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Final Report

Phillips Petroleum Company

Composition analysis. (Embla Oils Correlation. A Comparison of Geochemical Data Wells 2/7-D-06 and 2/7-D-09 with wells 2/7-26S, 2/7-27S, 2/7-21S and 2/7-20X)
7032/22-00

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1. INTRODUCTION

This report contains the results from the analyses of the oils from Embla wells. The analyses have been performed in accordance to scope of work and in agreement with Phillips Petroleum Co. Wells 2/7-D-06 and 2/7-D-09 compared with wells 2/7-26S, 2/7-27S, 2/7-21S and 2/7-20X.

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Forus. Wednesday, 23 August 2000

2. SCOPE OF WORK

The following analyses have been performed:

Analysis	Number of samples	Requested	Performed
Whole oil GC *)	6	6	6
Star diagram *)	6	6	6
Topping, deasphalting and separation *)	2	2	2
SAT and ARO Hydrocarbon GC *)	2	2	2
GC-MS (SAT and ARO) *)	2	2	2
Carbon isotope *)	12	12	12
Composition analysis of oil, C10+	3	3	3
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*) Reported in a separate report

3. Composition analysis of stock tank oil from well 2/7-D06

Composition of the stock tank oil				
Well	2/7-D06			
COMPONENT	Mole %	Weight %	Molar Weight	Density kg/m^3
Nitrogen				
Carbon dioxide				
Hydrogensulphide				
Methane	0.055	0.005	16.04	260.0
Ethane	0.405	0.069	30.07	370.0
Propane	1.699	0.425	44.09	500.5
iso-Butane	0.865	0.285	58.12	557.2
n-Butane	3.067	1.011	58.12	578.8
Neopentane	0.000	0.000	0.00	591.0
iso-Pentane	2.033	0.832	72.15	619.7
n-Pentane	3.470	1.420	72.15	626.2
Hexanes, C6 total	5.948	2.878	85.3	665.1
n-Paraffin	3.120	1.525	86.17	659.4
iso-Paraffins	2.508	1.226	86.17	664.9
Naphtenes	0.319	0.127	70.13	745.4
Heptanes, C7 total	9.879	5.242	93.55	721.0
n-Paraffin	2.801	1.592	100.2	683.8
iso-Paraffins	2.866	1.629	100.20	685.3
Naphtenes	3.045	1.504	87.08	760.9
Aromates	1.167	0.517	78.11	879.0
Octanes, C8 total	10.580	6.448	107.44	745.3
n-Paraffin	2.284	1.480	114.2	702.5
iso-Paraffins	2.038	1.325	114.61	701.9
Naphtenes	4.936	2.952	105.45	764.7
Aromates	1.322	0.691	92.14	867.0
Nonanes, C9 total	8.360	5.752	121.30	762.8
n-Paraffin	2.153	1.566	128.3	717.6
iso-Paraffins	2.413	1.758	128.43	731.4
Naphtenes	1.858	1.262	119.76	783.0
Aromates	1.936	1.166	106.17	868.3
Decanes plus, C10+	53.640	75.633	249	855
Sum	100.000	100.000		
Mean molecular weight:			176	
Density of oil				811.6

4. Composition analysis of stock tank oil from well 2/7-D09

Composition of the stock tank oil				
Well	2/7-D09			
COMPONENT	Mole %	Weight %	Molar Weight	Density kg/m^3
Nitrogen				
Carbon dioxide				
Hydrogensulphide				
Methane	0.150	0.013	16.04	260.0
Ethane	0.314	0.051	30.07	370.0
Propane	0.980	0.233	44.09	500.5
iso-Butane	0.616	0.193	58.12	557.2
n-Butane	2.207	0.692	58.12	578.8
Neopentane	0.000	0.000	0.00	591.0
iso-Pentane	1.853	0.721	72.15	619.7
n-Pentane	3.215	1.251	72.15	626.2
Hexanes, C6 total	6.149	2.840	85.6	663.9
n-Paraffin	3.242	1.507	86.17	659.4
iso-Paraffins	2.700	1.255	86.17	665.0
Naphtenes	0.206	0.078	70.13	745.4
Heptanes, C7 total	10.061	5.097	93.93	719.6
n-Paraffin	2.973	1.607	100.2	683.8
iso-Paraffins	3.136	1.695	100.20	685.2
Naphtenes	2.605	1.228	87.40	761.1
Aromates	1.346	0.567	78.11	879.0
Octanes, C8 total	10.359	6.062	108.50	739.5
n-Paraffin	2.363	1.456	114.2	702.5
iso-Paraffins	2.288	1.414	114.58	701.7
Naphtenes	4.838	2.760	105.76	764.2
Aromates	0.869	0.432	92.14	867.0
Nonanes, C9 total	8.072	5.331	122.45	757.6
n-Paraffin	2.163	1.496	128.3	717.6
iso-Paraffins	2.617	1.813	128.43	732.7
Naphtenes	1.839	1.190	119.98	782.8
Aromates	1.453	0.832	106.17	868.7
Decanes plus, C10+	56.025	77.516	257	848
Sum	100.000	100.000		
Mean molecular weight:			185	
Density of oil				810.9

5. Composition analysis of stock tank oil from well 2/7-27S

Composition of the stock tank oil				
Well	2/7-27S			
COMPONENT	Mole %	Weight %	Molar Weight	Density kg/m^3
Nitrogen				
Carbon dioxide				
Hydrogensulphide				
Methane	0.000	0.000		
Ethane	0.006	0.001		
Propane	0.151	0.036	44.09	500.5
iso-Butane	0.238	0.075	58.12	557.2
n-Butane	0.927	0.292	58.12	578.8
Neopentane	0.000	0.000	0.00	591.0
iso-Pentane	1.297	0.507	72.15	619.7
n-Pentane	2.105	0.823	72.15	626.2
Hexanes, C6 total	5.238	2.427	85.5	664.6
n-Paraffin	2.674	1.249	86.17	659.4
iso-Paraffins	2.342	1.094	86.17	665.1
Naphtenes	0.221	0.084	70.13	745.4
Heptanes, C7 total	10.051	5.127	94.11	717.4
n-Paraffin	2.937	1.595	100.2	683.8
iso-Paraffins	3.123	1.696	100.20	685.0
Naphtenes	3.001	1.417	87.11	761.5
Aromates	0.990	0.419	78.11	879.0
Octanes, C8 total	12.278	7.188	108.01	742.3
n-Paraffin	2.746	1.700	114.2	702.5
iso-Paraffins	2.483	1.542	114.59	701.8
Naphtenes	5.828	3.336	105.61	764.8
Aromates	1.221	0.610	92.14	867.0
Nonanes, C9 total	10.638	7.029	121.90	759.6
n-Paraffin	2.893	2.011	128.3	717.6
iso-Paraffins	3.157	2.198	128.43	730.7
Naphtenes	2.379	1.549	120.13	782.7
Aromates	2.209	1.271	106.17	868.1
Decanes plus, C10+	57.072	76.495	247	847
Sum	100.000	100.000		
Mean molecular weight:			185	
Density of oil				813.7

6. Thompson indices, oils from wells 2/7-D-06, 2/7-D-09 and 2/7-27S.

A: Benzene/n-Hexane
B: Toluene/n-Heptane
X: (m-Xylene + p-Xylene)/n-Octane
C: (n-Hexane + n-Heptane)/(Cy-Hexane + Methyl-Cy-Hexane)
I: (2-Methyl-Hexane + 3-Methyl-Hexane)/(1-cis,3-DiMethyl-Cy-Pentane + 1-trans,3-DiMethyl-Cy-Pentane)
F: n-Heptane/Methyl-Cy-Hexane
H: 100*n-Heptane/(Cy-Hexane + 2-Methyl-Hexane + 1,1-DiMethyl-Cy-Pentane + 3-Methyl-Hexane + 1-cis,3-Dimethyl-Cy-Pentane + 1-trans,3-DiMethyl-Cy-Pentane + 1-trans,2-DiMethyl-Cy-Pentane + n-Heptane + Methyl-Cy-Hexane)
U: Cy-Hexane/Methyl-Cy-Pentane
R: n-Heptane/2-Methyl-Hexane
R`: n-Heptane/3-Methyl-Hexane
W: Benzene/Cy-Hexane

Well no.:	2/7-D-06	2/7-D-09	2/7-27S
A:	0.339	0.376	0.335
B:	0.434	0.269	0.382
X:	0.477	0.332	0.469
C:	1.526	1.750	1.306
I:	4.159	4.881	4.733
F:	1.127	1.279	1.025
H:	31.142	32.856	30.111
U:	0.446	0.416	0.400
R:	2.442	2.360	2.282
R`:	3.380	3.182	3.262
W:	0.821	1.084	0.674

7. Detailed Composition analysis

	Well 2/7-D-09		Well 2/7-D-06		Well 2/7-27S		
Component:	Mole %	Weight %	Mole %	Weight %	Mole %	Weight %	Molecular weight
Methane	0.150	0.013	0.055	0.005	0.000	0.000	16.04
Ethane	0.314	0.051	0.405	0.069	0.006	0.001	30.07
Propane	0.980	0.233	1.699	0.425	0.151	0.036	44.09
iso-butane	0.616	0.193	0.865	0.285	0.238	0.075	58.12
n-n-butane	2.207	0.692	3.067	1.011	0.927	0.292	58.12
Neopentane	0.000	0.000	0.000	0.000	0.000	0.000	72.15
iso-pentane	1.853	0.721	2.033	0.832	1.297	0.507	72.15
n-pentane	3.215	1.251	3.470	1.420	2.105	0.823	72.15
2,2-Dm-Butane	0.039	0.018	0.041	0.020	0.043	0.020	86.17
Cyclopentane	0.206	0.078	0.319	0.127	0.221	0.084	70.13
2,3-dimethyl-butane	0.196	0.091	0.176	0.086	0.203	0.095	86.17
2-methyl-pentane	1.543	0.717	1.438	0.703	1.291	0.603	86.17
3-methyl-pentane	0.923	0.429	0.853	0.417	0.805	0.376	86.17
n-hexane	**3.242**	**1.507**	**3.120**	**1.525**	**2.674**	**1.249**	**86.17**
2,2-dimethyl-pentane	0.043	0.023	0.040	0.023	0.052	0.028	100.20
Methyl-cyclopentane	0.850	0.386	1.089	0.520	1.006	0.459	84.16
2,4-dimethyl-pentane	0.133	0.072	0.120	0.068	0.136	0.074	100.20
2,2,3-Dm-Butane	0.007	0.004	0.007	0.004	0.011	0.006	100.20
Benzene	1.346	0.567	1.167	0.517	0.990	0.419	78.11
3,3-Dm-Pentane	0.022	0.012	0.023	0.013	0.029	0.016	100.20
Cyclohexane	1.152	0.523	1.320	0.630	1.364	0.622	84.16
2-methyl-hexane	1.260	0.681	1.147	0.652	1.287	0.699	100.20
2,3-dimethyl-pentane	0.315	0.170	0.269	0.153	0.282	0.153	100.20
1,1-dimethyl-cyclopentane	0.144	0.076	0.151	0.084	0.160	0.085	98.18
3-methyl-hexane	0.934	0.505	0.829	0.471	0.900	0.489	100.20
1,3-cis-dimethyl-cyclopentane	0.213	0.113	0.226	0.126	0.220	0.117	98.18
1,3-trans-dimethyl-cyclopentane	0.245	0.130	0.259	0.144	0.252	0.134	98.18
3-ethyl-pentane	0.422	0.228	0.431	0.245	0.425	0.231	100.20
n-heptane	**2.973**	**1.607**	**2.801**	**1.592**	**2.937**	**1.595**	**100.20**
Methyl-cyclohexane	2.354	1.256	2.518	1.413	2.902	1.556	98.93
c-1,2-Dm-CyC5	0.000	0.000	0.000	0.000	0.000	0.000	98.18
1,1,3-Tm-CyC5	0.152	0.092	0.143	0.091	0.159	0.097	112.21
Ethyl-cyclopentane	0.088	0.053	0.096	0.061	0.115	0.070	112.21
2,5-Dm-Hexane	0.118	0.073	0.096	0.062	0.124	0.077	114.22
2,4-Dm-Hexane	0.154	0.095	0.133	0.086	0.157	0.097	114.22
tc-1,2,4-Tm-CyC5	0.134	0.081	0.129	0.082	0.136	0.083	112.21
3,3-Dm-Hexane	0.031	0.019	0.026	0.017	0.034	0.021	114.22
tc-1,2,3-Tm-CyC5	0.112	0.068	0.108	0.069	0.110	0.067	112.21
2,3,4-Tm-Pentane	0.050	0.031	0.043	0.028	0.034	0.021	114.22
Toluen	0.869	0.432	1.322	0.691	1.221	0.610	92.14
1,1,2-Tm-CyC5	0.050	0.030	0.044	0.028	0.048	0.029	112.21
2,3-Dm-Hexane	0.122	0.075	0.106	0.069	0.147	0.091	114.22
2-Me-3-Et-Pentane	0.031	0.019	0.026	0.017	0.000	0.000	114.22
2-methyl-heptane	1.099	0.677	0.957	0.620	1.153	0.714	114.22
4-Me-Heptane	0.333	0.205	0.299	0.194	0.373	0.231	114.22
3,4-Dm-Hexane	0.000	0.000	0.000	0.000	0.024	0.015	114.22
ct-1,2,4-Tm-CyC5	0.547	0.331	0.559	0.356	0.740	0.450	112.21
c-1,3-Dm-CyC6	0.634	0.384	0.584	0.372	0.709	0.431	112.21

3-Me-Heptane *	0.323	0.199	0.321	0.208	0.405	0.251	114.22
1,1-Dm-CyC6	0.088	0.053	0.088	0.056	0.117	0.071	112.21
2,2,5-Tm-Hexane	0.040	0.028	0.040	0.029	0.046	0.032	128.25
c-1-Me-3-Et-CyC5	0.045	0.027	0.044	0.028	0.043	0.026	112.21
t-1-Me-2-Et-CyC5	0.078	0.047	0.077	0.049	0.071	0.043	112.21
2,2,4-Tm-Hexane	0.017	0.012	0.016	0.012	0.019	0.013	128.25
t-1,2-Dm-CyC6	0.317	0.192	0.311	0.198	0.370	0.225	112.21
cc1,2,3-Tm-CyC5	0.000	0.000	0.000	0.000	0.003	0.002	112.21
t-1,3-Dm-CyC6	0.210	0.127	0.207	0.132	0.271	0.165	112.21
n-octane	**2.363**	**1.456**	**2.284**	**1.480**	**2.746**	**1.700**	**114.22**
C9-N (*)	0.021	0.014	0.020	0.014	0.025	0.017	126.23
C8-N (*)	0.000	0.000	0.000	0.000	0.002	0.001	112.21
C9-N (*)	0.013	0.009	0.011	0.008	0.013	0.009	126.23
c-1-Me-2-Et-CyC5	0.030	0.018	0.028	0.018	0.030	0.018	112.21
2,2-Dm-Heptane	0.030	0.021	0.029	0.021	0.047	0.033	128.25
c-1,2-Dm-CyC6	0.068	0.041	0.066	0.042	0.082	0.050	112.21
2,2,3-Tm-Hexane	0.146	0.101	0.132	0.096	0.157	0.109	128.25
2,4-Dm-Heptane	0.010	0.007	0.010	0.007	0.010	0.007	128.25
Ethyl-cyclohexane	0.722	0.437	0.764	0.486	0.922	0.561	112.21
2-Me-4-Et-Hexane	0.009	0.006	0.011	0.008	0.014	0.010	128.25
2,6-Dm-Heptane	0.392	0.271	0.313	0.228	0.391	0.272	128.25
1,1,3-Tm-CyC6	0.225	0.153	0.198	0.142	0.254	0.174	126.23
C9-N (*)	0.038	0.026	0.035	0.025	0.047	0.032	126.23
2,5-Dm-Heptane	0.176	0.122	0.158	0.115	0.223	0.155	128.25
3,5-Dm-Heptane	0.058	0.040	0.055	0.040	0.063	0.044	128.25
C9-N (*)	0.038	0.026	0.039	0.028	0.034	0.023	126.23
C9-N (*)	0.016	0.011	0.020	0.014	0.015	0.010	126.23
Ethyl-benzene	0.190	0.109	0.241	0.145	0.250	0.144	106.17
C9-N (*)	0.038	0.026	0.039	0.028	0.034	0.023	126.23
2,3,4-Tm-Hexane	0.175	0.121	0.168	0.122	0.216	0.150	128.25
N (*)	0.000	0.000	0.001	0.001	0.003	0.002	126.23
N (*)	0.007	0.005	0.010	0.007	0.016	0.011	126.23
meta-xylene	0.655	0.375	0.897	0.540	1.051	0.605	106.17
para-xylene	0.189	0.108	0.276	0.166	0.334	0.192	106.17
2,3-Dm-Heptane	0.337	0.233	0.301	0.219	0.338	0.235	128.25
3,4-Dm-Heptane	0.072	0.050	0.087	0.063	0.099	0.069	128.25
3,4-Dm-Heptane (b)	0.023	0.016	0.027	0.020	0.040	0.028	128.25
N (*)	0.032	0.022	0.034	0.024	0.045	0.031	126.23
4-Me-Octane	0.291	0.201	0.275	0.200	0.365	0.254	128.25
2-Me-Octane	0.411	0.284	0.386	0.281	0.512	0.356	128.25
N (*)	0.000	0.000	0.000	0.000	0.000	0.000	126.23
N (*)	0.043	0.029	0.038	0.027	0.054	0.037	126.23
3-Et-Heptane	0.069	0.048	0.063	0.046	0.094	0.065	128.25
3-methyl-octane	0.385	0.266	0.367	0.267	0.527	0.366	128.25
N (*)	0.021	0.014	0.018	0.013	0.025	0.017	126.23
ortho-xylene	0.419	0.240	0.523	0.315	0.573	0.330	106.17
2,4,6-Tm-Heptane	0.034	0.026	0.031	0.025	0.041	0.032	142.28
N (*)	0.001	0.001	0.006	0.004	0.013	0.009	126.23
P (*)	0.000	0.000	0.000	0.000	0.007	0.005	128.25
N (*)	0.338	0.230	0.348	0.249	0.455	0.311	126.23
N (*)	0.125	0.085	0.124	0.089	0.042	0.029	126.23
N (*)	0.001	0.001	0.004	0.003	0.175	0.120	126.23
P (*)	0.000	0.000	0.000	0.000	0.012	0.008	128.25
N (*)	0.009	0.006	0.008	0.006	0.012	0.008	126.23
N (*)	0.022	0.015	0.015	0.011	0.031	0.021	126.23
N (*)	0.013	0.009	0.015	0.011	0.029	0.020	126.23

N (*)	0.018	0.012	0.017	0.012	0.022	0.015	126.23
n-nonane	**2.163**	**1.496**	**2.153**	**1.566**	**2.893**	**2.011**	**128.25**
Sum	43.975	22.484	46.360	24.367	42.928	23.505	
C10+	56.025	77.516	53.640	75.633	57.072	76.495	
Total	100.000	100.000	100.000	100.000	100.000	100.000	

8. LABORATORY PROCEDURES

Oil composition analysis.

Oil analysis is carried out in a Chrompack ASTM D-5134 Analyzer, Chrompach CP-9001 GC. The injector is a split injector. The column is a PONA capillary column. The identification of the components is in agreement to ASTM D-5134. The detector is FID and the detector temperature is 300 °C.
Carrier gas: Helium
Column:
Capillary column: PONA, 50 m, ID 0.21 µm

Density.

The oil density at atmospheric pressure is determined with an Anton PAAR densitometer . The densitometer is calibrated with air and distilled water.

Molecular weight.

The number average molecular weight of oil is determined by cryoscopy, freezing point depression in benzene.
The instrument is Reobling Kryometer.