HYDROCARBON REPORT

DOLPHIN - 1

OIL and GAS DIVISION

ESSO PRODUCTION RESEARCH COMPANY

HYDROCARBON REPORT - SUBSURFACE OIL
ESSO STANDARD OIL (AUSTRALIA) LTD.
DOLPHIN A-1 WELL

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DOLPHIN SUBSURFACE OIL SAMPLE

Source: Esso Standard Oil (Australia) Ltd., Dolphin A-1 Well

Date Taken: October 15, 1967

Sampling Depth: 4000 ft

Saturation Pressure

567 psig at 75° F
700 psig at 155° F

Reservoir Data

Elevation RDB	31 ft
Top of Sand	3993 ft
Water-oil contact	4040 ft
Original reservoir pressure	1780 psig
Original reservoir temperature	155° F

Properties of Sample

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TABLE I

Pressure-Volume Relations of Subsurface Oil Sample

Source: Esso Standard Oil (Australia) Ltd., Dolphin A-1 Well

Date Taken: October 15, 1967

Temperature: 155° F

Pressure psia	Relative Volume V/V_{bp}	*$Y = \frac{P_s - P}{P(\frac{V_t}{V_{bp}} - 1)}$
3015	0.9777	
2515	0.9821	
2015	0.9866	
1515	0.9914	
1015	0.9967	
P_s - 715	1.0000	
680	1.0236	2.183
650	1.0468	2.138
620	1.0733	2.090
560	1.1386	1.997
510	1.2094	1.920
435	1.3566	1.805
385	1.4943	1.734
345	1.6410	1.673
285	1.9531	1.583
250	2.2070	1.541
230	2.4077	1.498
180	3.0858	1.425
145	3.8694	1.370
125	4.5145	1.343
107	5.3110	1.312
100	5.7163	1.304

Specific Volume at Saturation Pressure = 0.02194 cu ft/lb

*Calculated data for use in correcting subsurface oil sample

P_s = Saturation pressure of sample at 155° F, psia
P = Pressure below saturation pressure, psia
V_t = Two-phase relative volume factor at 155° F and P
V_{bp} = Saturated oil relative volume at 155° F and 715 psia (700 psig)

FLASH LIBERATION AND DIFFERENTIAL [illegible]
SUBSURFACE OIL SAMPLE

Source: Esso Standard Oil (Australia) Ltd., Dolphin A-1 Well

Date Taken: October 15, 1967

Properties of Saturated Oil:

Temperature, °F	155
Saturation Pressure, psig	700

Properties of Residual Oil:

Wax Content	0.65% by wt
Sulphur Content	0.00% by wt
Pour Point	- 45° F

Gas Liberation and Shrinkage of Oil:
(Flash)

Pressure(p_1) psig	Temp. °F	Gas-Oil Ratio: cu. ft. at 60°F and 14.7 psia/bbl. Residual Oil: Flashed at p_1	Gas-Oil Ratio: cu. ft. at 60°F and 14.7 psia/bbl. Residual Oil: Flashed from p_1 to 0	Residual Oil Gravity °API at 60°F	Sp. Gr. Gas at 60°F (air=1)	V_R/V_S*
0	75	-	231	45.4	1.160	0.8520
50	75	152	26	47.0	-	0.8814
100	75	135	49	46.9	-	0.8831

(Differential at 155° F)

Pressure psig	Properties of Liberated Gas at 155 °F and Indicated Pressure***: Compressibility, Z	Viscosity, cp	Gas-Oil Ratio: cu. ft. at 14.7 psia and 60°F/bbl. Reservoir Oil at 700 psig, 155 ° F	Residual Oil Gravity °API at 60°F	V**/V_S
700	-	-	0		1.0000
600	0.934	0.0124	22		0.9880
500	0.942	0.0123	43		0.9790
400	0.949	0.0121	64		0.9690
300	0.956	0.0118	85		0.9591
200	0.964	0.0115	109		0.9489
100	0.973	0.0107	141		0.9369
0	0.991	-	208	44.8	0.8760

*V_R, Volume residual oil at 0 psig, 60°F
V_S, Volume saturated oil at 700 psig, 155 ° F
**V, Volume saturated oil at indicated pressure, 155 ° F
***, Determined from calculated composition of equilibrium gas

SUBSURFACE OIL SAMPLE

Source: Esso Standard Oil (Australia) Ltd., Dolphin [redacted]-1 Well

Date Taken: October 15, 1967

(P_1) Pressure psig	Temperature °F	Gas-Oil Ratio - cu ft/bbl Residual Oil: Flashed at P_1 Experimental	Flashed at P_1 Computed	Flashed from P_1 to 0 Experimental	Flashed from P_1 to 0 Computed	Residual Oil Gravity °API at 60°F Experimental	Residual Oil Gravity °API at 60°F Computed	V_R/V_S Experimental	V_R/V_S Computed
0	75	231	234	-	-	45.4	45.6	0.8520	0.8536
0	85	-	249	-	-	-	45.2	-	0.8447
50	75	152	150	26	32	47.0	47.3	0.8814	0.8847
50	85	-	156	-	34	-	47.0	-	0.8797
100	75	135	125	49	61	46.9	47.1	0.8831	0.8819
100	85	-	130	-	65	-	46.8	-	0.8765
200	85	-	93	-	119	-	46.3	-	0.8663

Data Used in Flash Calculations

Subsurface Oil Sample

Component	Mol %	gal/mol
Hydrogen Sulfide	0.00	
Carbon Dioxide	0.52	9.25
Nitrogen	0.19	
Methane	14.49	
Ethane	0.38	
Propane	2.19	
Iso-Butane	4.70	
N-Butane	4.91	
Iso-Pentane	7.89	
N-Pentane	1.20	
Hexanes	6.60	16.14
Heptanes	9.73	17.43
Octanes	9.41	17.42
Nonanes	7.00	18.80
Heavier Fraction	30.79	27.82
Total	100.00	

K-value Source: NGAA (1957)

Convergence Pressure: 10,000 psia

Unadjusted Flash Data

Molecular weight of heavier fraction	206
Density of heavier fraction, gm/cc at 60 F	0.8699
Specific volume of reservoir fluid at bubble point and 155° F cu. ft./lb.	0.02194
Mols per barrel	2.249

Data adjustment for flash checks
+ 2% C_{10+} density.

TABLE III

Hydrocarbon Analysis of Subsurface Oil Sample

Source: Esso Standard Oil (Australia) Ltd., Dolphin A-1 Well

Date Taken: October 15, 1967

Component	Weight %	Density g/cc at 60°F	Molecular Weight
Hydrogen Sulfide	0.00		
Carbon Dioxide	0.20		
Nitrogen	0.05		
Methane	2.04		
Ethane	0.10		
Propane	0.85		
Iso-Butane	2.40		
N-Butane	2.51		
Iso-Pentane	5.00		
N-Pentane	0.76		
Hexanes	5.28	0.6755	91
Heptanes	8.55	0.6873	100
Octanes	9.09	0.7565	110
Nonanes	7.44	0.7711	121
Heavier Fraction	55.73	0.8699	206
Total	100.00		
Pentane-Free Fraction		0.8178	153

Orsat Analysis of Gas Liberated at 0 psig and 75°F

Component	Volume %
Hydrocarbons	97.80
Hydrogen Sulfide	0.00
Carbon Dioxide	2.20
Total	100.00

TABLE IV

Viscosity of Reservoir Oil at 155°F

Source: Esso Standard Oil (Australia) Ltd., Dolphin A-1 Well

Date Taken: October 15, 1967

Pressure, psig		Viscosity, cp	Density, gm/cc
3000		0.655	0.7417
2500		0.635	0.7384
2000		0.617	0.7350
1500		0.600	0.7315
1000		0.583	0.7276
700	(Saturation Pressure)	0.574	0.7252
405		0.602	0.7414
300		0.625	0.7471
203		0.637	0.7525
100		0.718	0.7581
0		0.792	0.7636

TABLE IV-A

Viscosity of Reservoir Oil at 60° F

Source: Esso Standard Oil (Australia) Ltd., Dolphin A-1 Well

Date Taken: October 15, 1967

Pressure, psig	Viscosity, cp	Density, gm/cc
3000	1.185	0.7788
2500	1.148	0.7754
2000	1.091	0.7718
1500	1.048	0.7681
1000	1.010	0.7640
534 (Saturation Pressure)	0.977	0.7602
405	1.035	0.7786
300	1.112	0.7845
200	1.179	0.7903
100	1.272	0.7961
0	1.402	0.8018