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Final Report

PVT analysis of MDT oil samples from well 15/9-F-4, Volve

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Composition and mud filtrate contamination

PVT analysis

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EXECUTIVE SUMMARY

Four MDT samples; two water and two oil samples from well 15/9-F-4 were supplied by StatoilHydro for analyses.

A quality check was performed on the oil samples by determination of the bubble point pressure at reservoir temperature and single stage separation including composition analyses and mud filtrate contamination.

The mud filtrate contamination was determined by subtraction of the actual fractions in the oil after composition analysis of the mud filtrate.

The following contamination levels were determined:

- Bottle 4720-EA, 13.5 weight %
- Bottle 6103-MA, 12.5 weight %

StatoilHydro evaluated the results from the quality check, and decided to perform more PVT analyses on sample with the lowest contamination.

The following additional PVT analyses were performed on the reservoir fluid:

- Constant Mass Expansion at reservoir temperature
- Viscosity at reservoir temperature from above P_{Res} to atmospheric pressure.
- Two stage separator test

Main results from the PVT analyses:

Constant mass expansion:

Bottle no.	Reservoir temperature °C	P_{BP} bar	Isothermal compressibility bar^{-1}	Viscosity at P_{BP} mPas
6103-MA	107	213.1	1.901E-04	0.606

Single stage separation, measured values:

Bottle no.	GOR Sm^3/Sm^3	B_o at P_{BP} m^3/Sm^3	Density of stock tank oil kg/m^3	Molecular weight	Measured density at P_{BP}	Gas gravity	OBM contamination Wt% in STO
6103-MA	109.8	1.382	872.5	237.6	720.5	0.879	12.5

Two stage separation:

Bottle no.	GOR/ R_s Sm^3/Sm^3	B_o at P_{BP} m^3/Sm^3	Density of stock tank oil kg/m^3	Molecular weight	Calculated density at P_{BP} kg/m^3
6103-MA	104.9	1.362	868.9	232.3	716.8

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1. INTRODUCTION

This report contains the results from the PVT analyses of the reservoir fluid from well 15/9-F-4. Two MDT oil samples and two MDT water samples were supplied by StatoilHydro for analyses. The Two MDT oil samples were quality checked prior to further PVT analyses

The mud system used was oil based.

The mud filtrate contamination was determined by subtraction of the actual fractions in the oil after performing composition analysis of the mud filtrate.

The contamination in bottle 4720-EA was determined to be 13.5 weight % and 12.5 weight % in bottle 6103-MA.

The results from these analyses were evaluated by StatoilHydro and the sample with the lowest contamination was deemed to be the most representative sample, and thus selected for further PVT analyses.

The following PVT analyses were performed on the reservoir fluid:

- Quality check by determination of the bubble point pressure at reservoir temperature
- Single Stage Separation
- Constant Mass Expansion
- Viscosity at reservoir temperature from above P_{Res} to atmospheric pressure.
- Two Stage Separator test

2. FLUID SAMPLES

2.1. MDT samples.

The samples from well 15/9-F-4 were supplied by StatoilHydro.

For the reservoir characteristics, refer to Table 2.1.1

Sample bottles supplied, refer to Table 2.1.2

Table 2.1.1 Reservoir characteristics.

Well no.	15/9-F-4
Field	Volve
Reservoir Temperature	107 °C
Reservoir pressure, actual.	332.8 bar
Sampling depth	3245.5 m MD RKB/ 2928.7 m TVD MSL
Formation	Heather
Sampler type	MDT
Drawdown during sampling	60 bar
Mud	Oil based

Table 2.1.2 MDT sample information.

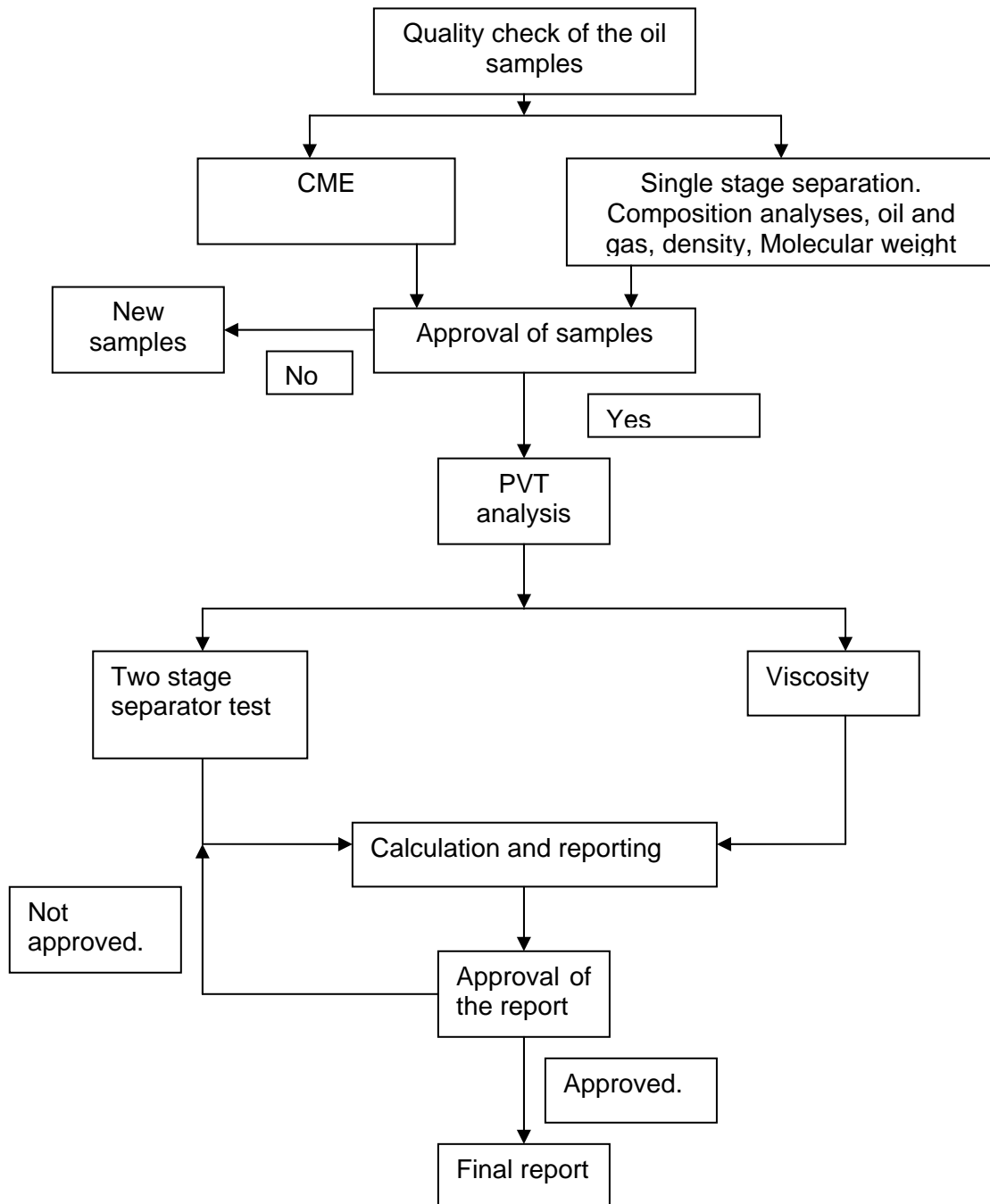
Fluid type	Chamber no MPSR	Sampling depth m MD	Draw-down bar	Opening pressure bar	Transfer Pressure bar	Transfer Temp °C	Storage Pressure bar	Bottle no	Bottle type	Sample volume cc
Oil	2824	3245.5	272.7	116.92 @ 8°C	412.65	80	116.91 @ 10°C	4720-EA	CSB	400
Oil	3011	3245.5	272.7	110.04 @ 8°C	412.65	80	113.48 @ 10°C	6103-MA	CSB	395
Water	537	3417.5	185	68.77 @ 15°C	412.65	15	27.51 @ 15°C	4623-EA	CSB	405
Water	2520	3412.5	185	82.53 @ 15°C	413.69	15	58.46 @ 15°C	4516-EA	CSB	405

3. EXPERIMENTAL PROGRAM

3.1. Performed PVT analyses.

Analysis	Number of samples	Requested	Performed
Single stage separation of MDT reservoir fluid including compositional analyses of stock tank gas and oil, C36+. Mud filtrate invasion correction.	2	2	2
Composition analysis of mud filtrate.	2	2	2
CME of MDT reservoir fluid (oil) at reservoir temperature.	2	2	2
Viscosity of reservoir fluid at reservoir temperature.	1	1	1
Two stage separator test of reservoir fluid.	1	1	1

Figure 3.1-1 Flow chart of the analyses



4. RESULTS

4.1. Quality check of MDT Samples

Table 4.1.1 Determination of bubble point pressure at reservoir temperature.

Bottle no.	Reservoir temperature °C	P _{BP} bar
6103-MA	107	213.1
4720-EA	107	215.4

Table 4.1.2 Single Stage Separation, measured values.

Bottle no.	GOR Sm ³ /Sm ³	Density of stock tank oil kg/m ³	Molecular weight	Gas gravity
6103-MA	109.8	872.5	237.6	0.879
4720-EA	117.9	872.6	238.6	0.879

Table 4.1.3 Corrected for mud filtrate contamination.

Bottle no.	GOR Sm ³ /Sm ³	Density of stock tank oil kg/m ³	Molecular weight	Mud filtrate contamination Wt % in STO
6103-MA	126.5	879.8	241.1	12.5
4720-EA	137.6	880.8	242.5	13.5

Table 4.1.4 Composition of reservoir fluid, uncorrected for contamination.

Bottle no. COMPONENT	6103-MA Mole %	4720-EA Mole %
Nitrogen	0.385	0.376
Carbon dioxide	3.568	3.628
Hydrogen Sulphide	0.000	0.000
Methane	37.477	38.977
Ethane	5.701	5.729
Propane	5.116	5.113
iso-Butane	0.724	0.717
n-Butane	2.644	2.608
Neopentane	0.001	0.002
iso-Pentane	0.986	0.964
n-Pentane	1.593	1.546
Hexanes	2.199	2.093
Heptanes	3.369	3.207
Octanes	3.219	3.061
Nonanes	2.432	2.313
Decanes	2.080	1.983
Undecanes	1.849	1.773
Dodecanes	1.751	1.689
Tridecanes	1.826	1.774
Tetradecanes	2.076	2.047
Pentadecanes	2.767	2.772
Hexadecanes	2.375	2.390
Heptadecanes	1.954	1.947
Octadecanes	1.396	1.376
Nonadecanes	1.093	1.053
Eicosanes	0.741	0.712
C ₂₁	0.655	0.626
C ₂₂	0.594	0.567
C ₂₃	0.534	0.509
C ₂₄	0.492	0.473
C ₂₅	0.452	0.437
C ₂₆	0.436	0.418
C ₂₇	0.409	0.393
C ₂₈	0.398	0.381
C ₂₉	0.398	0.380
C ₃₀	0.392	0.374
C ₃₁	0.377	0.360
C ₃₂	0.340	0.325
C ₃₃	0.292	0.281
C ₃₄	0.268	0.257
C ₃₅	0.253	0.239
C ₃₆₊	4.387	4.131
Sum	100.000	100.000
Mean molecular weight:	119.1	115.6

Table 4.1.5 Composition corrected for mud filtrate contamination.

Bottle no. COMPONENT	6103-MA Mole %	4720-EA Mole %
Nitrogen	0.410	0.402
Carbon dioxide	3.798	3.871
Hydrogen Sulphide	0.000	0.000
Methane	39.901	41.596
Ethane	6.070	6.114
Propane	5.447	5.456
iso-Butane	0.771	0.765
n-Butane	2.815	2.783
Neopentane	0.002	0.003
iso-Pentane	1.050	1.029
n-Pentane	1.696	1.649
Hexanes	2.341	2.234
Heptanes	3.587	3.422
Octanes	3.427	3.266
Nonanes	2.590	2.469
Decanes	2.207	2.107
Undecanes	1.890	1.811
Dodecanes	1.672	1.602
Tridecanes	1.586	1.520
Tetradecanes	1.443	1.386
Pentadecanes	1.365	1.312
Hexadecanes	1.034	0.994
Heptadecanes	1.046	1.000
Octadecanes	0.909	0.866
Nonadecanes	0.950	0.901
Eicosanes	0.737	0.706
C ₂₁	0.667	0.636
C ₂₂	0.621	0.593
C ₂₃	0.560	0.535
C ₂₄	0.515	0.495
C ₂₅	0.473	0.458
C ₂₆	0.460	0.443
C ₂₇	0.432	0.416
C ₂₈	0.421	0.403
C ₂₉	0.422	0.403
C ₃₀	0.418	0.399
C ₃₁	0.402	0.384
C ₃₂	0.362	0.346
C ₃₃	0.311	0.300
C ₃₄	0.285	0.274
C ₃₅	0.269	0.255
C ₃₆₊	4.643	4.396
Sum	100.000	100.000
Mean molecular weight:	112.9	108.8

4.2. Composition and chromatogram of mud filtrate.

Component C ₁ - C ₃₆₊	Mole %	Weight %	Molecular weight	Density kg/m ³
Methane	0.000	0.000		
Ethane	0.000	0.000		
Propane	0.000	0.000		
iso-Butane	0.004	0.001		
n-Butane	0.000	0.000		
Neopentane	0.000	0.000		
iso-Pentane	0.000	0.000		
n-Pentane	0.000	0.000		
Hexanes	0.000	0.000		
Heptanes	0.002	0.001	100.2	687
Octanes	0.014	0.007	107.9	740
Nonanes	0.083	0.048	128.3	730
Decanes	0.131	0.079	134	782
Undecanes	1.245	0.822	147	793
Dodecanes	2.894	2.209	170	804
Tridecanes	5.407	4.468	184	815
Tetradecanes	11.680	10.387	198	826
Pentadecanes	24.377	23.209	212	836
Hexadecanes	23.304	23.654	226	843
Heptadecanes	16.204	17.466	240	851
Octadecanes	9.065	10.341	254	856
Nonadecanes	3.332	4.010	268	861
Eicosanes	0.804	1.018	282	866
C ₂₁	0.478	0.635	296	871
C ₂₂	0.175	0.244	310	876
C ₂₃	0.122	0.178	324	881
C ₂₄	0.138	0.209	338	885
C ₂₅	0.127	0.200	352	888
C ₂₆	0.054	0.089	366	892
C ₂₇	0.049	0.084	380	896
C ₂₈	0.044	0.078	394	899
C ₂₉	0.036	0.065	408	902
C ₃₀	0.027	0.051	422	905
C ₃₁	0.021	0.040	436	909
C ₃₂	0.022	0.044	450	912
C ₃₃	0.033	0.068	464	915
C ₃₄	0.050	0.108	478	917
C ₃₅	0.020	0.043	492	920
C ₃₆₊	0.059	0.141	535	
Sum	100.000	100.000		
Mean molecular weight:			222.7	
Density, kg/m ³ :				824.6

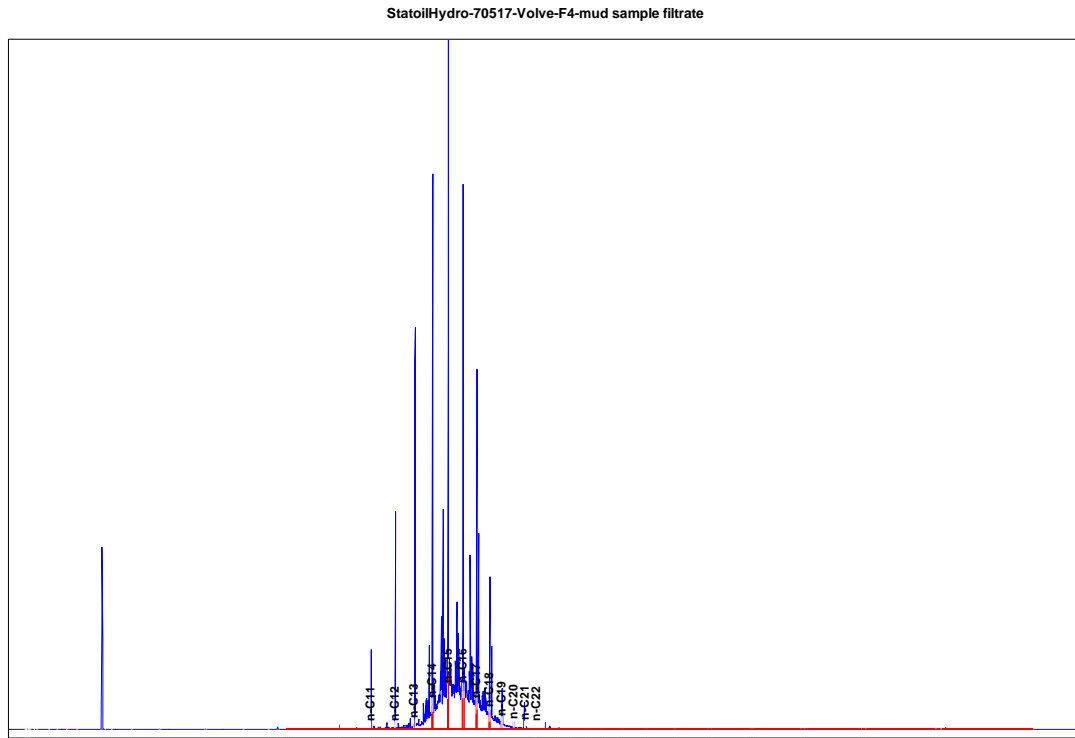


Figure 4.2-1 Chromatogram of mud filtrate

4.3. Single stage separation of reservoir fluid, bottle no.: 6103-MA. Uncorrected for mud filtrate contamination.

Table 4.3.1 Results from single stage separation.

Flash conditions:	From:	107	°C, and	351.5	bar
	To:	22.4	°C, and	atm.	pressure
Bottle no:	6103-MA				

Gas oil ratio (GOR):	109.8	Sm ³ /Sm ³	1)
Oil formation volume factor at reservoir pressure:	1.353	m ³ /Sm ³	2)
Oil formation volume factor at saturation pressure:	1.382	m ³ /Sm ³	3)
Density of stock tank oil at 15 °C	872.5	kg/Sm ³	
Calculated density of oil at P _{BP}	717.1	kg/m ³	
Gas gravity:	0.879		
Mean molecular weight:	237.6		4)
Mean molecular weight, C7+:	258		4)
Density of C7+:	885	kg/Sm ³	4)
Mean molecular weight, C10+:	302		4)
Density of C10+:	900	kg/Sm ³	4)
Density by high pressure pycnometer at P _{BP}	720.5	kg/m ³	

- 1) m³ gas at standard conditions per Sm³ stock tank oil.
- 2) m³ oil at reservoir pressure per Sm³ stock tank oil.
- 3) m³ oil at bubble point pressure per Sm³ stock tank oil.
- 4) Stock tank oil.

Standard conditions: Gas: 15 °C and 1.01325 bar
 Oil: 15 °C and atmospheric pressure.

Table 4.3.2 Compositional analysis of reservoir fluid, bottle no.: 6103-MA. Uncorrected for mud filtrate contamination.

COMPONENT	Composition of the stock tank gas					Composition of the stock tank oil				Composition of recombined fluid			
	Mole %	Weight %	Molar Weight	Density kg/m ³	LNG m ³ /10 ³ Sm ³	Mole %	Weight %	Molar Weight	Density kg/m ³	Mole %	Weight %	Molar Weight	Density kg/m ³
Nitrogen	0.689	0.758	28.02	804.0						0.385	0.091	28.02	804.0
Carbon Dioxide	6.388	11.042	44.01	809.0						3.568	1.318	44.01	809.0
Hydrogen Sulphide	0.000	0.000	34.08	797.0						0.000	0.000	34.08	797.0
Methane	67.036	42.235	16.04	300.0		0.089	0.006	16.04	300.0	37.477	5.047	16.04	300.0
Ethane	10.034	11.849	30.07	356.7		0.221	0.028	30.07	356.7	5.701	1.439	30.07	356.7
Propane	8.377	14.507	44.09	506.7	308.4	0.991	0.184	44.09	506.7	5.116	1.894	44.09	506.7
iso-Butane	1.032	2.355	58.12	562.1	45.1	0.335	0.082	58.12	562.1	0.724	0.353	58.12	562.1
n-Butane	3.335	7.614	58.12	583.1	140.7	1.770	0.433	58.12	583.1	2.644	1.290	58.12	583.1
Neopentane	0.000	0.000	72.15	597.0	0.0	0.003	0.001	72.15	597.0	0.001	0.001	72.15	597.0
iso-Pentane	0.813	2.304	72.15	623.3	39.8	1.205	0.366	72.15	623.3	0.986	0.597	72.15	623.3
n-Pentane	1.058	2.997	72.15	629.9	51.3	2.269	0.689	72.15	629.9	1.593	0.965	72.15	629.9
Hexanes, C6 total	0.616	2.035	84.1	670.0	32.7	4.200	1.498	84.7	667.7	2.199	1.562	84.6	668.0
<i>n-Hexane</i>	0.272	0.921	86.2	662.7		2.107	0.764	86.2	662.7	1.082	0.783	86.2	662.7
<i>iso-Paraffins</i>	0.265	0.897	86.2	660.7		1.718	0.623	86.2	661.1	0.906	0.656	86.2	661.0
<i>Naphtenes</i>	0.079	0.218	70.1	748.1		0.376	0.111	70.1	748.1	0.210	0.124	70.1	748.1
Heptanes, C7 total	0.450	1.581	89.5	747.1	22.8	7.061	2.729	91.8	735.2	3.369	2.592	91.7	736.0
<i>n-Heptane</i>	0.068	0.266	100.2	686.9		1.752	0.739	100.2	686.9	0.811	0.683	100.2	686.9
<i>iso-Paraffins</i>	0.097	0.383	100.2	691.0		1.719	0.725	100.2	691.6	0.813	0.684	100.2	691.5
<i>Naphtenes</i>	0.197	0.662	85.7	761.6		2.406	0.876	86.5	763.6	1.172	0.850	86.4	763.4
<i>Aromatics</i>	0.088	0.271	78.1	883.1		1.183	0.389	78.1	883.1	0.572	0.375	78.1	883.1
Octanes, C8 total	0.146	0.599	104.5	769.3	8.4	7.106	3.194	106.8	756.5	3.219	2.884	106.7	756.8
<i>n-Octane</i>	0.016	0.072	114.2	707.0		1.346	0.647	114.2	707.0	0.603	0.578	114.2	707.0
<i>iso-Paraffins</i>	0.021	0.097	115.1	705.9		1.585	0.768	115.2	707.7	0.712	0.688	115.2	707.6
<i>Naphtenes</i>	0.075	0.307	104.9	770.9		2.685	1.201	106.3	770.4	1.227	1.094	106.2	770.5
<i>Aromatics</i>	0.034	0.122	92.1	872.0		1.490	0.578	92.1	872.0	0.677	0.524	92.1	872.0
Nonanes, C9 total	0.024	0.112	118.7	779.4	1.5	5.479	2.791	121.0	769.6	2.432	2.471	121.0	769.7
<i>n-Nonane</i>	0.002	0.009	128.3	723.0		1.167	0.630	128.3	723.0	0.516	0.556	128.3	723.0
<i>iso-Paraffins</i>	0.007	0.037	128.3	721.5		1.556	0.841	128.4	722.8	0.691	0.745	128.4	722.8
<i>Naphtenes</i>	0.008	0.035	118.5	793.1		1.417	0.722	121.1	795.8	0.630	0.640	121.1	795.8
<i>Aromatics</i>	0.007	0.029	106.2	872.2		1.338	0.598	106.2	874.0	0.595	0.530	106.2	873.9
Decanes plus, C10+	0.002	0.012	137		0.2	69.269	87.999	302	900	30.585	77.496	302	900
Sum	100.000	100.000			650.9	100.000	100.000			100.000	100.000		
Mean molecular weight:			25.46					237.6				119.1	
Gas gravity:			0.879										

Table 4.3.3 Composition analysis of stock tank oil, C₃₆₊, bottle no.: 6103-MA. Uncorrected for mud filtrate contamination.

Component C ₁ - C ₃₆₊	Mole %	Weight %	Molecular weight	Density kg/m ³
Methane	0.089	0.006	16.04	300.0
Ethane	0.221	0.028	30.07	356.7
Propane	0.991	0.184	44.09	506.7
iso-Butane	0.335	0.082	58.12	562.1
n-Butane	1.770	0.433	58.12	583.1
Neopentane	0.003	0.001	72.15	597.0
iso-Pentane	1.205	0.366	72.15	623.3
n-Pentane	2.269	0.689	72.15	629.9
Hexanes	4.200	1.498	84.7	667.7
Heptanes	7.061	2.729	91.8	735.2
Octanes	7.106	3.194	106.8	756.5
Nonanes	5.479	2.791	121.0	769.6
Decanes	4.709	2.656	134	782
Undecanes	4.188	2.591	147	793
Dodecanes	3.965	2.687	161	804
Tridecanes	4.136	3.046	175	815
Tetradecanes	4.702	3.760	190	826
Pentadecanes	6.268	5.434	206	836
Hexadecanes	5.379	5.026	222	843
Heptadecanes	4.425	4.414	237	851
Octadecanes	3.163	3.341	251	856
Nonadecanes	2.475	2.740	263	861
Eicosanes	1.678	1.942	275	866
C ₂₁	1.484	1.817	291	871
C ₂₂	1.346	1.699	300	876
C ₂₃	1.209	1.587	312	881
C ₂₄	1.115	1.520	324	885
C ₂₅	1.024	1.452	337	888
C ₂₆	0.986	1.449	349	892
C ₂₇	0.925	1.402	360	896
C ₂₈	0.901	1.411	372	899
C ₂₉	0.903	1.451	382	902
C ₃₀	0.888	1.473	394	905
C ₃₁	0.855	1.453	404	909
C ₃₂	0.769	1.344	415	912
C ₃₃	0.661	1.186	426	915
C ₃₄	0.607	1.116	437	917
C ₃₅	0.573	1.073	445	920
C ₃₆₊	9.936	28.929	692	1012
Sum	100.000	100.000		
Mean molecular weight:			237.6	
Density, kg/m ³ :				872.5

Table 4.3.4 Composition analyses of reservoir fluid, C36+, bottle no.: 6103-MA. Uncorrected for mud filtrate contamination.

COMPONENT	Stock tank gas		Stock tank oil		Reservoir fluid	
	Mole %	Weight %	Mole %	Weight %	Mole %	Weight %
Nitrogen	0.689	0.758	0.000	0.000	0.385	0.091
Carbon dioxide	6.388	11.042	0.000	0.000	3.568	1.318
Hydrogen Sulphide	0.000	0.000	0.000	0.000	0.000	0.000
Methane	67.036	42.235	0.089	0.006	37.477	5.047
Ethane	10.034	11.849	0.221	0.028	5.701	1.439
Propane	8.377	14.507	0.991	0.184	5.116	1.894
iso-Butane	1.032	2.355	0.335	0.082	0.724	0.353
n-Butane	3.335	7.614	1.770	0.433	2.644	1.290
Neopentane	0.000	0.000	0.003	0.001	0.001	0.001
iso-Pentane	0.813	2.304	1.205	0.366	0.986	0.597
n-Pentane	1.058	2.997	2.269	0.689	1.593	0.965
Hexanes	0.616	2.035	4.200	1.498	2.199	1.562
Heptanes	0.450	1.581	7.061	2.729	3.369	2.592
Octanes	0.146	0.599	7.106	3.194	3.219	2.884
Nonanes	0.024	0.112	5.479	2.791	2.432	2.471
Decanes	0.002	0.010	4.709	2.656	2.080	2.340
Undecanes	0.000	0.001	4.188	2.591	1.849	2.282
Dodecanes	0.000	0.001	3.965	2.687	1.751	2.366
Tridecanes	0.000	0.000	4.136	3.046	1.826	2.682
Tetradecanes	0.000	0.000	4.702	3.760	2.076	3.311
Pentadecanes	0.000	0.000	6.268	5.434	2.767	4.785
Hexadecanes	0.000	0.000	5.379	5.026	2.375	4.426
Heptadecanes	0.000	0.000	4.425	4.414	1.954	3.887
Octadecanes	0.000	0.000	3.163	3.341	1.396	2.942
Nonadecanes	0.000	0.000	2.475	2.740	1.093	2.413
Eicosanes	0.000	0.000	1.678	1.942	0.741	1.710
C ₂₁	0.000	0.000	1.484	1.817	0.655	1.600
C ₂₂	0.000	0.000	1.346	1.699	0.594	1.496
C ₂₃	0.000	0.000	1.209	1.587	0.534	1.398
C ₂₄	0.000	0.000	1.115	1.520	0.492	1.339
C ₂₅	0.000	0.000	1.024	1.452	0.452	1.279
C ₂₆	0.000	0.000	0.986	1.449	0.436	1.276
C ₂₇	0.000	0.000	0.925	1.402	0.409	1.235
C ₂₈	0.000	0.000	0.901	1.411	0.398	1.243
C ₂₉	0.000	0.000	0.903	1.451	0.398	1.278
C ₃₀	0.000	0.000	0.888	1.473	0.392	1.297
C ₃₁	0.000	0.000	0.855	1.453	0.377	1.280
C ₃₂	0.000	0.000	0.769	1.344	0.340	1.184
C ₃₃	0.000	0.000	0.661	1.186	0.292	1.044
C ₃₄	0.000	0.000	0.607	1.116	0.268	0.983
C ₃₅	0.000	0.000	0.573	1.073	0.253	0.945
C ₃₆₊	0.000	0.000	9.936	28.929	4.387	25.476
Sum	100.000	100.000	100.000	100.000	100.000	100.000
Mean molecular weight:	25.46		237.6		119.1	
Gas gravity:	0.879					

Table 4.3.5 Results, Single stage separation, corrected for mud filtrate contamination, bottle no.: 6103-MA.

Flash conditions:	From:	107	°C, and	351.5	bar
	To:	22.4	°C, and	atm.	pressure
Bottle no:	6103-MA				

Gas oil ratio (GOR):	126.5	Sm ³ /Sm ³	1)
Density of stock tank oil at 15 °C	879.8	kg/Sm ³	
Gas gravity:	0.879		
Mean molecular weight:	241.1		4)
Mean molecular weight, C7+:	266		4)
Density of C7+:	894	kg/Sm ³	4)
Mean molecular weight, C10+:	323		4)
Density of C10+:	914	kg/Sm ³	4)

- 1) m³ gas at standard conditions per Sm³ stock tank oil.
- 2) m³ oil at reservoir pressure per Sm³ stock tank oil.
- 3) m³ oil at bubble point pressure per Sm³ stock tank oil.
- 4) Stock tank oil.

Standard conditions: Gas: 15 °C and 1.01325 bar
 Oil: 15 °C and atmospheric pressure.

Table 4.3.6 Compositional analysis of reservoir fluid, bottle no.: 6103-MA. Corrected for mud filtrate contamination.

COMPONENT	Composition of the stock tank gas					Composition of the stock tank oil				Composition of recombined fluid			
	Mole %	Weight %	Molar Weight	Density kg/m ³	LNG m ³ /10 ³ Sm ³	Mole %	Weight %	Molar Weight	Density kg/m ³	Mole %	Weight %	Molar Weight	Density kg/m ³
Nitrogen	0.689	0.758	28.02	804.0						0.410	0.102	28.02	804.0
Carbon Dioxide	6.388	11.042	44.01	809.0						3.798	1.481	44.01	809.0
Hydrogen Sulphide	0.000	0.000	34.08	797.0						0.000	0.000	34.08	797.0
Methane	67.036	42.235	16.04	300.0		0.103	0.007	16.04	300.0	39.901	5.671	16.04	300.0
Ethane	10.034	11.849	30.07	356.7		0.257	0.032	30.07	356.7	6.070	1.617	30.07	356.7
Propane	8.377	14.507	44.09	506.7	308.4	1.150	0.210	44.09	506.7	5.447	2.128	44.09	506.7
iso-Butane	1.032	2.355	58.12	562.1	45.1	0.389	0.094	58.12	562.1	0.771	0.397	58.12	562.1
n-Butane	3.335	7.614	58.12	583.1	140.7	2.052	0.495	58.12	583.1	2.815	1.450	58.12	583.1
Neopentane	0.000	0.000	72.15	597.0	0.0	0.004	0.001	72.15	597.0	0.002	0.001	72.15	597.0
iso-Pentane	0.813	2.304	72.15	623.3	39.8	1.398	0.418	72.15	623.3	1.050	0.671	72.15	623.3
n-Pentane	1.058	2.997	72.15	629.9	51.3	2.631	0.787	72.15	629.9	1.696	1.084	72.15	629.9
Hexanes, C6 total	0.616	2.035	84.1	670.0	32.7	4.870	1.712	84.7	667.7	2.341	1.755	84.6	668.0
<i>n-Hexane</i>	0.272	0.921	86.2	662.7		2.443	0.873	86.2	662.7	1.152	0.880	86.2	662.7
<i>iso-Paraffins</i>	0.265	0.897	86.2	660.7		1.992	0.712	86.2	661.1	0.965	0.737	86.2	661.0
<i>Naphtenes</i>	0.079	0.218	70.1	748.1		0.436	0.127	70.1	748.1	0.224	0.139	70.1	748.1
Heptanes, C7 total	0.450	1.581	89.5	747.1	22.8	8.187	3.119	91.8	735.2	3.587	2.913	91.7	736.0
<i>n-Heptane</i>	0.068	0.266	100.2	686.9		2.032	0.845	100.2	686.9	0.864	0.767	100.2	686.9
<i>iso-Paraffins</i>	0.097	0.383	100.2	691.0		1.993	0.829	100.2	691.6	0.866	0.769	100.2	691.5
<i>Naphtenes</i>	0.197	0.662	85.7	761.6		2.790	1.001	86.5	763.6	1.248	0.956	86.4	763.4
<i>Aromatics</i>	0.088	0.271	78.1	883.1		1.372	0.445	78.1	883.1	0.609	0.421	78.1	883.1
Octanes, C8 total	0.146	0.599	104.5	769.3	8.4	8.240	3.650	106.8	756.5	3.427	3.241	106.7	756.8
<i>n-Octane</i>	0.016	0.072	114.2	707.0		1.560	0.739	114.2	707.0	0.642	0.650	114.2	707.0
<i>iso-Paraffins</i>	0.021	0.097	115.1	705.9		1.837	0.878	115.2	707.7	0.758	0.773	115.2	707.6
<i>Naphtenes</i>	0.075	0.307	104.9	770.9		3.114	1.373	106.3	770.4	1.307	1.230	106.2	770.5
<i>Aromatics</i>	0.034	0.122	92.1	872.0		1.728	0.661	92.1	872.0	0.721	0.588	92.1	872.0
Nonanes, C9 total	0.024	0.112	118.7	779.4	1.5	6.353	3.190	121.0	769.6	2.590	2.777	121.0	769.7
<i>n-Nonane</i>	0.002	0.009	128.3	723.0		1.353	0.720	128.3	723.0	0.550	0.625	128.3	723.0
<i>iso-Paraffins</i>	0.007	0.037	128.3	721.5		1.805	0.961	128.4	722.8	0.736	0.837	128.4	722.8
<i>Naphtenes</i>	0.008	0.035	118.5	793.1		1.643	0.825	121.1	795.8	0.671	0.719	121.1	795.8
<i>Aromatics</i>	0.007	0.029	106.2	872.2		1.552	0.683	106.2	874.0	0.633	0.596	106.2	873.9
Decanes plus, C10+	0.002	0.012	137		0.2	64.368	86.285	323	914	26.097	74.713	323	914
Sum	100.000	100.000			650.9	100.000	100.000			100.000	100.000		
Mean molecular weight:			25.46					241.1				112.9	
Gas gravity:			0.879										

Table 4.3.7 Composition analysis of stock tank oil, C₃₆₊, bottle no.: 6103-MA. Corrected for mud filtrate contamination.

Component C ₁ - C ₃₆₊	Mole %	Weight %	Molecular weight	Density kg/m ³
Methane	0.103	0.007	16.04	300.0
Ethane	0.257	0.032	30.07	356.7
Propane	1.150	0.210	44.09	506.7
iso-Butane	0.389	0.094	58.12	562.1
n-Butane	2.052	0.495	58.12	583.1
Neopentane	0.004	0.001	72.15	597.0
iso-Pentane	1.398	0.418	72.15	623.3
n-Pentane	2.631	0.787	72.15	629.9
Hexanes	4.870	1.712	84.7	667.7
Heptanes	8.187	3.119	91.8	735.2
Octanes	8.240	3.650	106.8	756.5
Nonanes	6.353	3.190	121.0	769.6
Decanes	5.440	3.024	134	771
Undecanes	4.662	2.843	147	780
Dodecanes	4.123	2.754	161	804
Tridecanes	3.911	2.840	175	815
Tetradecanes	3.560	2.806	190	826
Pentadecanes	3.368	2.878	206	836
Hexadecanes	2.549	2.348	222	843
Heptadecanes	2.580	2.537	237	851
Octadecanes	2.241	2.333	251	856
Nonadecanes	2.342	2.556	263	861
Eicosanes	1.817	2.073	275	866
C ₂₁	1.645	1.985	291	871
C ₂₂	1.532	1.907	300	876
C ₂₃	1.382	1.788	312	881
C ₂₄	1.270	1.707	324	885
C ₂₅	1.166	1.631	337	888
C ₂₆	1.135	1.643	349	892
C ₂₇	1.065	1.590	360	896
C ₂₈	1.038	1.601	372	899
C ₂₉	1.041	1.649	382	902
C ₃₀	1.030	1.683	394	905
C ₃₁	0.991	1.661	404	909
C ₃₂	0.892	1.536	415	912
C ₃₃	0.767	1.355	426	915
C ₃₄	0.704	1.275	437	917
C ₃₅	0.664	1.226	445	920
C ₃₆₊	11.452	33.055	696	1027
Sum	100.000	100.000		
Mean molecular weight:			241.1	
Density, kg/m ³ :				879.8

Table 4.3.8 Composition analyses of reservoir fluid, C36+, bottle no.: 6103-MA. Corrected for mud filtrate contamination.

COMPONENT	Stock tank gas		Stock tank oil		Reservoir fluid	
	Mole %	Weight %	Mole %	Weight %	Mole %	Weight %
Nitrogen	0.689	0.758	0.000	0.000	0.410	0.102
Carbon dioxide	6.388	11.042	0.000	0.000	3.798	1.481
Hydrogen Sulphide	0.000	0.000	0.000	0.000	0.000	0.000
Methane	67.036	42.235	0.103	0.007	39.901	5.671
Ethane	10.034	11.849	0.257	0.032	6.070	1.617
Propane	8.377	14.507	1.150	0.210	5.447	2.128
iso-Butane	1.032	2.355	0.389	0.094	0.771	0.397
n-Butane	3.335	7.614	2.052	0.495	2.815	1.450
Neopentane	0.000	0.000	0.004	0.001	0.002	0.001
iso-Pentane	0.813	2.304	1.398	0.418	1.050	0.671
n-Pentane	1.058	2.997	2.631	0.787	1.696	1.084
Hexanes	0.616	2.035	4.870	1.712	2.341	1.755
Heptanes	0.450	1.581	8.187	3.119	3.587	2.913
Octanes	0.146	0.599	8.240	3.650	3.427	3.241
Nonanes	0.024	0.112	6.353	3.190	2.590	2.777
Decanes	0.002	0.010	5.440	3.024	2.207	2.620
Undecanes	0.000	0.001	4.662	2.843	1.890	2.462
Dodecanes	0.000	0.001	4.123	2.754	1.672	2.384
Tridecanes	0.000	0.000	3.911	2.840	1.586	2.459
Tetradecanes	0.000	0.000	3.560	2.806	1.443	2.429
Pentadecanes	0.000	0.000	3.368	2.878	1.365	2.492
Hexadecanes	0.000	0.000	2.549	2.348	1.034	2.033
Heptadecanes	0.000	0.000	2.580	2.537	1.046	2.196
Octadecanes	0.000	0.000	2.241	2.333	0.909	2.020
Nonadecanes	0.000	0.000	2.342	2.556	0.950	2.213
Eicosanes	0.000	0.000	1.817	2.073	0.737	1.795
C ₂₁	0.000	0.000	1.645	1.985	0.667	1.719
C ₂₂	0.000	0.000	1.532	1.907	0.621	1.651
C ₂₃	0.000	0.000	1.382	1.788	0.560	1.548
C ₂₄	0.000	0.000	1.270	1.707	0.515	1.478
C ₂₅	0.000	0.000	1.166	1.631	0.473	1.412
C ₂₆	0.000	0.000	1.135	1.643	0.460	1.423
C ₂₇	0.000	0.000	1.065	1.590	0.432	1.377
C ₂₈	0.000	0.000	1.038	1.601	0.421	1.387
C ₂₉	0.000	0.000	1.041	1.649	0.422	1.428
C ₃₀	0.000	0.000	1.030	1.683	0.418	1.458
C ₃₁	0.000	0.000	0.991	1.661	0.402	1.438
C ₃₂	0.000	0.000	0.892	1.536	0.362	1.330
C ₃₃	0.000	0.000	0.767	1.355	0.311	1.174
C ₃₄	0.000	0.000	0.704	1.275	0.285	1.104
C ₃₅	0.000	0.000	0.664	1.226	0.269	1.062
C ₃₆₊	0.000	0.000	11.452	33.055	4.643	28.621
Sum	100.000	100.000	100.000	100.000	100.000	100.000
Mean molecular weight:	25.46		241.1		112.9	
Gas gravity:	0.879					

4.4. Constant Mass Expansion of reservoir fluid, bottle no.: 6103-MA.

Table 4.4.1 Results, CME

Bubble point pressure:	213.1	bar	
Reservoir temperature:	107	°C	
Sampling depth:	3245.5	m MD RKB	
Pressure	Relative volumes	Isothermal compressibility	Y
bar	$V_s/V_{s,BP}$	bar ⁻¹	Function
401.1	0.9703	1.338E-04	
374.0	0.9735	1.423E-04	
350.8	0.9769	1.494E-04	
332.8	P_{Res} 0.9795	1.549E-04	
326.2	0.9806	1.569E-04	
301.3	0.9848	1.644E-04	
276.5	0.9888	1.717E-04	
251.4	0.9929	1.791E-04	
226.6	0.9975	1.862E-04	
213.1	P_{BP} 1.0000	1.901E-04	
202.2	1.0147		3.675
177.1	1.0586		3.465
151.0	1.1272		3.231
126.2	1.2253		3.056
100.5	1.3938		2.845
81.7	1.6014		2.674

Best fit equation monophasic fluid above P_{BP}:

$$V_{rel} = 1.0478 - 2.584 \cdot 10^{-4} \cdot P + 1.603 \cdot 10^{-7} \cdot P^2$$

Best fit Y-function:

$$Y = 2.0100 + 8.210 \cdot 10^{-3} \cdot P$$

Constant Mass Expansion, Relative volume, refer to Figure 4.4-1

Constant Mass Expansion, Y-function, refer to Figure 4.4-2.

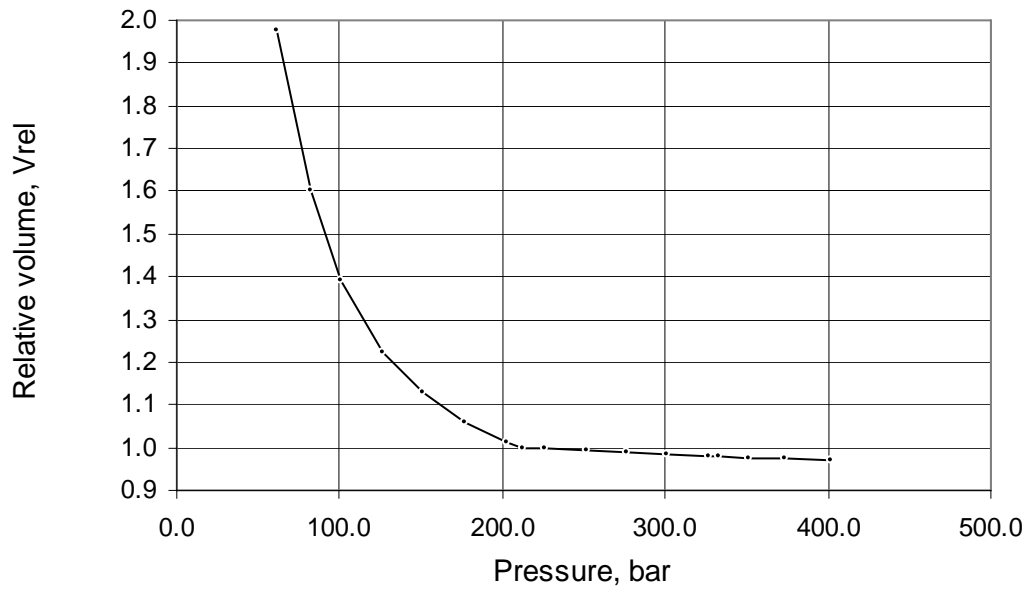


Figure 4.4-1 Constant mass expansion of reservoir fluid at reservoir temperature, 107 °C. Bubble point pressure: 213.1 bar.

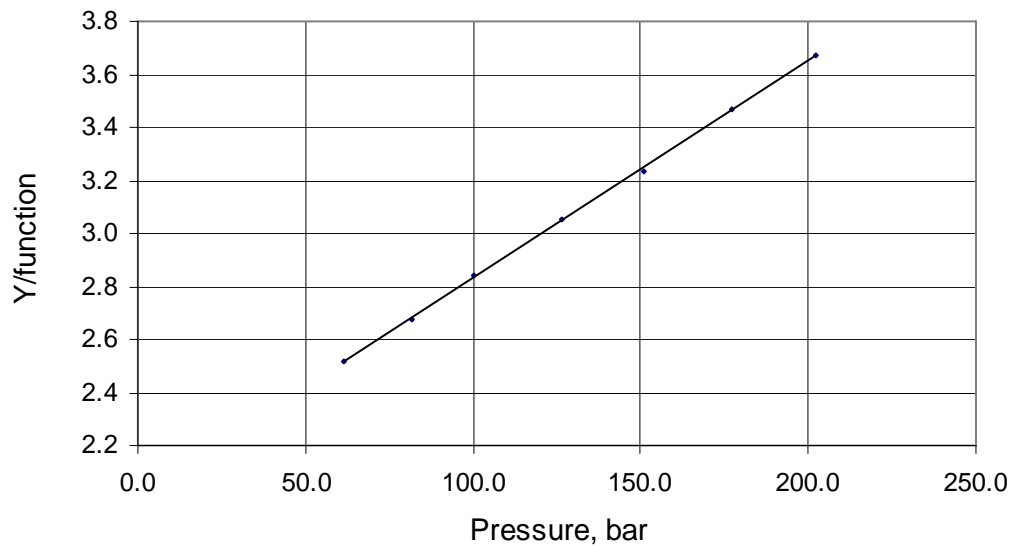


Figure 4.4-2 Constant mass expansion of reservoir fluid at reservoir temperature, 107 °C. Y-function.

4.5. Viscosity of reservoir fluid, liquid phase, bottle no.: 6130-MA.

Table 4.5.1 Results, Viscosity.

Bubble point pressure:	213.1	bar
Reservoir temperature:	107.0	°C
Viscosity at bubble point pressure:	0.606	mPas
	Pressure	Viscosity
	bar	mPas
	400.0	0.768
	374.0	0.744
	350.4	0.724
P_{Res}	332.8	0.709
	325.3	0.703
	300.3	0.682
	277.2	0.661
	251.0	0.639
	226.0	0.616
P_{BP}	213.1	0.606
	175.8	0.652
	140.0	0.711
	75.0	0.869
	34.0	1.033
	1.0	1.987

Viscosity of reservoir fluid, liquid phase, refer to Figure 4.5-1.

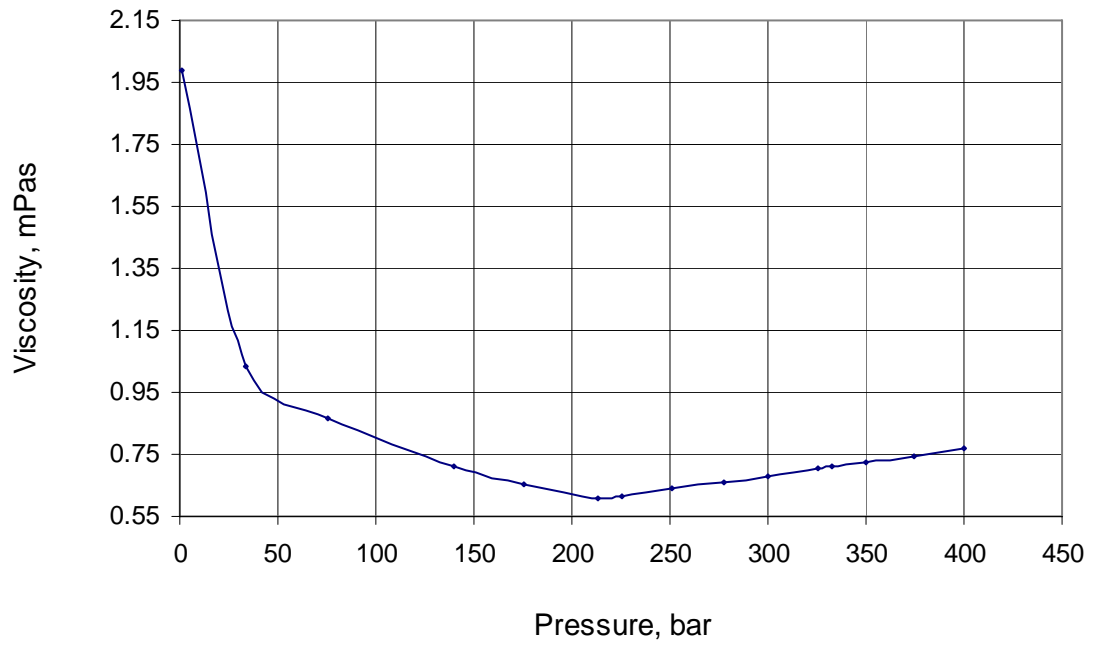


Figure 4.5-1 Viscosity of reservoir fluid, liquid phase at reservoir temperature, 107 °C.

4.6. Two stage separator test, bottle no.: 6103-MA.

Table 4.6.1 Results from two stage separator test.

Step no.	Temperature °C	Pressure bar	Gas released Sm ³ /Sm ³	Rs Sm ³ /Sm ³	Bo m ³ /Sm ³	Density of saturated fluid kg/m ³	Gas gravity
0	107.0	213.1		104.9	1.362	716.8	
1	35.0	35.0	71.6	33.3	1.137	803.6	0.713
2	15.0	atm.	33.3	0.0	1.362	868.9	1.105

Step no. 0 is the reservoir fluid at reservoir temperature and bubble point pressure.
Last step is to standard conditions.

Table 4.6.2 Two stage separator test, composition of released gases

COMPONENT	Composition of the gas				
	Mole %	Weight %	Molar Weight	Density kg/m ³	LNG m ³ /10 ⁶ m ³ gas
Nitrogen	1.032	1.401	28.02	804.0	
Carbon Dioxide	6.251	13.322	44.01	809.0	
Hydrogen Sulphide	0.000	0.000	34.08	797.0	
Methane	80.651	62.657	16.04	300.0	
Ethane	7.241	10.544	30.07	356.7	
Propane	3.274	6.991	44.09	506.7	120.5
iso-Butane	0.265	0.745	58.12	562.1	11.6
n-Butane	0.685	1.927	58.12	583.1	28.9
Neopentane	0.001	0.005	72.15	597.0	0.1
iso-Pentane	0.131	0.459	72.15	623.3	6.4
n-Pentane	0.164	0.572	72.1	629.9	7.9
Hexanes, C6 total	0.113	0.463	84.4	669.0	6.0
<i>n-Hexane</i>	0.054	0.226	86.2	662.7	3.0
<i>Iso-Paraffins</i>	0.046	0.193	86.2	660.8	2.6
<i>Naphtenes</i>	0.013	0.043	70.1	748.1	0.5
Heptanes, C7 total	0.105	0.461	90.8	739.4	5.4
<i>n-Heptane</i>	0.020	0.099	100.2	686.9	1.3
<i>iso-Paraffins</i>	0.025	0.121	100.2	691.2	1.5
<i>Naphtenes</i>	0.042	0.176	86.0	762.4	2.0
<i>Aromatics</i>	0.017	0.065	78.1	883.1	0.6
Octanes, C8 total	0.068	0.342	103.4	777.7	3.8
<i>n-Octane</i>	0.009	0.049	114.2	707.0	0.6
<i>iso-Paraffins</i>	0.009	0.051	115.2	706.1	0.6
<i>Naphtenes</i>	0.027	0.138	105.6	770.8	1.6
<i>Aromatics</i>	0.023	0.104	92.1	872.0	1.0
Nonanes, C9 total	0.017	0.098	119.7	775.2	1.1
<i>n-Nonane</i>	0.002	0.011	128.3	723.0	0.1
<i>iso-Paraffins</i>	0.005	0.034	128.3	722.0	0.4
<i>Naphtenes</i>	0.005	0.030	119.6	794.4	0.3
<i>Aromatics</i>	0.004	0.023	106.2	872.9	0.2
Decanes+, C10+	0.002	0.013	136.3	781.2	0.1
Sum	100.000	100.000			192.0
Mean molecular weight:	20.65				
Gas gravity (air=1):	0.713				

Separator test **Stage** **2**
 Pressure Atm.
 Temperature 15.0 °C

COMPONENT	Composition of the gas				
	Mole %	Weight %	Molar	Density	LNG
			Weight	kg/m ³	m ³ /10 ⁶ m ³ gas
Nitrogen	0.182	0.159	28.02	804.0	
Carbon Dioxide	6.763	9.302	44.01	809.0	
Hydrogen Sulphide	0.000	0.000	34.08	797.0	
Methane	45.075	22.600	16.04	300.0	
Ethane	16.699	15.693	30.07	356.7	
Propane	17.836	24.580	44.09	506.7	656.7
iso-Butane	2.072	3.763	58.12	562.1	90.6
n-Butane	6.267	11.383	58.12	583.1	264.3
Neopentane	0.006	0.012	72.15	597.0	0.3
iso-Pentane	1.398	3.153	72.15	623.3	68.5
n-Pentane	1.765	3.980	72.1	629.9	85.5
Hexanes, C6 total	1.003	2.637	84.1	670.1	53.3
<i>n-Hexane</i>	0.443	1.194	86.2	662.7	24.4
<i>Iso-Paraffins</i>	0.430	1.157	86.2	660.7	23.7
<i>Naphtenes</i>	0.130	0.285	70.1	748.1	5.2
Heptanes, C7 total	0.698	1.952	89.4	747.5	35.3
<i>n-Heptane</i>	0.104	0.324	100.2	686.9	6.4
<i>iso-Paraffins</i>	0.150	0.470	100.2	690.9	9.2
<i>Naphtenes</i>	0.305	0.817	85.6	761.3	14.5
<i>Aromatics</i>	0.140	0.341	78.1	883.1	5.2
Octanes, C8 total	0.206	0.673	104.5	769.6	11.8
<i>n-Octane</i>	0.022	0.079	114.2	707.0	1.5
<i>iso-Paraffins</i>	0.031	0.111	115.1	705.9	2.1
<i>Naphtenes</i>	0.105	0.343	105.1	770.8	6.0
<i>Aromatics</i>	0.049	0.140	92.1	872.0	2.2
Nonanes, C9 total	0.029	0.107	119.1	778.0	1.9
<i>n-Nonane</i>	0.002	0.007	128.3	723.0	0.1
<i>iso-Paraffins</i>	0.010	0.038	128.3	721.4	0.7
<i>Naphtenes</i>	0.009	0.035	119.1	793.8	0.6
<i>Aromatics</i>	0.008	0.026	106.2	872.6	0.4
Decanes+, C10+	0.001	0.006	135.7	783.6	0.1
Sum	100.000	100.000			1268.3
Mean molecular weight:	32.00				
Gas gravity (air=1):	1.105				

Table 4.6.3 Two stage separator test, composition of residual oil.

Component C ₁ -C ₃₆₊	Mole %	Weight %	Molecular weight	Density kg/m ³
Methane	0.087	0.006	16.04	300.0
Ethane	0.324	0.042	30.07	356.7
Propane	1.607	0.305	44.09	506.7
iso-Butane	0.504	0.126	58.12	562.1
n-Butane	2.498	0.625	58.12	583.1
Neopentane	0.032	0.010	72.15	597.0
iso-Pentane	1.433	0.445	72.15	623.3
n-Pentane	2.563	0.796	72.15	629.9
Hexanes	4.263	1.554	84.7	668
Heptanes	6.931	2.738	91.8	735
Octanes	6.879	3.159	106.7	760
Nonanes	5.290	2.756	121.0	770
Decanes	4.551	2.625	134	782
Undecanes	4.090	2.588	147	793
Dodecanes	3.852	2.670	161	804
Tridecanes	4.057	3.056	175	815
Tetradecanes	4.601	3.763	190	826
Pentadecanes	6.065	5.378	206	836
Hexadecanes	5.257	5.024	222	843
Heptadecanes	4.255	4.341	237	851
Octadecanes	3.135	3.387	251	856
Nonadecanes	2.440	2.762	263	861
Eicosanes	1.658	1.963	275	866
C ₂₁	1.450	1.816	291	871
C ₂₂	1.334	1.723	300	876
C ₂₃	1.187	1.594	312	881
C ₂₄	1.116	1.557	324	885
C ₂₅	1.022	1.483	337	888
C ₂₆	0.986	1.482	349	892
C ₂₇	0.926	1.435	360	896
C ₂₈	0.894	1.432	372	899
C ₂₉	0.914	1.503	382	902
C ₃₀	0.892	1.513	394	905
C ₃₁	0.864	1.502	404	909
C ₃₂	0.776	1.386	415	912
C ₃₃	0.681	1.249	426	915
C ₃₄	0.623	1.172	437	917
C ₃₅	0.585	1.121	445	920
C ₃₆₊	9.379	27.913	691	1012
Sum	100.000	100.000		
Mean molecular weight:			232.3	
Density, kg/m ³				868.9

4.7. Single stage separation of reservoir fluid, bottle no.: 4720-EA. Uncorrected for mud filtrate contamination.

Table 4.7.1 Results from single stage separation.

Flash conditions:	From:	107	°C, and	251.9	bar
	To:	24.0	°C, and	atm.	pressure
Bottle no:	4720-EA				

Gas oil ratio (GOR):	117.9	Sm ³ /Sm ³	1)
Oil formation volume factor at reservoir pressure:	1.360	m ³ /Sm ³	2)
Oil formation volume factor at saturation pressure:	1.387	m ³ /Sm ³	3)
Density of stock tank oil at 15 °C	872.6	kg/Sm ³	
Calculated density of oil at P _{BP}	720.9	kg/m ³	
Gas gravity:	0.879		
Mean molecular weight:	238.6		4)
Mean molecular weight, C7+:	258		4)
Density of C7+:	884	kg/Sm ³	4)
Mean molecular weight, C10+:	301		4)
Density of C10+:	899	kg/Sm ³	4)
Density by high pressure pycnometer at P _{BP}	720.5	kg/m ³	

- 1) m³ gas at standard conditions per Sm³ stock tank oil.
- 2) m³ oil at reservoir pressure per Sm³ stock tank oil.
- 3) m³ oil at bubble point pressure per Sm³ stock tank oil.
- 4) Stock tank oil.

Standard conditions: Gas: 15 °C and 1.01325 bar
 Oil: 15 °C and atmospheric pressure.

Table 4.7.2 Compositional analysis of reservoir fluid, bottle no.: 4720-EA. Uncorrected for mud filtrate contamination.

COMPONENT	Composition of the stock tank gas					Composition of the stock tank oil				Composition of recombined fluid			
	Mole %	Weight %	Molar	Density	LNG	Mole %	Weight %	Molar	Density	Mole %	Weight %	Molar	Density
			Weight	kg/m ³	m ³ /10 ³ Sm ³			Weight	kg/m ³			Weight	kg/m ³
Nitrogen	0.652	0.718	28.02	804.0						0.376	0.091	28.02	804.0
Carbon Dioxide	6.287	10.865	44.01	809.0						3.628	1.381	44.01	809.0
Hydrogen Sulphide	0.000	0.000	34.08	797.0						0.000	0.000	34.08	797.0
Methane	67.473	42.502	16.04	300.0		0.104	0.007	16.04	300.0	38.977	5.408	16.04	300.0
Ethane	9.755	11.517	30.07	356.7		0.238	0.030	30.07	356.7	5.729	1.490	30.07	356.7
Propane	8.146	14.104	44.09	506.7	299.9	0.974	0.180	44.09	506.7	5.113	1.950	44.09	506.7
iso-Butane	1.010	2.305	58.12	562.1	44.2	0.316	0.077	58.12	562.1	0.717	0.360	58.12	562.1
n-Butane	3.309	7.552	58.12	583.1	139.6	1.650	0.402	58.12	583.1	2.608	1.311	58.12	583.1
Neopentane	0.002	0.005	72.15	597.0	0.1	0.003	0.001	72.15	597.0	0.002	0.002	72.15	597.0
iso-Pentane	0.851	2.411	72.15	623.3	41.7	1.118	0.338	72.15	623.3	0.964	0.602	72.15	623.3
n-Pentane	1.137	3.220	72.15	629.9	55.1	2.103	0.636	72.15	629.9	1.546	0.964	72.15	629.9
Hexanes, C6 total	0.701	2.317	84.1	669.9	37.3	3.992	1.418	84.8	667.6	2.093	1.532	84.6	668.1
<i>n-Hexane</i>	0.312	1.055	86.2	662.7		2.007	0.725	86.2	662.7	1.029	0.767	86.2	662.7
<i>iso-Paraffins</i>	0.300	1.016	86.2	660.7		1.631	0.589	86.2	661.1	0.863	0.643	86.2	661.0
<i>Naphtenes</i>	0.089	0.246	70.1	748.1		0.354	0.104	70.1	748.1	0.201	0.122	70.1	748.1
Heptanes, C7 total	0.510	1.794	89.5	746.7	25.9	6.885	2.651	91.9	735.0	3.207	2.542	91.7	736.0
<i>n-Heptane</i>	0.076	0.299	100.2	686.9		1.719	0.722	100.2	686.9	0.771	0.668	100.2	686.9
<i>iso-Paraffins</i>	0.111	0.438	100.2	691.0		1.681	0.706	100.2	691.6	0.775	0.672	100.2	691.5
<i>Naphtenes</i>	0.224	0.753	85.6	761.4		2.333	0.846	86.5	763.6	1.116	0.834	86.4	763.3
<i>Aromatics</i>	0.099	0.303	78.1	883.1		1.152	0.377	78.1	883.1	0.544	0.368	78.1	883.1
Octanes, C8 total	0.148	0.606	104.6	768.5	8.5	7.035	3.149	106.8	757.0	3.061	2.826	106.7	757.3
<i>n-Octane</i>	0.015	0.068	114.2	707.0		1.337	0.640	114.2	707.0	0.574	0.567	114.2	707.0
<i>iso-Paraffins</i>	0.022	0.101	115.1	705.9		1.568	0.757	115.2	707.7	0.676	0.674	115.2	707.6
<i>Naphtenes</i>	0.078	0.320	104.9	770.8		2.646	1.179	106.3	771.6	1.164	1.070	106.3	771.6
<i>Aromatics</i>	0.032	0.117	92.1	872.0		1.484	0.573	92.1	872.0	0.646	0.515	92.1	872.0
Nonanes, C9 total	0.017	0.080	118.7	779.0	1.1	5.446	2.762	121.0	770.3	2.313	2.421	121.0	770.3
<i>n-Nonane</i>	0.001	0.004	128.3	723.0		1.161	0.624	128.3	723.0	0.492	0.545	128.3	723.0
<i>iso-Paraffins</i>	0.005	0.027	128.3	720.5		1.504	0.809	128.4	722.6	0.639	0.710	128.4	722.6
<i>Naphtenes</i>	0.006	0.028	118.3	792.7		1.447	0.735	121.2	795.9	0.615	0.645	121.2	795.9
<i>Aromatics</i>	0.005	0.019	106.2	872.3		1.335	0.594	106.2	874.0	0.567	0.521	106.2	873.9
Decanes plus, C10+	0.001	0.004	142	788	0.0	70.135	88.349	301	899	29.666	77.120	301	899
Sum	100.000	100.000			653.4	100.000	100.000			100.000	100.000		
Mean molecular weight:			25.47					238.6				115.6	
Gas gravity:			0.879										

Table 4.7.3 Composition analysis of stock tank oil, C₃₆₊, bottle no.: 4720-EA. Uncorrected for mud filtrate contamination.

Component C ₁ - C ₃₆₊	Mole %	Weight %	Molecular weight	Density kg/m ³
Methane	0.104	0.007	16.04	300.0
Ethane	0.238	0.030	30.07	356.7
Propane	0.974	0.180	44.09	506.7
iso-Butane	0.316	0.077	58.12	562.1
n-Butane	1.650	0.402	58.12	583.1
Neopentane	0.003	0.001	72.15	597.0
iso-Pentane	1.118	0.338	72.15	623.3
n-Pentane	2.103	0.636	72.15	629.9
Hexanes	3.992	1.418	84.8	667.6
Heptanes	6.885	2.651	91.9	735.0
Octanes	7.035	3.149	106.8	757.0
Nonanes	5.446	2.762	121.0	770.3
Decanes	4.687	2.632	134	782
Undecanes	4.193	2.583	147	793
Dodecanes	3.992	2.694	161	804
Tridecanes	4.194	3.076	175	815
Tetradecanes	4.840	3.854	190	826
Pentadecanes	6.555	5.659	206	836
Hexadecanes	5.651	5.258	222	843
Heptadecanes	4.602	4.571	237	851
Octadecanes	3.252	3.421	251	856
Nonadecanes	2.490	2.745	263	861
Eicosanes	1.684	1.941	275	866
C ₂₁	1.480	1.805	291	871
C ₂₂	1.340	1.685	300	876
C ₂₃	1.203	1.573	312	881
C ₂₄	1.119	1.519	324	885
C ₂₅	1.034	1.460	337	888
C ₂₆	0.989	1.446	349	892
C ₂₇	0.929	1.401	360	896
C ₂₈	0.901	1.404	372	899
C ₂₉	0.898	1.437	382	902
C ₃₀	0.884	1.460	394	905
C ₃₁	0.850	1.440	404	909
C ₃₂	0.768	1.335	415	912
C ₃₃	0.665	1.188	426	915
C ₃₄	0.607	1.111	437	917
C ₃₅	0.565	1.054	445	920
C ₃₆₊	9.766	28.597	699	1012
Sum	100.000	100.000		
Mean molecular weight:			238.6	
Density, kg/m ³ :				872.6

**Table 4.7.4 Composition analyses of reservoir fluid, C36+, bottle no.: 4720-EA.
Uncorrected for mud filtrate contamination.**

COMPONENT	Stock tank gas		Stock tank oil		Reservoir fluid	
	Mole %	Weight %	Mole %	Weight %	Mole %	Weight %
Nitrogen	0.652	0.718	0.000	0.000	0.376	0.091
Carbon dioxide	6.287	10.865	0.000	0.000	3.628	1.381
Hydrogen Sulphide	0.000	0.000	0.000	0.000	0.000	0.000
Methane	67.473	42.502	0.104	0.007	38.977	5.408
Ethane	9.755	11.517	0.238	0.030	5.729	1.490
Propane	8.146	14.104	0.974	0.180	5.113	1.950
iso-Butane	1.010	2.305	0.316	0.077	0.717	0.360
n-Butane	3.309	7.552	1.650	0.402	2.608	1.311
Neopentane	0.002	0.005	0.003	0.001	0.002	0.002
iso-Pentane	0.851	2.411	1.118	0.338	0.964	0.602
n-Pentane	1.137	3.220	2.103	0.636	1.546	0.964
Hexanes	0.701	2.317	3.992	1.418	2.093	1.532
Heptanes	0.510	1.794	6.885	2.651	3.207	2.542
Octanes	0.148	0.606	7.035	3.149	3.061	2.826
Nonanes	0.017	0.080	5.446	2.762	2.313	2.421
Decanes	0.000	0.002	4.687	2.632	1.983	2.298
Undecanes	0.000	0.000	4.193	2.583	1.773	2.255
Dodecanes	0.000	0.001	3.992	2.694	1.689	2.352
Tridecanes	0.000	0.000	4.194	3.076	1.774	2.685
Tetradecanes	0.000	0.000	4.840	3.854	2.047	3.364
Pentadecanes	0.000	0.000	6.555	5.659	2.772	4.940
Hexadecanes	0.000	0.000	5.651	5.258	2.390	4.590
Heptadecanes	0.000	0.000	4.602	4.571	1.947	3.990
Octadecanes	0.000	0.000	3.252	3.421	1.376	2.986
Nonadecanes	0.000	0.000	2.490	2.745	1.053	2.396
Eicosanes	0.000	0.000	1.684	1.941	0.712	1.694
C ₂₁	0.000	0.000	1.480	1.805	0.626	1.576
C ₂₂	0.000	0.000	1.340	1.685	0.567	1.471
C ₂₃	0.000	0.000	1.203	1.573	0.509	1.373
C ₂₄	0.000	0.000	1.119	1.519	0.473	1.326
C ₂₅	0.000	0.000	1.034	1.460	0.437	1.274
C ₂₆	0.000	0.000	0.989	1.446	0.418	1.262
C ₂₇	0.000	0.000	0.929	1.401	0.393	1.223
C ₂₈	0.000	0.000	0.901	1.404	0.381	1.226
C ₂₉	0.000	0.000	0.898	1.437	0.380	1.254
C ₃₀	0.000	0.000	0.884	1.460	0.374	1.274
C ₃₁	0.000	0.000	0.850	1.440	0.360	1.257
C ₃₂	0.000	0.000	0.768	1.335	0.325	1.165
C ₃₃	0.000	0.000	0.665	1.188	0.281	1.037
C ₃₄	0.000	0.000	0.607	1.111	0.257	0.970
C ₃₅	0.000	0.000	0.565	1.054	0.239	0.920
C ₃₆₊	0.000	0.000	9.766	28.597	4.131	24.962
Sum	100.000	100.000	100.000	100.000	100.000	100.000
Mean molecular weight:	25.47		238.6		115.6	
Gas gravity:	0.879					

Table 4.7.5 Results, Single stage separation, corrected for mud filtrate contamination, bottle no.: 4720-EA.

Flash conditions:	From:	107	°C, and	251.9	bar
	To:	24.0	°C, and	atm. pressure	
Bottle no:	4720-EA				

Gas oil ratio (GOR):	137.6	Sm ³ /Sm ³	1)
Density of stock tank oil at 15 °C	880.8	kg/Sm ³	
Gas gravity:	0.879		
Mean molecular weight:	242.5		4)
Mean molecular weight, C7+:	267		4)
Density of C7+:	895	kg/Sm ³	4)
Mean molecular weight, C10+:	323		4)
Density of C10+:	914	kg/Sm ³	4)

- 1) m³ gas at standard conditions per Sm³ stock tank oil.
- 2) m³ oil at reservoir pressure per Sm³ stock tank oil.
- 3) m³ oil at bubble point pressure per Sm³ stock tank oil.
- 4) Stock tank oil.

Standard conditions: Gas: 15 °C and 1.01325 bar
 Oil: 15 °C and atmospheric pressure.

Table 4.7.6 Compositional analysis of reservoir fluid, bottle no.: 4720-EA. Corrected for mud filtrate contamination.

COMPONENT	Composition of the stock tank gas					Composition of the stock tank oil				Composition of recombined fluid			
	Mole %	Weight %	Molar Weight	Density kg/m ³	LNG m ³ /10 ³ Sm ³	Mole %	Weight %	Molar Weight	Density kg/m ³	Mole %	Weight %	Molar Weight	Density kg/m ³
Nitrogen	0.652	0.718	28.02	804.0						0.402	0.103	28.02	804.0
Carbon Dioxide	6.287	10.865	44.01	809.0						3.871	1.565	44.01	809.0
Hydrogen Sulphide	0.000	0.000	34.08	797.0						0.000	0.000	34.08	797.0
Methane	67.473	42.502	16.04	300.0		0.122	0.008	16.04	300.0	41.596	6.131	16.04	300.0
Ethane	9.755	11.517	30.07	356.7		0.280	0.035	30.07	356.7	6.114	1.689	30.07	356.7
Propane	8.146	14.104	44.09	506.7	299.9	1.144	0.208	44.09	506.7	5.456	2.210	44.09	506.7
iso-Butane	1.010	2.305	58.12	562.1	44.2	0.371	0.089	58.12	562.1	0.765	0.408	58.12	562.1
n-Butane	3.309	7.552	58.12	583.1	139.6	1.939	0.465	58.12	583.1	2.783	1.486	58.12	583.1
Neopentane	0.002	0.005	72.15	597.0	0.1	0.004	0.001	72.15	597.0	0.003	0.002	72.15	597.0
iso-Pentane	0.851	2.411	72.15	623.3	41.7	1.313	0.391	72.15	623.3	1.029	0.682	72.15	623.3
n-Pentane	1.137	3.220	72.15	629.9	55.1	2.471	0.735	72.15	629.9	1.649	1.093	72.15	629.9
Hexanes, C6 total	0.701	2.317	84.1	669.9	37.3	4.690	1.639	84.8	667.6	2.234	1.737	84.6	668.1
<i>n</i> -Hexane	0.312	1.055	86.2	662.7		2.358	0.838	86.2	662.7	1.098	0.869	86.2	662.7
iso-Paraffins	0.300	1.016	86.2	660.7		1.916	0.681	86.2	661.1	0.921	0.729	86.2	661.0
Naphtenes	0.089	0.246	70.1	748.1		0.416	0.120	70.1	748.1	0.215	0.138	70.1	748.1
Heptanes, C7 total	0.510	1.794	89.5	746.7	25.9	8.088	3.065	91.9	735.0	3.422	2.882	91.7	736.0
<i>n</i> -Heptane	0.076	0.299	100.2	686.9		2.020	0.835	100.2	686.9	0.823	0.758	100.2	686.9
iso-Paraffins	0.111	0.438	100.2	691.0		1.975	0.816	100.2	691.6	0.827	0.762	100.2	691.5
Naphtenes	0.224	0.753	85.6	761.4		2.740	0.978	86.5	763.6	1.191	0.946	86.4	763.3
Aromatics	0.099	0.303	78.1	883.1		1.353	0.436	78.1	883.1	0.581	0.417	78.1	883.1
Octanes, C8 total	0.148	0.606	104.6	768.5	8.5	8.265	3.640	106.8	757.0	3.266	3.203	106.7	757.3
<i>n</i> -Octane	0.015	0.068	114.2	707.0		1.571	0.740	114.2	707.0	0.613	0.643	114.2	707.0
iso-Paraffins	0.022	0.101	115.1	705.9		1.842	0.875	115.2	707.7	0.722	0.764	115.2	707.6
Naphtenes	0.078	0.320	104.9	770.8		3.109	1.363	106.3	771.6	1.242	1.213	106.3	771.6
Aromatics	0.032	0.117	92.1	872.0		1.743	0.662	92.1	872.0	0.690	0.584	92.1	872.0
Nonanes, C9 total	0.017	0.080	118.7	779.0	1.1	6.398	3.193	121.0	770.3	2.469	2.744	121.0	770.3
<i>n</i> -Nonane	0.001	0.004	128.3	723.0		1.364	0.721	128.3	723.0	0.525	0.618	128.3	723.0
iso-Paraffins	0.005	0.027	128.3	720.5		1.766	0.935	128.4	722.6	0.682	0.804	128.4	722.6
Naphtenes	0.006	0.028	118.3	792.7		1.700	0.850	121.2	795.9	0.657	0.731	121.2	795.9
Aromatics	0.005	0.019	106.2	872.3		1.568	0.687	106.2	874.0	0.605	0.591	106.2	873.9
Decanes plus, C10+	0.001	0.004	142	788	0.0	64.914	86.531	323	914	24.942	74.064	323	914
Sum	100.000	100.000			653.4	100.000	100.000			100.000	100.000		
Mean molecular weight:			25.47					242.5				108.8	
Gas gravity:			0.879										

Table 4.7.7 Composition analysis of stock tank oil, C₃₆₊, bottle no.: 4720-EA. Corrected for mud filtrate contamination.

Component C ₁ - C ₃₆₊	Mole %	Weight %	Molecular weight	Density kg/m ³
Methane	0.122	0.008	16.04	300.0
Ethane	0.280	0.035	30.07	356.7
Propane	1.144	0.208	44.09	506.7
iso-Butane	0.371	0.089	58.12	562.1
n-Butane	1.939	0.465	58.12	583.1
Neopentane	0.004	0.001	72.15	597.0
iso-Pentane	1.313	0.391	72.15	623.3
n-Pentane	2.471	0.735	72.15	629.9
Hexanes	4.690	1.639	84.8	667.6
Heptanes	8.088	3.065	91.9	735.0
Octanes	8.265	3.640	106.8	757.0
Nonanes	6.398	3.193	121.0	770.3
Decanes	5.484	3.030	134	771
Undecanes	4.713	2.857	147	780
Dodecanes	4.169	2.768	161	804
Tridecanes	3.956	2.855	175	815
Tetradecanes	3.607	2.826	190	826
Pentadecanes	3.415	2.901	206	836
Hexadecanes	2.587	2.368	222	843
Heptadecanes	2.603	2.545	237	851
Octadecanes	2.253	2.333	251	856
Nonadecanes	2.346	2.544	263	861
Eicosanes	1.838	2.084	275	866
C ₂₁	1.656	1.987	291	871
C ₂₂	1.544	1.910	300	876
C ₂₃	1.392	1.791	312	881
C ₂₄	1.290	1.723	324	885
C ₂₅	1.192	1.656	337	888
C ₂₆	1.152	1.658	349	892
C ₂₇	1.082	1.607	360	896
C ₂₈	1.050	1.611	372	899
C ₂₉	1.048	1.651	382	902
C ₃₀	1.039	1.688	394	905
C ₃₁	0.999	1.665	404	909
C ₃₂	0.902	1.543	415	912
C ₃₃	0.782	1.373	426	915
C ₃₄	0.713	1.284	437	917
C ₃₅	0.664	1.218	445	920
C ₃₆₊	11.442	33.053	700	1028
Sum	100.000	100.000		
Mean molecular weight:			242.5	
Density, kg/m ³ :				880.8

**Table 4.7.8 Composition analyses of reservoir fluid, C36+, bottle no.: 4720-EA.
Corrected for mud filtrate contamination.**

COMPONENT	Stock tank gas		Stock tank oil		Reservoir fluid	
	Mole %	Weight %	Mole %	Weight %	Mole %	Weight %
Nitrogen	0.652	0.718	0.000	0.000	0.402	0.103
Carbon dioxide	6.287	10.865	0.000	0.000	3.871	1.565
Hydrogen Sulphide	0.000	0.000	0.000	0.000	0.000	0.000
Methane	67.473	42.502	0.122	0.008	41.596	6.131
Ethane	9.755	11.517	0.280	0.035	6.114	1.689
Propane	8.146	14.104	1.144	0.208	5.456	2.210
iso-Butane	1.010	2.305	0.371	0.089	0.765	0.408
n-Butane	3.309	7.552	1.939	0.465	2.783	1.486
Neopentane	0.002	0.005	0.004	0.001	0.003	0.002
iso-Pentane	0.851	2.411	1.313	0.391	1.029	0.682
n-Pentane	1.137	3.220	2.471	0.735	1.649	1.093
Hexanes	0.701	2.317	4.690	1.639	2.234	1.737
Heptanes	0.510	1.794	8.088	3.065	3.422	2.882
Octanes	0.148	0.606	8.265	3.640	3.266	3.203
Nonanes	0.017	0.080	6.398	3.193	2.469	2.744
Decanes	0.000	0.002	5.484	3.030	2.107	2.594
Undecanes	0.000	0.000	4.713	2.857	1.811	2.446
Dodecanes	0.000	0.001	4.169	2.768	1.602	2.369
Tridecanes	0.000	0.000	3.956	2.855	1.520	2.444
Tetradecanes	0.000	0.000	3.607	2.826	1.386	2.419
Pentadecanes	0.000	0.000	3.415	2.901	1.312	2.483
Hexadecanes	0.000	0.000	2.587	2.368	0.994	2.027
Heptadecanes	0.000	0.000	2.603	2.545	1.000	2.178
Octadecanes	0.000	0.000	2.253	2.333	0.866	1.997
Nonadecanes	0.000	0.000	2.346	2.544	0.901	2.178
Eicosanes	0.000	0.000	1.838	2.084	0.706	1.784
C ₂₁	0.000	0.000	1.656	1.987	0.636	1.701
C ₂₂	0.000	0.000	1.544	1.910	0.593	1.635
C ₂₃	0.000	0.000	1.392	1.791	0.535	1.533
C ₂₄	0.000	0.000	1.290	1.723	0.495	1.475
C ₂₅	0.000	0.000	1.192	1.656	0.458	1.418
C ₂₆	0.000	0.000	1.152	1.658	0.443	1.419
C ₂₇	0.000	0.000	1.082	1.607	0.416	1.375
C ₂₈	0.000	0.000	1.050	1.611	0.403	1.379
C ₂₉	0.000	0.000	1.048	1.651	0.403	1.413
C ₃₀	0.000	0.000	1.039	1.688	0.399	1.445
C ₃₁	0.000	0.000	0.999	1.665	0.384	1.425
C ₃₂	0.000	0.000	0.902	1.543	0.346	1.321
C ₃₃	0.000	0.000	0.782	1.373	0.300	1.176
C ₃₄	0.000	0.000	0.713	1.284	0.274	1.099
C ₃₅	0.000	0.000	0.664	1.218	0.255	1.043
C ₃₆₊	0.000	0.000	11.442	33.053	4.396	28.290
Sum	100.000	100.000	100.000	100.000	100.000	100.000
Mean molecular weight:	25.47		242.5		108.9	
Gas gravity:	0.879					

4.8. Constant Mass Expansion of reservoir fluid, bottle no.: 4720-EA.

Table 4.8.1 Results, CME

Bubble point pressure:		215.4	bar	
Reservoir temperature:		107	°C	
Sampling depth:		3245.5	m MD RKB	
Pressure	Relative volumes	Isothermal compressibility		Y
bar	$V_s/V_{s,BP}$	bar ⁻¹		Function
398.8	0.9714	1.371E-04		
375.4	0.9744	1.427E-04		
346.2	0.9788	1.497E-04		
332.8	P_{Res}	0.9807	1.528E-04	
326.2	0.9818	1.544E-04		
299.8	0.9858	1.605E-04		
276.9	0.9894	1.658E-04		
250.2	0.9936	1.719E-04		
227.1	0.9982	1.771E-04		
215.4	P_{BP}	1.0000	1.797E-04	
198.3	1.0238			3.625
176.5	1.0636			3.462
152.3	1.1268			3.266
127.0	1.2265			3.073
102.0	1.3891			2.856
76.7	1.6832			2.647

Best fit equation monophasic fluid above P_{BP}:

$$V_{rel} = 1.0446 - 2.343 \cdot 10^{-4} \cdot P + 1.269 \cdot 10^{-7} \cdot P^2$$

Best fit Y-function:

$$Y = 2.0362 + 8.060 \cdot 10^{-3} \cdot P$$

Constant Mass Expansion, Relative volume, refer to Figure 4.8-1
 Constant Mass Expansion, Y-function, refer to Figure 4.8-2.

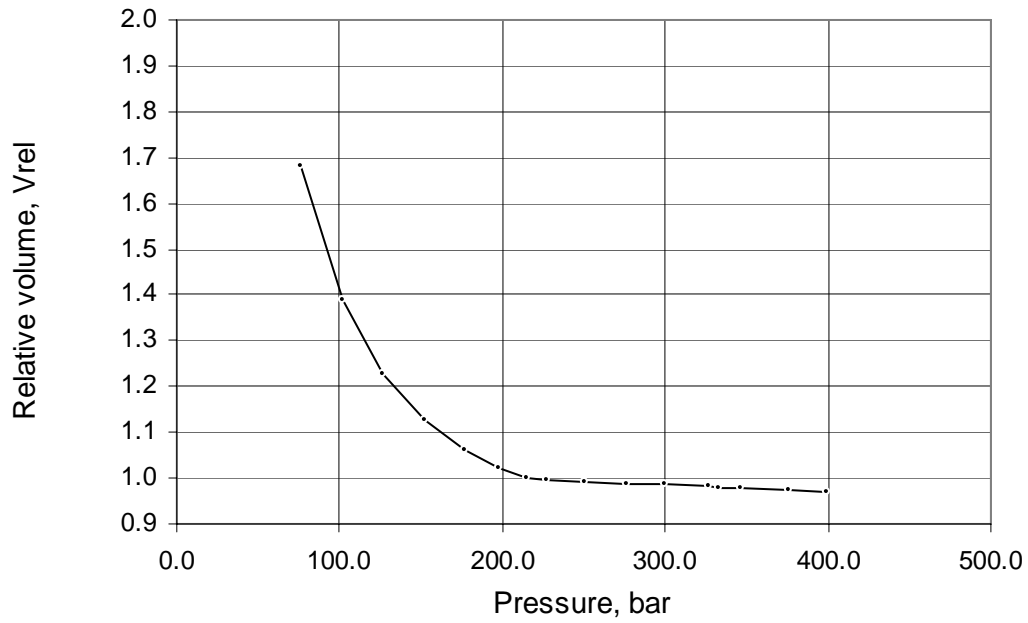


Figure 4.8-1 Constant mass expansion of reservoir fluid at reservoir temperature, 107 °C. Bubble point pressure: 215.4 bar.

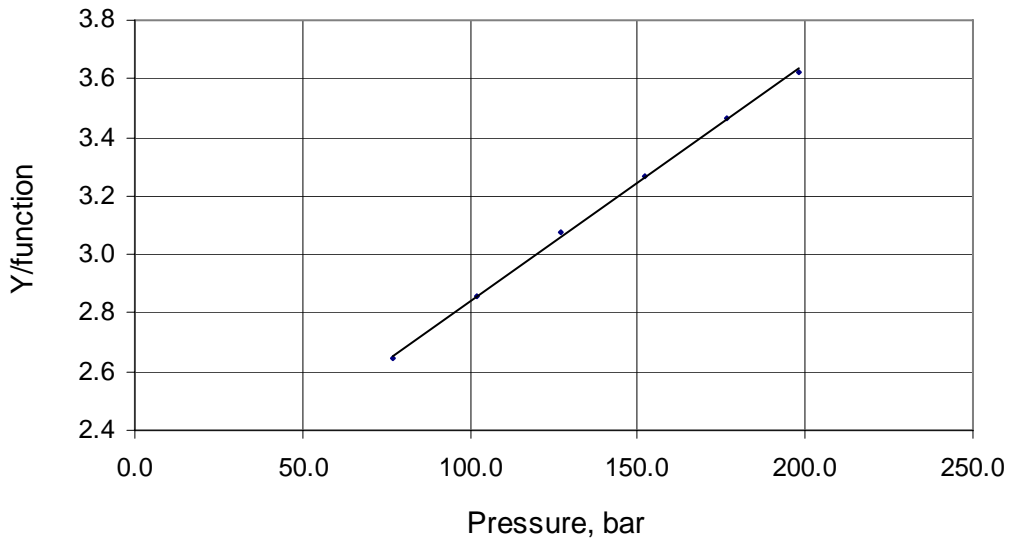


Figure 4.8-2 Constant mass expansion of reservoir fluid at reservoir temperature, 107 °C. Y-function.

4.9. Chromatograms

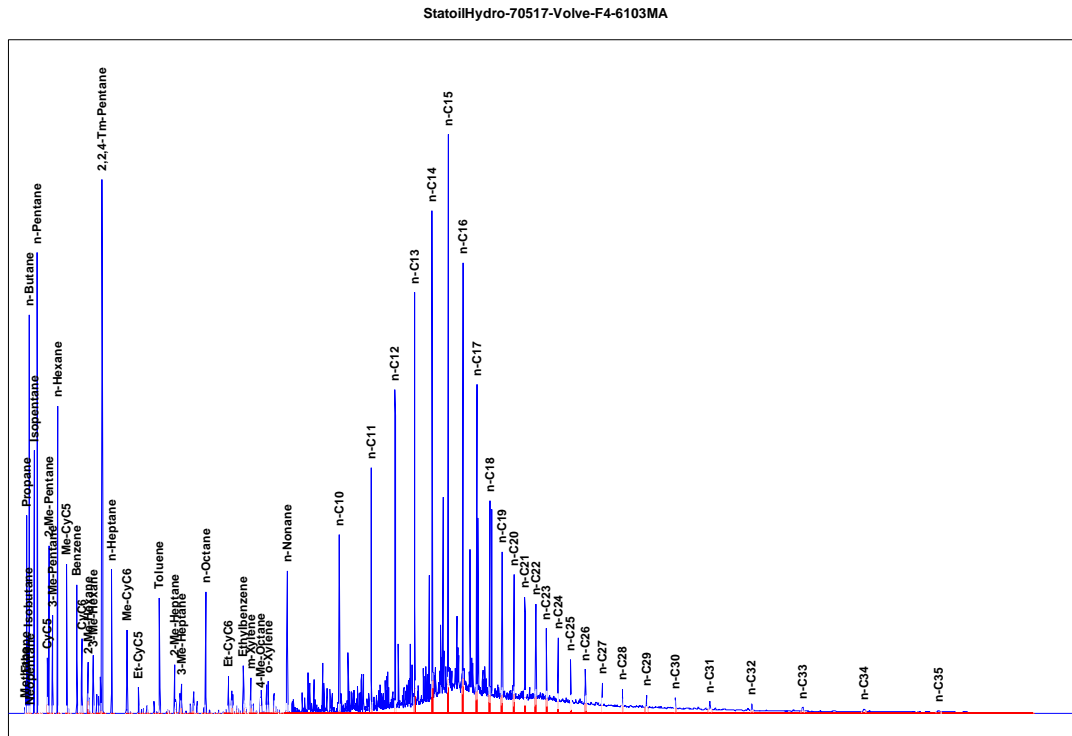


Figure 4.9-1 Chromatogram of oil from bottle no.: 6103-MA

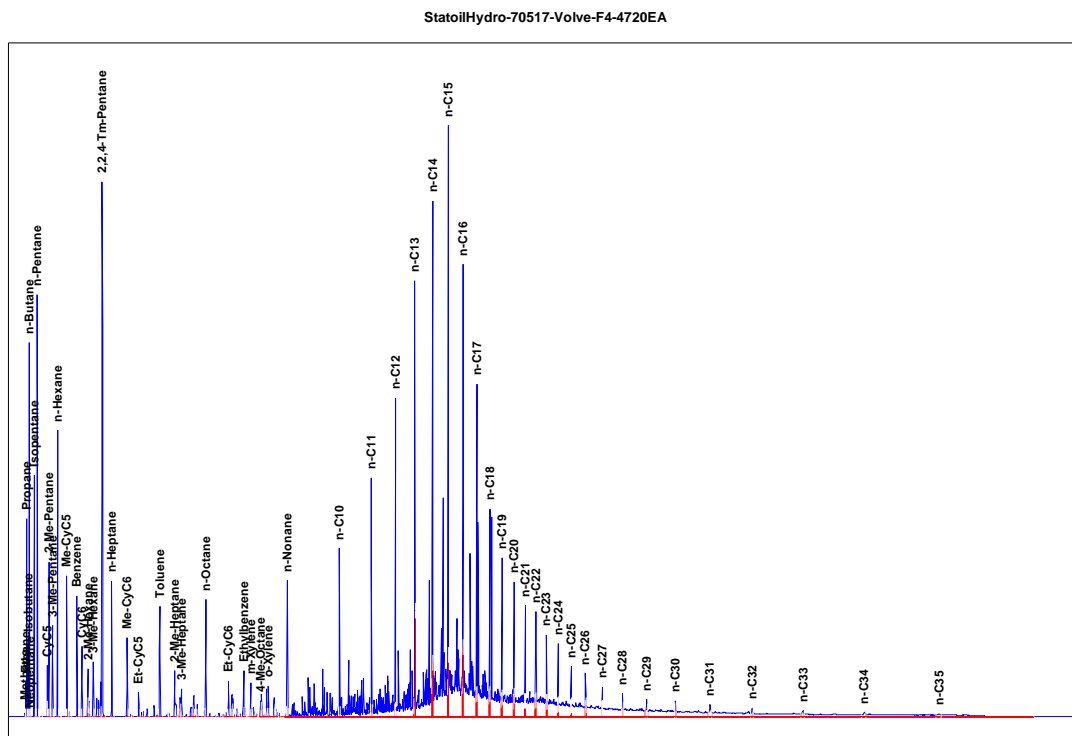


Figure 4.9-2 Chromatogram of oil from bottle no.: 4720-EA

5. SUMMARY AND CONCLUSIONS

This report contains the results from the PVT analyses of the reservoir fluid from well 15/9-F-4 Four MDT samples, two water and two oil samples were supplied by StatoilHydro for analyses.

A quality check was performed on oil samples by determination of the bubble point pressure at reservoir temperature and single stage separation including composition analyses and determination of mud filtrate contamination. The mud filtrate contamination was determined by subtraction of the actual fractions in the oil after performing composition analysis of the mud filtrate.

The following contamination levels were determined:

- Bottle 4720-EA, 13.5 weight %
- Bottle 6103-MA, 12.5 weight %

StatoilHydro evaluated the results from the quality check, and decided to perform more PVT analyses on sample with the lowest contamination.

The following PVT analyses were performed on the reservoir fluid:

- Single Stage Separation
- Constant Mass Expansion
- Viscosity at reservoir temperature from above P_{Res} to atmospheric pressure
- Two stage separator test

Main results from the PVT analyses:

Constant mass expansion:

Bottle no.	Reservoir temperature °C	P_{BP} bar	Isothermal compressibility bar ⁻¹	Viscosity at P_{BP} mPas
6103-MA	107	213.1	1.901E-04	0.606

Single stage separation, measured values:

Bottle no.	GOR Sm ³ /Sm ³	B_o at P_{BP} m ³ /Sm ³	Density of stock tank oil kg/m ³	Molecular weight	Measured density at P_{BP}	Gas gravity	OBM contamination Wt% in STO
6103-MA	109.8	1.382	872.5	237.6	720.5	0.879	12.5

Two stage separation:

Bottle no.	GOR/Rs Sm ³ /Sm ³	B_o at P_{BP} m ³ /Sm ³	Density of stock tank oil kg/m ³	Molecular weight	Calculated density at P_{BP} kg/m ³
6103-MA	104.9	1.362	868.9	232.3	716.8

6. NOMENCLATURE

Description	Symbol	Unit
Temperature	t	°C
Abs. temperature	T	K
Volume	V	m ³
Pressure, PVT calculations& tables	P	bar (absolute)
Pressure, gauge displays	P	barg (gauge)
Density		kg/ m ³ or °API
Gas gravity		-
Isothermal compressibility		MPa abs ⁻¹
Viscosity		mPa ·s
Thermal expansion		°C ⁻¹
Heating Value		kJ/Sm ³
P _{BP} :	Bubble point pressure (saturation pressure)	MPa abs
Bo :	Oil formation volume factor	
	Volume of reservoir fluid at P and t/Volume of stock tank oil (STO)	(m ³ /Sm ³)
GOR :	Gas oil ratio	
	Standard volume of gas/volume of STO (Sm ³ /m ³), (Sm ³ /Sm ³)	
Viscosity:	Expressing the resistance to internal movement of a gas or liquid, measured in mPas (miliPascal second) or cP (centi Poise).	
GCR :	Gas condensate ratio	
	Standard volume of gas/volume of stock tank condensate (Sm ³ /m ³), (Sm ³ /Sm ³)	
LNG :	Liquefied natural gas	
	Calculated liquid volume of the gas component as liquid (m ³ liquid/10 ⁶ Sm ³ gas)	
PNA :	Paraffins, Naphtenes, Aromatics	
Rs :	Solution gas oil ratio	
	Gas in solution at P and t /volume of stock tank oil (Sm ³ /m ³ STO)	
Bg :	Gas formation volume factor	
	Volume of gas at P and t/Volume of the same gas at standard conditions (m ³ /Sm ³)	
Bt :	Total volume factor. Volume of oil and liberated gas at P and t (from PV-relations/volume of STO (m ³ /Sm ³))	

APPENDICES

Appendix 1: General Experimental Methods

PVT analysis.

Constant mass expansion, differential liberation and the determination of the saturation pressure are determined in a Jefry PVT cell. The cell is a piston glass cell with confining pressure equal to the cell pressure. The sample volume is determined with a cathetometer.

The gas is separated and the gas oil ratio is determined with a GOR equipment from DB Robinson. The gas is circulating through the system until equilibrium. Gas sample for composition analysis is collected in a 75 cc Whitey steel cylinder.

Gas composition analysis.

Gas analysis is carried out in a Chrompack Natural Gas Analyser, Chrompack CP-9001 GC. The gas is injected in two different gas loops. One loop is for the light end separating Oxygen, Nitrogen, Methane, Ethane, Carbon Dioxide and Hydrogen Sulphide. These components are separated in packed columns. The detector is a TCD.

The heavy end from Propane and higher is separated in a fused silica capillary column. PONA. The detector is a FID and the detection temperature is 175 °C

Carrier gas: Helium

Columns:

Packed columns: HAYESEP Q. HAYESEP T AND MOLESIEVE 13X.

Capillary column: PONA. 50 m. ID 0.21 µm

Oil composition analysis.

Oil analysis is carried out in a Agilent ASTM D-5134 Analyzer. Agilent 6890 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: Hydrogen

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.

The density at higher pressure is determined with a high-pressure pycnometer.

Molecular weight.

The number average Molecular weight of oil is determined by cryoscopy. freezing point depression in benzene.

The instrument is Reobling Kryometer.

Appendix 2: Sample sheets

Client: StatoilHydro ASA
Job No: 08.002.02
Date: 17 to 29 February 2008

Well: 15/9-F-4
Field: Volve
Rig: Maersk Inspirer

Schlumberger

MDT Sample Data Sheet

IDENTIFICATION

Sample No:	1.01	Sample Nature:	Bottomhole Sample
Bottle No:	4720 - EA	Formation:	Volve
Sampling Date:	19-Feb-08	MDT Run No:	1A
Sampling Time	2:00	Chamber S/N:	MPSR-2824
Sampling Point:	3230 m		

SHIPPING CONDITIONS

Sample Bottle Type:	CSB	Gas Cap Created:	40 cc
Sample Bottle Volume:	700 cc	Fluid Remaining:	260 cc water / glycol
Sample Volume:	400 cc	Final Pressure:	116.91 @ 10 c

TRANSFER CONDITIONS

Initial Pressure:	116.92 @ 8 c	Transfer Duration:	20 min
Transfer Pressure:	412.65 @ 80 c	Apparent Bubble Point:	N/A

SAMPLING CONDITIONS

Formation Pressure:	327.83
Formation Temp:	105.6
At depth:	3230 m
Maximum Drawdown:	272.65
Pump out Time:	11130 sec
Pump out Volume:	43 ltr

REMARKS

Unit of measurement: Pressure = bar, Temperature = degree celsius, Depth = metre MDRKB.
 OCM contamination prediction : 13.5-14%
 Sampling conditions data supplied by Schlumberger Wireline.

Client: StatoilHydro ASA
Job No: 08.002.02
Date: 17 to 29 February 2008

Well: 15/9-F-4
Field: Volve
Rig: Maersk Inspirer

Schlumberger

MDT Sample Data Sheet

IDENTIFICATION

Sample No:	1.02	Sample Nature:	Bottomhole Sample
Bottle No:	6103-MA	Formation:	Volve
Sampling Date:	19-Feb-08	MDT Run No:	1A
Sampling Time	2:20	Chamber S/N:	MPSR-3011
Sampling Point:	3230 m		

SHIPPING CONDITIONS

Sample Bottle Type:	CSB	Gas Cap Created:	40 cc
Sample Bottle Volume:	700 cc	Fluid Remaining:	365 cc water/glycol
Sample Volume:	395 cc	Final Pressure:	113.48 @ 10 c

TRANSFER CONDITIONS

Initial Pressure:	110.04 @ 8 C	Transfer Duration:	20 min
Transfer Pressure:	412.65 @ 80 C	Apparent Bubble Point:	N/A

SAMPLING CONDITIONS

Formation Pressure:	327.83
Formation Temp:	105.6
At depth:	3230 m
Maximum Drawdown:	272.65
Pump out Time:	12334 sec
Pump out Volume:	48 ltr

REMARKS

Unit of measurement: Pressure = bar, Temperature = degree celsius, Depth = metre MDRKB.
 OCM contamination prediction : 13.5-14%
 Sampling conditions data supplied by Schlumberger Wireline.

Client: StatoilHydro ASA
Job No: 08.002.02
Date: 17 to 29 February 2008

Well: 15/9-F-4
Field: Volve
Rig: Maersk Inspirer

Schlumberger

MDT Sample Data Sheet

IDENTIFICATION

Sample No:	2.01	Sample Nature:	Bottomhole Water Sample
Bottle No:	4623-EA	Formation:	Volve
Sampling Date:	26-Feb-08	MDT Run No:	1B
Sampling Time	23:40	Chamber S/N:	MPSR-537
Sampling Point:	3417.5m		

SHIPPING CONDITIONS

Sample Bottle Type:	CSB	Gas Cap Created:	41 cc
Sample Bottle Volume:	700 cc	Fluid Remaining:	254 cc water/glycol
Sample Volume:	405 cc	Final Pressure:	27.51 @ 15 C

TRANSFER CONDITIONS

Initial Pressure:	68.77 @ 15 C	Transfer Duration:	20 min
Transfer Pressure:	412.65 @ 15 C	Apparent Bubble Point:	N/A

SAMPLING CONDITIONS

Formation Pressure:	326.08
Formation Temp:	112.8
At depth:	3417.5m
Maximum Drawdown:	185
Pump out Time:	8700 sec
Pump out Volume:	7.1 ltr

REMARKS

Unit of measurement: Pressure = bar, Temperature = degree celsius, Depth = metre MDRKB.
 Sampling conditions data supplied by Schlumberger Wireline.

Client: StatoilHydro ASA
Job No: 08.002.02
Date: 17 to 29 February 2008

Well: 15/9-F-4
Field: Volve
Rig: Maersk Inspirer

Schlumberger

MDT Sample Data Sheet

IDENTIFICATION

Sample No:	2.02	Sample Nature:	Bottomhole Water Sample
Bottle No:	4516-EA	Formation:	Volve
Sampling Date:	27-Feb-08	MDT Run No:	1B
Sampling Time	0:20	Chamber S/N:	MPSR-2520
Sampling Point:	3412.5m		

SHIPPING CONDITIONS

Sample Bottle Type:	CSB	Gas Cap Created:	41 cc
Sample Bottle Volume:	700 cc	Fluid Remaining:	254 cc water/glycol
Sample Volume:	405 cc	Final Pressure:	58.46 @ 15 C

TRANSFER CONDITIONS

Initial Pressure:	82.53 @ 15 C	Transfer Duration:	20 min
Transfer Pressure:	413.69 @ 15 C	Apparent Bubble Point:	N/A

SAMPLING CONDITIONS

Formation Pressure:	325.5
Formation Temp:	110.1
At depth:	3412.5m
Maximum Drawdown:	185
Pump out Time:	11100 sec
Pump out Volume:	36.4+C146 ltr

REMARKS

Unit of measurement: Pressure = bar, Temperature = degree celsius, Depth = metre MDRKB.
 Sampling conditions data supplied by Schlumberger Wireline.