Temperature: 220°F

<u>Pressure, psig</u>	<u>Relative Volume</u>	<u>Y*</u>
3500	0.9447	
3000	0.9593	
2500	0.9678	
2000	0.9728	
1500	0.9772	
1000	0.9836	
500	0.9949	
340 = P _b	1.0000	
300	1.1035	1.227
250	1.3104	1.094
200	1.6767	0.962
150	2.3874	0.830
100	3.9908	0.698
50	7.8868	0.566

Specific volume at saturation pressure = 0.02311 cu ft/lb

*Calculated data for use in correcting subsurface oil sample

P_b = Bubble point or saturation pressure of sample at 220°F, psia

P = Pressure below saturation pressure, psia

V_t = Two-phase relative volume factor at 220°F and P below P_b

V_{bp} = Saturated oil relative volume at 220°F and 355 psia (340 psig)

TABLE II

Flash Liberation and Differential Liberation Results

Source: Esso Australia Ltd., Mackerel A-12, Wellhead Oil Sample

Date Taken:

Properties of Saturated Oil: Temperature, °F 220 Saturation Pressure, psig 340

Gas Liberation and Shrinkage of Oil:

Pressure (P ₁), psig	Temperature, °F	R, Gas-Oil Ratio: cu ft at 60°F and 14.7 psia/bbl Residual Oil		Residual Oil Gravity API at 60°F	Specific Gravity Gas at 60°F (air = 1)	¹ V _r /V _{bp}
		Flashed at P ₁	Flashed from P ₁ to 0			
0	73	188	--	46.8	1.589	0.8091

(Differential at 220 °F)

Pressure, psig	Properties of Liberated Gas at 220°F and Indicated Pressure		Cas-Oil Ratio: cu ft at 14.7 psia and 60°F/bbl Reservoir Oil at 340 psig, 220°F	Residual Oil Gravity °API at 60°F	³ V/V _{bp}
	Compressibility, Z	Viscosity, cp			
340	--	--	0		1.0000
300	0.945	0.0116	15		0.9874
250	0.946	0.0114	34		0.9706
200	0.947	0.0111	56		0.9539
150	0.949	0.0107	76		0.9364
100	0.950	0.0100	98		0.9188
50	--	--	123		0.9004
0	--	--	152	47.1	0.8796

¹V_r/V_{bp} = Volume residual oil at 0 psig, 60°F/Volume saturated oil at 340 psig, 220 °F²Determined from calculated composition of equilibrium gas³V = Volume saturated oil at indicated pressure, 220 °F

TABLE II-A

Comparison of Experimental and Computed Flash Liberation Results

Source: Esso Australia Ltd., Mackerel A-12, Wellhead Oil Sample

Date Taken:

Pressure (P ₁) psig	Temperature °F	Gas-Oil Ratio - cu ft/bbl Residual Oil Flashed at P ₁		Residual Oil Gravity API at 60°F		V _r /V _{oi} or 1/B _{oi}	
		Experimental	Computed	Experimental	Computed	Experimental	Computed
0	73	188					
0	63		220	46.8		0.8091	
					46.9		0.8044

Data Used in Flash Calculations

Wellhead Oil Sample		gal/mol
Component	Mol %	
Hydrogen Sulfide	0.00	
Carbon Dioxide	0.36	6.38
Nitrogen	0.74	4.15
Methane	4.52	
Ethane	4.50	
Propane	11.60	
Iso-Butane	4.00	
N-Butane	7.42	
Iso-Pentane	2.08	
N-Pentane	3.53	
Hexanes	4.83	13.80
Heptanes	5.51	15.91
Octanes	6.14	17.39
Nonanes	6.66	18.33
Heavier fraction	38.11	30.04
Total	100.00	

Unadjusted Flash Data

Molecular weight of heavier fraction 212
 Density of heavier fraction, gm/cc at 60°F 0.8375
 Specific volume of wellhead fluid
 at 340 psig and 220°F, cu ft/lb 0.02311
 Mols per barrel 1.977

Adjustments for Computed Results:

+1% C10+ Density

-10°F Flash Temperature

TABLE III

Hydrocarbon Analysis of Wellhead Oil Sample

Source: Esso Australia Ltd., Mackerel A-12, Wellhead Oil Sample

Date Taken:

<u>Component</u>	<u>Wt %</u>	<u>Mol %</u>	<u>Density, gm/cc @ 60°F</u>	<u>Mol wt</u>
Hydrogen Sulfide	0.00	0.00		
Carbon Dioxide	0.13	0.36		
Nitrogen	0.17	0.74		
Methane	0.59	4.52		
Ethane	1.10	4.50		
Propane	4.16	11.60		
Iso-Butane	1.89	4.00		
N-Butane	3.51	7.42		
Iso-Pentane	1.22	2.08		
N-Pentane	2.07	3.53		
Hexanes	3.22	4.83	0.7121	82
Heptanes	4.35	5.51	0.7306	97
Octanes	5.45	6.14	0.7512	109
Nonane	6.39	6.66	0.7713	118
Decanes Plus	<u>65.75</u>	<u>38.11</u>	0.8375	212
TOTAL	100.00	100.00		

Properties of Hexanes Plus:

0.8061

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TABLE IV

Viscosity of Wellhead Oil at 220°F

Source: Esso Australia Ltd., Mackerel A-12, Wellhead Oil Sample

Date Taken:

<u>Pressure, psig</u>	<u>Viscosity, cp</u>	<u>Density, gm/cc</u>
3500	0.337	0.7292
3000	0.320	0.7235
2500	0.306	0.7179
2000	0.292	0.7124
1500	0.280	0.7070
1000	0.269	0.7017
500	0.258	0.6965
400	0.256	0.6954
340 = P_b	0.255	0.6948
300	0.262	0.6980
250	0.272	0.7020
200	0.291	0.7059
150	0.320	0.7099
100	0.446	0.7138
50	0.490	0.7178
0	0.916	0.7218

