CORE LAB

CORE LABORATORIES (U.K.) LIMITED
Advanced Technology Centre

SOLUBILITY-SWELLING STUDY

for

Statoil a.s.
15/9-19A
RFLA 980053

CORE LABORATORIES (U.K.) LIMITED
Advanced Technology Centre

23rd November 1998

Statoil a.s.
Postboks 300,
Forus N4001,
Stavanger
Norway

Attention : Tore Tjomsland

Dear Sirs,

Subject : Solubility-swelling study; well 15/9-19A; our file RFLA 980053.

Core Laboratories (U.K.) Limited have recently completed a solubility-swelling study on samples from well 15/9-19A and are pleased to present the results of these analyses in the following report.

Part of this study was to prepare and despatch a large volume recombined sample for P.R.I. Canada. This sample was despatched on 26th June 1998.

The sample cylinders will remain at Core Laboratories (U.K.) Limited until otherwise instructed.

Core Laboratories are very pleased to have been of service to Statoil a.s. in this work. Should any questions arise concerning the data presented in this report, or if Core Laboratories may be of assistance in any other matter, please do not hesitate to contact us.

Yours sincerely,

Core Laboratories (U.K.) Limited
Reservoir Fluid Analysis

Neil Tosh
PVT Laboratory Supervisor

Statoil a.s.
15/9-19A
RFLA 980053

TABLE OF CONTENTS

.....continued

Statoil a.s.
15/9-19A
RFLA 980053

TABLE OF CONTENTS

Section A
Summary of PVT Methods and Data

Statoil a.s.
15/9-19A
RFLA 980053

Summary of PVT Analysis Methods

Quality Checks

The saturation pressure of the separator liquid sample was attempted at room temperature as a quality check. However, the sample was found to be in two phases at the maximum working pressure of the cylinder upon opening. The separator liquid sample was heated to approximately 93°C prior to sample removal to eliminate wax precipitation and transferred to a large volume high pressure cylinder. The bubble point was then measured at 32.1 bara which suggested that gas had been lost due to opening the cylinder whilst the sample was in two phases.

A second separator liquid sample was delivered and the same scenario was encountered. On this occasion the cylinder was not opened which prevented any loss of gas. However, the sample volume was too large to perform a total fluid transfer to a high pressure cylinder. After discussion with Statoil a.s. it was agreed that a gas rich portion of the separator sample be transferred and then used with the separator gas sample to recombine to a specified bubble point.

The separator gas sample was heated to a temperature 20°F above separator temperature, agitated, and allowed to stabilise. The opening pressure, air content and hydrocarbon composition were then determined.

Liquid Composition

The separator liquid composition was determined using a flash/separation technique. The liquid was flashed at 120°F to obtain gas and liquid components. The gas was analysed using the extended analysis technique (see below) and the liquid by temperature programmed chromatography. The two analyses were then combined mathematically to the flash gas/liquid ratio.

Gas Data

Heptanes plus gas analysis was determined by routine gas chromatography using the GPA 2261-90 method. Extended gas analysis, to decanes plus, was determined by routine and extended chromatography. The extended chromatography was temperature programmed to improve the detection and resolution of the heptanes plus components. The two analyses were then combined mathematically.

The gas compressibility factor Z was calculated at 552.6 bara and the range of laboratory temperatures prevailing during the PVT study, using the method of Dranchuk, Purvis and Robinson, Institute of Petroleum Technical Series, No IP 74-008, 1974. From these values of Z the gas densities were also calculated for each gas addition and hence the weights of gas added.

Physical recombination

A measured volume of the gas rich separator liquid was charged to a high pressure visual cell at reservoir temperature (110°C). A known quantity of separator gas was added to the cell and the cell contents were stabilised in single phase at 552.6 bara. The saturation pressure of this recombined fluid was then determined. A second gas addition was performed to produce a recombined fluid which would have a saturation pressure close to the target value of 235.5 bara at 110°C. A partial constant mass expansion was performed and the bubble point was confirmed at 234.3 bara.

Statoil a.s.
15/9-19A
RFLA 980053

Summary of PVT Analysis Methods

Physical recombination (continued)
The recombined sample composition was determined, as detailed earlier, and the composition of the gas deficient separator liquid was also determined. A theoretical recombination ratio was used in conjunction with the compositions of the separator gas and gas deficient separator liquid samples to calculate a mathematical wellstream composition that matched the measured recombined fluid composition. The samples were then physically recombined to this ratio and the composition of the recombined fluid was then measured and agreed closely with the calculated wellstream composition.

Solubility-Swelling Study
A portion of the recombined fluid was charged to a high pressure visual cell at 552.6 bara and thermally expanded to the reservoir temperature of 110°C. A constant composition expansion was carried out and the bubble point pressure was determined. Pressure-volume data for the single phase liquid were also measured. The density was determined at 552.6 bara by pumping a measured volume from the PVT cell for direct weighing. This was repeated until data consistent to within 1% were obtained. Density data for the single phase liquid were then derived from the volumetric data.

A measured portion of injection gas was added to the cell at 552.6 bara. The cell contents were stabilised in single phase at this pressure and the change in volume due to the added gas was noted. The density of each mixture was calculated from the known weights of the mixture components and the measured volume. A constant composition expansion was then carried out from 552.6 bara during which the saturation pressure was determined. Pressure-volume data for the single phase and two phase fluid and the liquid volumes in the two phase region were also measured. This was repeated for three further gas additions.

Compositional Calculations for the Solubility-Swelling Mixtures
The gas-oil ratio values for each mixture were used together with the compositions of the initial recombined fluid and injection gas to calculate the mixture compositions.

Statoil a.s.
15/9-19A
RFLA 980053

SUMMARY OF SOLUBILITY-SWELLING DATA
INJECTION GAS = SEPARATOR GAS, CYLINDER 50249

Solubility-Swelling Study at 110°C				
Moles of Gas per 1.000 Mole of Reservoir Fluid	Gas-Oil Ratio (Sm3/m3) (1)	Vol. at Saturation Pressure Relative to Original Fluid	Bubble point Pressure (bara)	Density at Sat. Press. (g cm-3)
0.000	0	1.0000	234.3	0.7350
0.114	16.5	1.0389	278.9	0.7217
0.439	63.7	1.1515	391.3	0.6876
0.683	99.1	1.2376	459.5	0.6653
1.024	148.7	1.3572	536.3	0.6392

SUMMARY OF SOLUBILITY-SWELLING DATA
INJECTION GAS = CARBON DIOXIDE

Solubility-Swelling Study at 110°C					
Moles of Gas per 1.000 Mole of Reservoir Fluid	Gas-Oil Ratio (Sm3/m3) (1)	Vol. at Saturation Pressure Relative to Original Fluid	Saturation Pressure (bara)		Density at Sat. Press. (g cm-3)
0.000	0	1.0000	234.3	bp	0.7350
0.114	16.5	1.0413	257.2	bp	0.7353
0.438	63.7	1.1549	314.0	bp	0.7391
1.032	149.8	1.3551	402.3	bp	0.7483
2.324	337.5	1.7720	535.4	dp	0.7694

Note: bp - bubble point, dp - dew point.

(1) Cubic meters of gas at 1.0132 bara and 15.0°C per cubic meter of saturated recombined fluid at 234.3 bara and 110°C.

Section B
Samples Received and Compositional Analysis

Statoil a.s.
15/9-19A
RFLA 980053

SUMMARY OF SAMPLES RECEIVED

SEPARATOR GASES							
Sample Number	Cylinder Number	Sampling :- Pressure (bara)	Temp. (°C)	Laboratory opening : Pressure (bara)	Temp. (°C)	Liquid Hydro-C. (cm3)	Air Content (mole %)
93	50249	47.7	58.5	56.2	68.3	0	0.03

SEPARATOR LIQUIDS							
Sample Number	Cylinder Number	Sampling :- Pressure (bara)	Temp. (°C)	Laboratory Bubble point :- Pressure (bara)	Temp. (°C)	Water Recovered (cm3)	Sample Volume (cm3)
97	50273	47.7	58.5	Not possible		0	18000
100	55015	47.7	58.5	Not possible		0	2000

Note

Due to cylinder pressure limitations, neither separator liquid sample was able to be quality checked by determining ambient temperature bubble point pressure. Both samples existed in two phases at maximum cylinder working pressure.

CORE LAB

CORE LABORATORIES (U.K.) LIMITED
Advanced Technology Centre

Statoil a.s.
15/9-19A
RFLA 980053

MEASURED COMPOSITION OF SEPARATOR GAS SAMPLE - CYLINDER 50249

Component	Mole %
Hydrogen	0.00
Hydrogen sulphide	0.00
Carbon dioxide	2.94
Nitrogen	1.15
Methane	80.54
Ethane	7.86
Propane	4.50
i-Butane	0.42
n-Butane	1.21
neo-Pentane	0.00
i-Pentane	0.27
n-Pentane	0.36
Hexanes	0.28
Me-Cyclo-pentane	0.06
Benzene	0.04
Cyclo-hexane	0.05
Heptanes	0.11
Me-Cyclo-hexane	0.03
Toluene	0.03
Octanes	0.06
Ethyl-benzene	0.00
Meta/Para-xylene	0.00
Ortho-xylene	0.00
Nonanes	0.03
Decanes plus	0.06
Totals	100.00

Calculated properties	
Heptanes plus properties	
Mole %	0.47
Molecular Weight (g mol-1)	102.0
Density at 15°C (g cm-3)	0.7570
Real Relative Density (Air = 1 at 1.0132 bara and 15°C)	0.728

Statoil a.s.
15/9-19A
RFLA 980053

HYDROCARBON COMPOSITION OF RECOMBINED FLUID
(Recombined to bubble point = 235.5 Bara)

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	1.74	0.64
Nitrogen	0.56	0.13
Methane	41.88	5.62
Ethane	6.26	1.57
Propane	5.70	2.10
i-Butane	0.80	0.39
n-Butane	2.91	1.41
neo-Pentane	0.00	0.00
i-Pentane	1.06	0.64
n-Pentane	1.69	1.02
Hexanes	2.22	1.60
Me-Cyclo-pentane	0.67	0.47
Benzene	0.58	0.38
Cyclo-hexane	0.46	0.32
Heptanes	1.81	1.51
Me-Cyclo-hexane	0.57	0.47
Toluene	0.72	0.56
Octanes	2.03	1.94
Ethyl-benzene	0.36	0.32
Meta/Para-xylene	0.32	0.28
Ortho-xylene	0.19	0.17
Nonanes	1.66	1.78
Tri-Me-benzene	0.10	0.10
Decanes	2.00	2.38
Undecanes	1.89	2.33
Dodecanes	1.68	2.26
Tridecanes	1.68	2.46
Tetradecanes	1.44	2.29
Pentadecanes	1.44	2.48
Hexadecanes	1.15	2.13
Heptadecanes	1.06	2.09
Octadecanes	1.04	2.17
Nonadecanes	1.05	2.31
Eicosanes	0.75	1.72
Heneicosanes	0.68	1.66
Docosanes	0.64	1.63
Tricosanes	0.57	1.51
Tetracosanes	0.54	1.50
Pentacosanes	0.49	1.40
Hexacosanes	0.48	1.44
Heptacosanes	0.43	1.34
Octacosanes	0.42	1.36
Nonacosanes	0.39	1.32
Triacontanes	0.40	1.39

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES
(Recombined to bubble point = 235.5 Bara)

Components (continued)	Mole %	Weight %
Hentriacontanes	0.39	1.39
Dotriacontanes	0.33	1.24
Tritriacontanes	0.32	1.21
Tetratriacontanes	0.30	1.17
Pentatriacontanes	0.29	1.18
Hexatriacontanes plus	3.86	31.22
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	3.52	2.68	0.7322	91.4
Octanes	3.32	2.96	0.7432	106.7
Nonanes	2.53	2.54	0.7613	120.7
Decanes	2.10	2.48	0.7384	141.2

Calculated residue properties	
Heptanes plus	
Mole %	35.18
Molecular Weight (g mol-1)	289
Density at 15.6°C (g cm-3)	0.9079
Decanes plus	
Mole %	25.81
Molecular Weight (g mol-1)	356
Density at 15.6°C (g cm-3)	0.9296
Eicosanes plus	
Mole %	11.28
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	3.86
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	120

Section C
Hydrocarbon Gas Solubility Swelling

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
RECOMBINED SAMPLE

Pressure (bara)		Relative Volume (1)	Liquid Volume % (2)	Density (g cm-3)	Y-function (3)
552.6		0.9570		0.7680	
414.7		0.9727		0.7557	
345.8		0.9820		0.7485	
276.8		0.9926		0.7405	
269.9		0.9938		0.7396	
263.0		0.9949		0.7387	
256.1		0.9961		0.7379	
249.2		0.9973		0.7370	
242.3		0.9986		0.7361	
235.4		0.9998		0.7351	
234.3	**Bubble point pressure**	**1.0000**	**100.00**	**0.7350**	
233.7		1.0006	99.82		
232.5		1.0020	99.51		
231.4		1.0031	99.29		
230.5		1.0041	99.10		
229.4		1.0053	98.91		
228.4		1.0064	98.74		
216.0		1.0213	97.01		
196.3		1.0506	94.81		3.831
168.8		1.1074	92.60		3.619
140.4		1.1971			3.394
117.0		1.3133			3.201
97.5		1.4624			3.036
81.8		1.6428			2.900
68.7		1.8677			2.781
59.2		2.0980			2.694
51.6		2.3499			2.622
39.7		2.9577			2.505
30.2		3.8025			2.408
21.8		5.2175			2.316

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Liquid shrinkage as a percentage of volume at bubble point pressure.
(3) Y-function = (Psat - P) / (Pabs)(V/Vsat - 1)

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
1st GAS ADDITION - 0.114 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9597	0.9970		0.7520
483.6		0.9679	1.0055		0.7456
414.7		0.9772	1.0152		0.7385
345.8		0.9880	1.0264		0.7305
318.2		0.9927	1.0313		0.7270
311.3		0.9939	1.0326		0.7261
304.4		0.9952	1.0339		0.7251
297.5		0.9965	1.0352		0.7242
290.6		0.9978	1.0366		0.7233
283.7		0.9991	1.0379		0.7223
278.9	**Bubble point pressure**	**1.0000**	**1.0389**	**100.00**	**0.7217**
276.3		1.0020	1.0410	99.52	
274.3		1.0036	1.0427	99.18	
272.9		1.0048	1.0439	98.94	
271.4		1.0061	1.0452	98.70	
269.8		1.0074	1.0466	98.47	
268.5		1.0085	1.0477	98.28	
265.8		1.0110	1.0503	97.90	
257.9		1.0183	1.0579	96.96	
244.3		1.0327	1.0728	95.58	
222.3		1.0613	1.1026	93.64	
191.6		1.1167	1.1601	91.01	
160.8		1.2011	1.2478		
134.6		1.3129	1.3639		
112.9		1.4547	1.5113		
95.3		1.6275	1.6908		
81.0		1.8318	1.9030		
70.3		2.0466	2.1262		
63.8		2.2181	2.3044		
48.5		2.8154	2.9249		
37.0		3.6221	3.7629		
31.8		4.1950	4.3582		
26.5		5.0183	5.2135		

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 1st HYDROCARBON GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	1.86	0.75
Nitrogen	0.62	0.16
Methane	45.75	6.68
Ethane	6.42	1.76
Propane	5.58	2.24
i-Butane	0.76	0.40
n-Butane	2.74	1.45
neo-Pentane	0.00	0.00
i-Pentane	0.98	0.64
n-Pentane	1.56	1.02
Hexanes	2.03	1.59
Me-Cyclo-pentane	0.61	0.47
Benzene	0.53	0.37
Cyclo-hexane	0.42	0.32
Heptanes	1.64	1.50
Me-Cyclo-hexane	0.52	0.46
Toluene	0.65	0.55
Octanes	1.83	1.91
Ethyl-benzene	0.32	0.31
Meta/Para-xylene	0.29	0.28
Ortho-xylene	0.17	0.17
Nonanes	1.50	1.75
Tri-Me-benzene	0.09	0.10
Decanes	1.80	2.34
Undecanes	1.70	2.28
Dodecanes	1.51	2.22
Tridecanes	1.51	2.41
Tetradecanes	1.30	2.24
Pentadecanes	1.30	2.43
Hexadecanes	1.03	2.09
Heptadecanes	0.95	2.06
Octadecanes	0.94	2.14
Nonadecanes	0.94	2.26
Eicosanes	0.67	1.69
Heneicosanes	0.61	1.62
Docosanes	0.58	1.60
Tricosanes	0.51	1.49
Tetracosanes	0.49	1.46
Pentacosanes	0.44	1.39
Hexacosanes	0.43	1.41
Heptacosanes	0.39	1.32
Octacosanes	0.38	1.34
Nonacosanes	0.35	1.28
Triacontanes	0.36	1.36

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 1st HYDROCARBON GAS ADDITION

Components (continued)	Mole %	Weight %
Hentriacontanes	0.35	1.37
Dotriacontanes	0.30	1.20
Tritriacontanes	0.29	1.20
Tetratriacontanes	0.27	1.16
Pentatriacontanes	0.26	1.15
Hexatriacontanes plus	3.47	30.61
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	3.19	2.66	0.7319	91.4
Octanes	3.00	2.92	0.7432	106.7
Nonanes	2.28	2.51	0.7614	120.7
Decanes	1.89	2.44	0.7384	141.2

Calculated residue properties	
Heptanes plus	
Mole %	31.71
Molecular Weight (g mol-1)	289
Density at 15.6°C (g cm-3)	0.9077
Decanes plus	
Mole %	23.23
Molecular Weight (g mol-1)	356
Density at 15.6°C (g cm-3)	0.9296
Eicosanes plus	
Mole %	10.15
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	3.47
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	109.6

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
2nd GAS ADDITION - 0.439 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9710	1.1181		0.7081
483.6		0.9819	1.1307		0.7003
435.4		0.9907	1.1407		0.6941
428.5		0.9920	1.1423		0.6931
421.6		0.9934	1.1439		0.6922
414.7		0.9948	1.1455		0.6912
407.8		0.9963	1.1472		0.6902
400.9		0.9978	1.1489		0.6891
394.0		0.9994	1.1507		0.6881
391.3	**Bubble point pressure**	**1.0000**	**1.1515**	**100.00**	**0.6876**
388.2		1.0014	1.1531	98.75	
386.1		1.0024	1.1542	98.11	
383.9		1.0034	1.1554	97.57	
381.9		1.0044	1.1565	97.13	
379.9		1.0054	1.1577	96.74	
376.1		1.0073	1.1599	96.12	
354.3		1.0195	1.1740	93.39	
320.2		1.0438	1.2020	89.63	
271.9		1.0941	1.2599		
226.4		1.1702	1.3475		
188.6		1.2720	1.4647		
158.4		1.3988	1.6107		
134.2		1.5520	1.7871		
117.1		1.7054	1.9638		
104.2		1.8607	2.1425		
96.5		1.9763	2.2757		
72.8		2.5062	2.8858		
54.6		3.2605	3.7544		
38.8		4.5342	5.2210		

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 2nd HYDROCARBON GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	2.10	1.03
Nitrogen	0.74	0.23
Methane	53.48	9.52
Ethane	6.74	2.25
Propane	5.34	2.61
i-Butane	0.69	0.44
n-Butane	2.40	1.55
neo-Pentane	0.00	0.00
i-Pentane	0.82	0.66
n-Pentane	1.29	1.03
Hexanes	1.64	1.57
Me-Cyclo-pentane	0.49	0.45
Benzene	0.42	0.36
Cyclo-hexane	0.34	0.31
Heptanes	1.30	1.45
Me-Cyclo-hexane	0.41	0.44
Toluene	0.51	0.52
Octanes	1.44	1.82
Ethyl-benzene	0.25	0.30
Meta/Para-xylene	0.22	0.26
Ortho-xylene	0.13	0.16
Nonanes	1.17	1.67
Tri-Me-benzene	0.07	0.09
Decanes	1.41	2.23
Undecanes	1.33	2.17
Dodecanes	1.18	2.11
Tridecanes	1.18	2.28
Tetradecanes	1.01	2.13
Pentadecanes	1.01	2.30
Hexadecanes	0.81	1.98
Heptadecanes	0.74	1.95
Octadecanes	0.73	2.03
Nonadecanes	0.74	2.15
Eicosanes	0.53	1.60
Heneicosanes	0.48	1.54
Docosanes	0.45	1.52
Tricosanes	0.40	1.41
Tetracosanes	0.38	1.39
Pentacosanes	0.34	1.31
Hexacosanes	0.34	1.34
Heptacosanes	0.30	1.25
Octacosanes	0.29	1.27
Nonacosanes	0.27	1.22
Triacontanes	0.28	1.29

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 2nd HYDROCARBON GAS ADDITION

Components (continued)	Mole %	Weight %
Hentriacontanes	0.27	1.30
Dotriacontanes	0.23	1.14
Tritriacontanes	0.22	1.14
Tetratriacontanes	0.21	1.10
Pentatriacontanes	0.20	1.10
Hexatriacontanes plus	2.70	29.03
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	2.54	2.58	0.7323	91.4
Octanes	2.36	2.79	0.7432	106.7
Nonanes	1.78	2.39	0.7611	120.7
Decanes	1.48	2.32	0.7383	141.2

Calculated residue properties	
Heptanes plus	
Mole %	24.77
Molecular Weight (g mol-1)	288
Density at 15.6°C (g cm-3)	0.9074
Decanes plus	
Mole %	18.09
Molecular Weight (g mol-1)	355
Density at 15.6°C (g cm-3)	0.9295
Eicosanes plus	
Mole %	7.90
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	2.70
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	90.1

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
3rd GAS ADDITION - 0.683 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9805	1.2134		0.6786
518.1		0.9872	1.2218		0.6739
490.5		0.9930	1.2290		0.6700
483.6		0.9945	1.2308		0.6690
476.8		0.9961	1.2327		0.6679
469.9		0.9976	1.2347		0.6669
463.0		0.9992	1.2366		0.6658
459.5	**Bubble point pressure**	**1.0000**	**1.2376**	**100.00**	**0.6653**
454.5		1.0017	1.2397	97.31	
451.0		1.0030	1.2413	95.94	
447.8		1.0042	1.2428	94.94	
444.5		1.0054	1.2443	94.07	
441.7		1.0065	1.2456	93.45	
437.1		1.0083	1.2479	92.52	
413.3		1.0188	1.2609	88.88	
374.5		1.0405	1.2877	84.61	
318.5		1.0868	1.3450		
265.4		1.1580	1.4331		
221.9		1.2525	1.5501		
186.6		1.3726	1.6988		
158.8		1.5154	1.8754		
133.6		1.7070	2.1125		
112.4		1.9465	2.4089		
102.9		2.0907	2.5875		
80.6		2.5796	3.1924		
62.5		3.2552	4.0287		
54.0		3.7386	4.6269		
45.3		4.4303	5.4829		

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 3rd HYDROCARBON GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	2.22	1.22
Nitrogen	0.80	0.28
Methane	57.34	11.47
Ethane	6.90	2.59
Propane	5.22	2.87
i-Butane	0.65	0.47
n-Butane	2.23	1.62
neo-Pentane	0.00	0.00
i-Pentane	0.74	0.67
n-Pentane	1.16	1.04
Hexanes	1.44	1.55
Me-Cyclo-pentane	0.43	0.45
Benzene	0.36	0.35
Cyclo-hexane	0.30	0.31
Heptanes	1.13	1.41
Me-Cyclo-hexane	0.35	0.43
Toluene	0.44	0.51
Octanes	1.24	1.77
Ethyl-benzene	0.22	0.29
Meta/Para-xylene	0.19	0.25
Ortho-xylene	0.11	0.15
Nonanes	1.01	1.61
Tri-Me-benzene	0.06	0.09
Decanes	1.21	2.15
Undecanes	1.14	2.09
Dodecanes	1.01	2.03
Tridecanes	1.01	2.20
Tetradecanes	0.86	2.05
Pentadecanes	0.86	2.22
Hexadecanes	0.69	1.91
Heptadecanes	0.64	1.88
Octadecanes	0.62	1.95
Nonadecanes	0.63	2.07
Eicosanes	0.45	1.54
Heneicosanes	0.41	1.48
Docosanes	0.38	1.46
Tricosanes	0.34	1.36
Tetracosanes	0.32	1.34
Pentacosanes	0.29	1.26
Hexacosanes	0.29	1.29
Heptacosanes	0.26	1.20
Octacosanes	0.25	1.22
Nonacosanes	0.23	1.17
Triacontanes	0.24	1.24

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 3rd HYDROCARBON GAS ADDITION

Components (continued)	Mole %	Weight %
Hentriacontanes	0.23	1.25
Dotriacontanes	0.20	1.10
Tritriacontanes	0.19	1.10
Tetratriacontanes	0.18	1.06
Pentatriacontanes	0.17	1.05
Hexatriacontanes plus	2.32	27.95
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	2.22	2.52	0.7324	91.3
Octanes	2.04	2.71	0.7433	106.6
Nonanes	1.53	2.30	0.7610	120.7
Decanes	1.27	2.24	0.7383	141.2

Calculated residue properties	
Heptanes plus	
Mole %	21.30
Molecular Weight (g mol-1)	287
Density at 15.6°C (g cm-3)	0.9072
Decanes plus	
Mole %	15.51
Molecular Weight (g mol-1)	355
Density at 15.6°C (g cm-3)	0.9294
Eicosanes plus	
Mole %	6.77
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	2.32
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	80.2

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
4th GAS ADDITION - 1.024 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9959	1.3516		0.6419
545.7		0.9976	1.3539		0.6408
538.8		0.9994	1.3563		0.6396
536.3	**Bubble point pressure**	**1.0000**	**1.3572**	**100.00**	**0.6392**
532.3		1.0012	1.3588	89.85	
529.4		1.0021	1.3600	86.67	
525.7		1.0033	1.3616	84.60	
522.9		1.0041	1.3628	83.61	
519.8		1.0052	1.3642	82.76	
514.1		1.0070	1.3667	81.56	
488.0		1.0166	1.3797	77.91	
445.1		1.0358	1.4058	75.13	
379.3		1.0780	1.4631		
316.0		1.1429	1.5511		
263.2		1.2304	1.6699		
222.8		1.3348	1.8116		
189.4		1.4654	1.9888		
165.0		1.6031	2.1757		
144.6		1.7626	2.3921		
132.1		1.8896	2.5645		
103.2		2.3271	3.1582		
79.4		2.9747	4.0372		
68.6		3.4424	4.6719		
57.6		4.1255	5.5990		

Note.
Approximately 6.5 cm-3 of heavy liquid deposits, accumulated below bubble point pressure. The liquid volume % includes these liquid deposits.

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 4th HYDROCARBON GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	2.34	1.46
Nitrogen	0.86	0.34
Methane	61.21	13.96
Ethane	7.06	3.02
Propane	5.10	3.20
i-Butane	0.61	0.50
n-Butane	2.06	1.70
neo-Pentane	0.00	0.00
i-Pentane	0.67	0.68
n-Pentane	1.03	1.05
Hexanes	1.25	1.53
Me-Cyclo-pentane	0.37	0.44
Benzene	0.31	0.34
Cyclo-hexane	0.26	0.31
Heptanes	0.96	1.37
Me-Cyclo-hexane	0.30	0.42
Toluene	0.38	0.49
Octanes	1.05	1.70
Ethyl-benzene	0.18	0.27
Meta/Para-xylene	0.16	0.24
Ortho-xylene	0.10	0.14
Nonanes	0.85	1.54
Tri-Me-benzene	0.05	0.09
Decanes	1.02	2.05
Undecanes	0.96	2.00
Dodecanes	0.85	1.93
Tridecanes	0.84	2.09
Tetradecanes	0.72	1.94
Pentadecanes	0.72	2.11
Hexadecanes	0.58	1.81
Heptadecanes	0.53	1.79
Octadecanes	0.52	1.86
Nonadecanes	0.53	1.96
Eicosanes	0.38	1.47
Heneicosanes	0.34	1.41
Docosanes	0.32	1.39
Tricosanes	0.29	1.29
Tetracosanes	0.27	1.27
Pentacosanes	0.25	1.20
Hexacosanes	0.24	1.23
Heptacosanes	0.22	1.14
Octacosanes	0.21	1.16
Nonacosanes	0.20	1.11
Triacontanes	0.20	1.18

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 4th HYDROCARBON GAS ADDITION

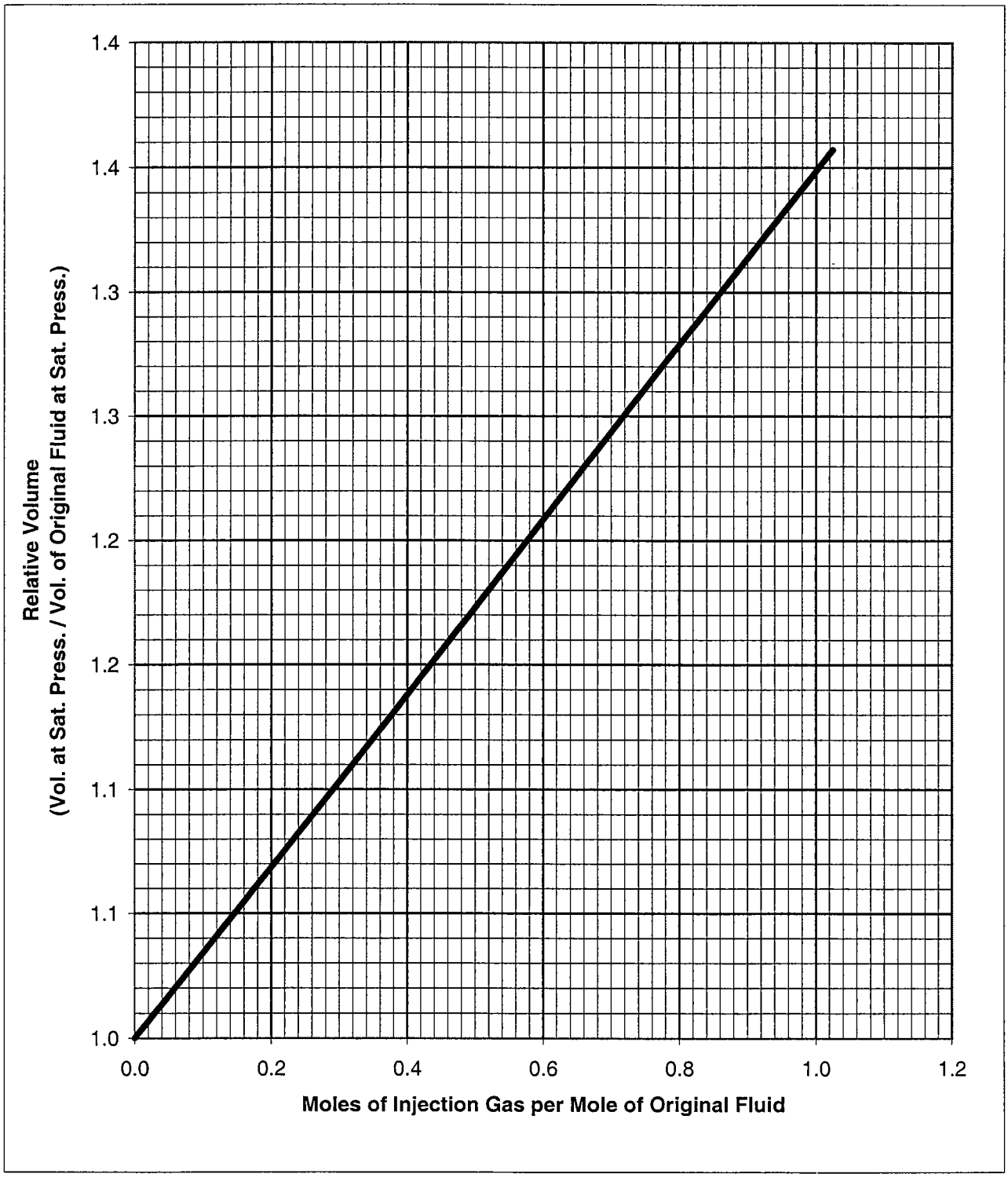
Components (continued)	Mole %	Weight %
Hentriacontanes	0.20	1.19
Dotriacontanes	0.17	1.04
Tritriacontanes	0.16	1.04
Tetratriacontanes	0.15	1.01
Pentatriacontanes	0.15	1.00
Hexatriacontanes plus	1.93	26.55
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	1.89	2.45	0.7326	91.3
Octanes	1.72	2.61	0.7434	106.6
Nonanes	1.28	2.20	0.7608	120.8
Decanes	1.07	2.14	0.7383	141.3

Calculated residue properties	
Heptanes plus	
Mole %	17.83
Molecular Weight (g mol-1)	286
Density at 15.6°C (g cm-3)	0.9069
Decanes plus	
Mole %	12.94
Molecular Weight (g mol-1)	355
Density at 15.6°C (g cm-3)	0.9294
Eicosanes plus	
Mole %	5.64
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	1.93
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	70.4

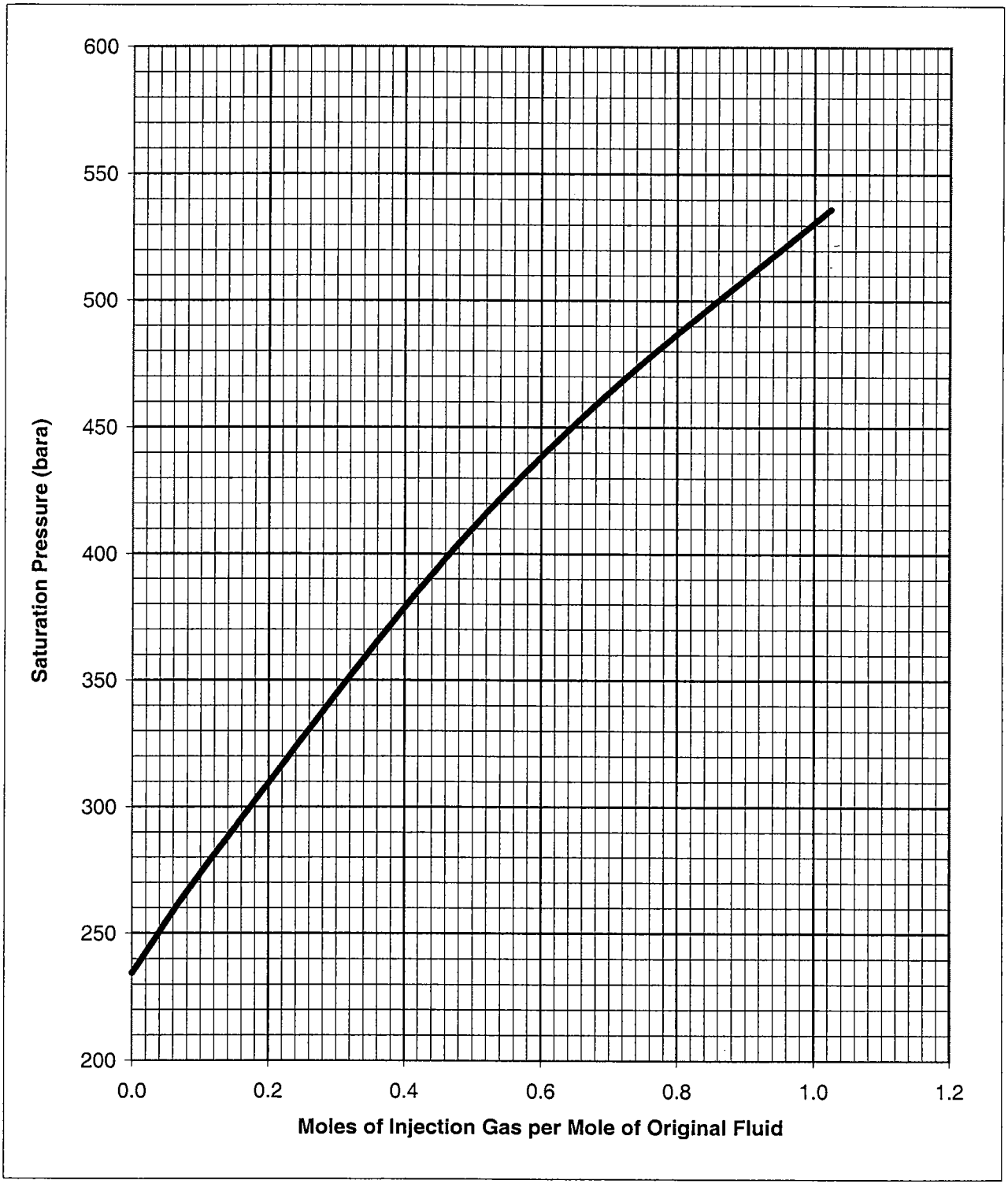
Statoil a.s.
15/9-19A
RFLA 980053

RELATIVE VOLUME v MOLES OF HYDROCARBON INJECTION GAS FROM THE SOLUBILITY-SWELLING TEST AT 110°C



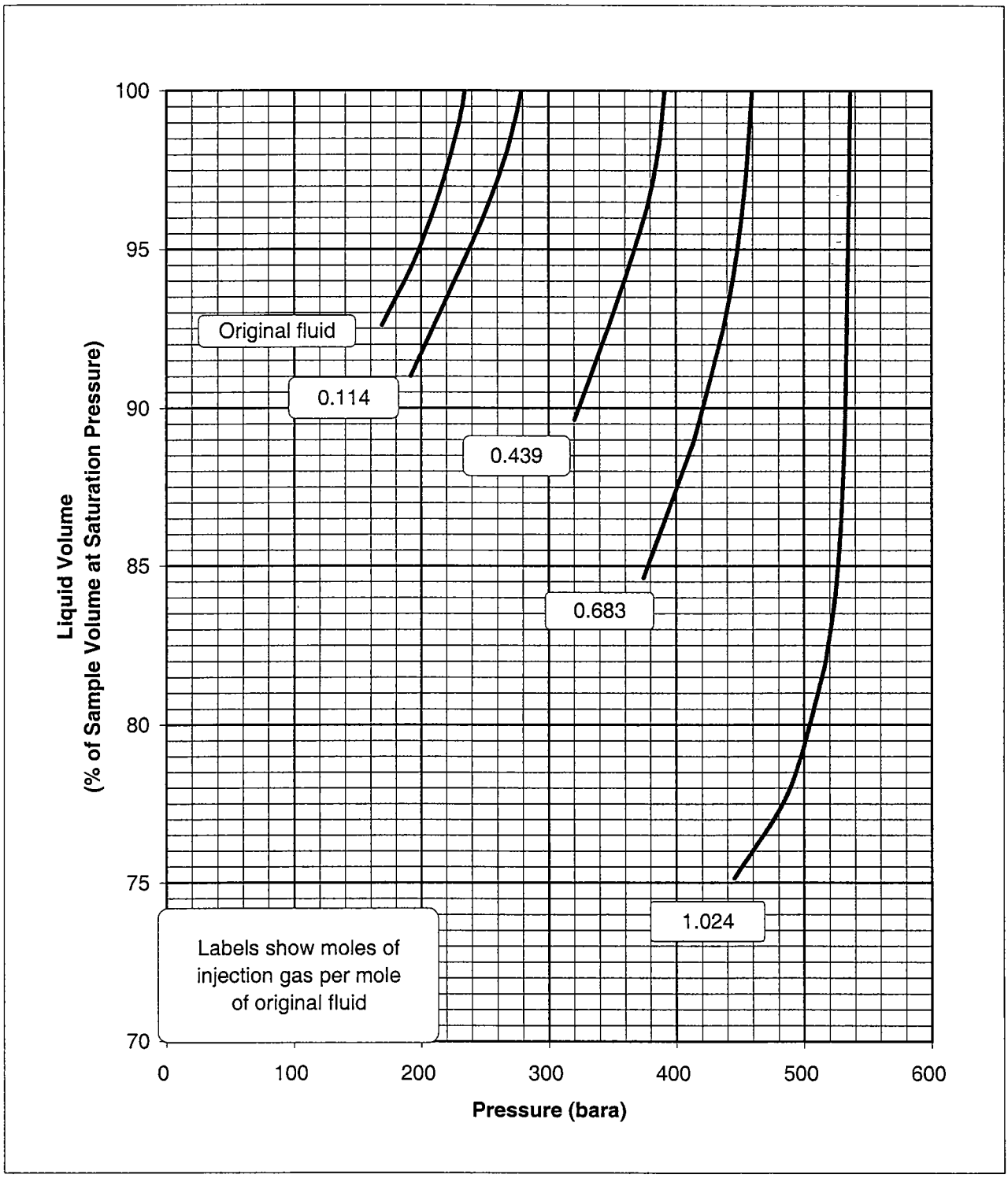
Statoil a.s.
15/9-19A
RFLA 980053

SATURATION PRESSURE v MOLES OF HYDROCARBON INJECTION GAS FROM THE SOLUBILITY-SWELLING TEST AT 110°C



Statoil a.s.
15/9-19A
RFLA 980053

LIQUID VOLUME% v PRESSURE
FROM THE H-C GAS SOLUBILITY-SWELLING TESTS AT 110°C



Section D
Carbon Dioxide Gas Solubility Swelling

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
RECOMBINED SAMPLE

Pressure (bara)		Relative Volume (1)	Liquid Volume % (2)	Density (g cm-3)	Y-function (3)
552.6		0.9570		0.7680	
414.7		0.9727		0.7557	
345.8		0.9820		0.7485	
276.8		0.9926		0.7405	
269.9		0.9938		0.7396	
263.0		0.9949		0.7387	
256.1		0.9961		0.7379	
249.2		0.9973		0.7370	
242.3		0.9986		0.7361	
235.4		0.9998		0.7351	
234.3	**Bubble point pressure**	**1.0000**	**100.00**	**0.7350**	
233.7		1.0006	99.82		
232.5		1.0020	99.51		
231.4		1.0031	99.29		
230.5		1.0041	99.10		
229.4		1.0053	98.91		
228.4		1.0064	98.74		
216.0		1.0213	97.01		
196.3		1.0506	94.81		3.831
168.8		1.1074	92.60		3.619
140.4		1.1971			3.394
117.0		1.3133			3.201
97.5		1.4624			3.036
81.8		1.6428			2.900
68.7		1.8677			2.781
59.2		2.0980			2.694
51.6		2.3499			2.622
39.7		2.9577			2.505
30.2		3.8025			2.408
21.8		5.2175			2.316

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Liquid shrinkage as a percentage of volume at bubble point pressure.
(3) Y-function = (Psat - P) / (Pabs)(V/Vsat - 1)

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
1st CO_2 GAS ADDITION - 0.114 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9563	0.9958		0.7689
483.6		0.9648	1.0047		0.7622
414.7		0.9741	1.0143		0.7549
345.8		0.9845	1.0251		0.7469
290.6		0.9938	1.0348		0.7399
283.7		0.9950	1.0361		0.7390
276.8		0.9963	1.0374		0.7381
269.9		0.9976	1.0388		0.7371
263.0		0.9989	1.0401		0.7362
257.2	**Bubble point pressure**	**1.0000**	**1.0413**	**100.00**	**0.7353**
257.0		1.0002	1.0415	99.93	
254.2		1.0028	1.0442	99.07	
253.2		1.0037	1.0451	98.80	
252.5		1.0044	1.0459	98.55	
244.5		1.0124	1.0542	96.85	
234.1		1.0241	1.0664	95.27	
216.7		1.0474	1.0907	93.44	
189.6		1.0965	1.1418	91.17	
156.2		1.1908	1.2400	88.40	
134.6		1.2860	1.3391		
107.1		1.4783	1.5394		
86.8		1.7175	1.7884		
63.3		2.2199	2.3115		
46.9		2.9025	3.0223		
32.7		4.0946	4.2637		

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 1st CARBON DIOXIDE GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	11.57	4.54
Nitrogen	0.50	0.13
Methane	37.69	5.39
Ethane	5.63	1.51
Propane	5.13	2.02
i-Butane	0.72	0.37
n-Butane	2.62	1.36
neo-Pentane	0.00	0.00
i-Pentane	0.95	0.61
n-Pentane	1.52	0.98
Hexanes	2.00	1.54
Me-Cyclo-pentane	0.60	0.45
Benzene	0.52	0.36
Cyclo-hexane	0.41	0.31
Heptanes	1.63	1.46
Me-Cyclo-hexane	0.51	0.45
Toluene	0.65	0.53
Octanes	1.83	1.86
Ethyl-benzene	0.32	0.31
Meta/Para-xylene	0.29	0.27
Ortho-xylene	0.17	0.16
Nonanes	1.49	1.71
Tri-Me-benzene	0.09	0.10
Decanes	1.80	2.28
Undecanes	1.70	2.23
Dodecanes	1.51	2.17
Tridecanes	1.51	2.36
Tetradecanes	1.30	2.20
Pentadecanes	1.30	2.38
Hexadecanes	1.03	2.05
Heptadecanes	0.95	2.02
Octadecanes	0.94	2.10
Nonadecanes	0.94	2.22
Eicosanes	0.67	1.66
Heneicosanes	0.61	1.59
Docosanes	0.58	1.57
Tricosanes	0.51	1.46
Tetracosanes	0.49	1.44
Pentacosanes	0.44	1.36
Hexacosanes	0.43	1.38
Heptacosanes	0.39	1.29
Octacosanes	0.38	1.31
Nonacosanes	0.35	1.26
Triacontanes	0.36	1.34

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 1st CARBON DIOXIDE GAS ADDITION

Components (continued)	Mole %	Weight %
Hentriacontanes	0.35	1.35
Dotriacontanes	0.30	1.18
Tritriacontanes	0.29	1.18
Tetratriacontanes	0.27	1.14
Pentatriacontanes	0.26	1.13
Hexatriacontanes plus	3.47	29.99
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	3.17	2.58	0.7321	91.4
Octanes	2.99	2.84	0.7430	106.7
Nonanes	2.28	2.45	0.7614	120.7
Decanes	1.89	2.38	0.7384	141.2

Calculated residue properties	
Heptanes plus	
Mole %	31.66
Molecular Weight (g mol-1)	289
Density at 15.6°C (g cm-3)	0.9078
Decanes plus	
Mole %	23.23
Molecular Weight (g mol-1)	356
Density at 15.6°C (g cm-3)	0.9296
Eicosanes plus	
Mole %	10.15
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	3.47
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	112.1

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
2nd CO_2 GAS ADDITION - 0.438 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9568	1.1049		0.7725
483.6		0.9667	1.1164		0.7645
414.7		0.9782	1.1297		0.7555
345.8		0.9922	1.1459		0.7449
338.9		0.9938	1.1477		0.7437
332.0		0.9955	1.1496		0.7425
325.1		0.9972	1.1516		0.7412
318.2		0.9989	1.1536		0.7399
314.0	**Bubble point pressure**	**1.0000**	**1.1549**	**100.00**	**0.7391**
312.7		1.0008	1.1558	99.09	
310.2		1.0024	1.1577	97.92	
308.0		1.0039	1.1593	97.22	
306.7		1.0047	1.1603	96.88	
302.9		1.0074	1.1634	96.03	
300.7		1.0089	1.1652	95.59	
299.8		1.0096	1.1659	95.41	
300.9		1.0087	1.1649	95.64	
296.9		1.0117	1.1684	94.86	
282.2		1.0239	1.1825	92.40	
261.0		1.0458	1.2077	89.58	
231.9		1.0874	1.2558		
193.9		1.1736	1.3553		
164.1		1.2838	1.4826		
141.0		1.4148	1.6339		
122.6		1.5658	1.8083		
106.1		1.7573	2.0294		
92.2		1.9806	2.2873		
73.7		2.4299	2.8062		
58.2		3.0474	3.5193		
43.1		4.0927	4.7264		

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 2nd CARBON DIOXIDE GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	31.21	14.16
Nitrogen	0.39	0.11
Methane	29.32	4.85
Ethane	4.38	1.36
Propane	3.99	1.81
i-Butane	0.56	0.34
n-Butane	2.04	1.22
neo-Pentane	0.00	0.00
i-Pentane	0.74	0.55
n-Pentane	1.18	0.88
Hexanes	1.55	1.38
Me-Cyclo-pentane	0.47	0.41
Benzene	0.41	0.33
Cyclo-hexane	0.32	0.28
Heptanes	1.27	1.31
Me-Cyclo-hexane	0.40	0.40
Toluene	0.50	0.48
Octanes	1.42	1.67
Ethyl-benzene	0.25	0.28
Meta/Para-xylene	0.22	0.25
Ortho-xylene	0.13	0.15
Nonanes	1.16	1.54
Tri-Me-benzene	0.07	0.09
Decanes	1.40	2.05
Undecanes	1.32	2.01
Dodecanes	1.18	1.95
Tridecanes	1.18	2.12
Tetradecanes	1.01	1.97
Pentadecanes	1.01	2.14
Hexadecanes	0.81	1.84
Heptadecanes	0.74	1.81
Octadecanes	0.73	1.88
Nonadecanes	0.74	1.99
Eicosanes	0.53	1.49
Heneicosanes	0.48	1.43
Docosanes	0.45	1.41
Tricosanes	0.40	1.31
Tetracosanes	0.38	1.29
Pentacosanes	0.34	1.22
Hexacosanes	0.34	1.24
Heptacosanes	0.30	1.16
Octacosanes	0.29	1.18
Nonacosanes	0.27	1.13
Triacontanes	0.28	1.20

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 2nd CARBON DIOXIDE GAS ADDITION

Components (continued)	Mole %	Weight %
Hentriacontanes	0.27	1.21
Dotriacontanes	0.23	1.06
Tritriacontanes	0.22	1.06
Tetratriacontanes	0.21	1.02
Pentatriacontanes	0.20	1.02
Hexatriacontanes plus	2.70	26.96
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	2.46	2.33	0.7323	91.4
Octanes	2.32	2.55	0.7432	106.7
Nonanes	1.77	2.22	0.7611	120.7
Decanes	1.47	2.14	0.7383	141.2

Calculated residue properties	
Heptanes plus	
Mole %	24.63
Molecular Weight (g mol-1)	289
Density at 15.6°C (g cm-3)	0.9078
Decanes plus	
Mole %	18.07
Molecular Weight (g mol-1)	356
Density at 15.6°C (g cm-3)	0.9296
Eicosanes plus	
Mole %	7.90
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	2.70
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	97.0

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
3rd CO_2 GAS ADDITION - 1.032 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9653	1.3080		0.7752
518.1		0.9717	1.3167		0.7701
483.6		0.9787	1.3262		0.7646
449.2		0.9866	1.3370		0.7584
435.4		0.9902	1.3417		0.7557
428.5		0.9920	1.3443		0.7543
421.6		0.9940	1.3469		0.7528
414.7		0.9960	1.3496		0.7513
407.8		0.9981	1.3525		0.7497
402.3	**Bubble point pressure**	**1.0000**	**1.3551**	**100.00**	**0.7483**
399.3		1.0011	1.3565	91.63	
397.5		1.0017	1.3573	88.94	
395.1		1.0026	1.3585	86.47	
392.7		1.0035	1.3598	84.83	
379.0		1.0090	1.3673	80.27	
360.9		1.0176	1.3789	77.12	
332.3		1.0350	1.4025	74.57	
290.2		1.0728	1.4537		
241.0		1.1484	1.5562		
206.3		1.2396	1.6798		
178.2		1.3553	1.8366		
159.2		1.4690	1.9907		
147.7		1.5583	2.1117		
136.4		1.6657	2.2572		
110.0		2.0381	2.7618		
87.5		2.5936	3.5145		
65.3		3.6069	4.8876		

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Liquid shrinkage as a percentage of volume at bubble point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 3rd CARBON DIOXIDE GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	50.87	27.36
Nitrogen	0.28	0.10
Methane	20.94	4.10
Ethane	3.13	1.15
Propane	2.85	1.54
i-Butane	0.40	0.28
n-Butane	1.46	1.03
neo-Pentane	0.00	0.00
i-Pentane	0.53	0.47
n-Pentane	0.85	0.74
Hexanes	1.11	1.17
Me-Cyclo-pentane	0.34	0.34
Benzene	0.29	0.28
Cyclo-hexane	0.23	0.24
Heptanes	0.91	1.11
Me-Cyclo-hexane	0.29	0.34
Toluene	0.36	0.41
Octanes	1.02	1.42
Ethyl-benzene	0.18	0.23
Meta/Para-xylene	0.16	0.21
Ortho-xylene	0.10	0.12
Nonanes	0.83	1.30
Tri-Me-benzene	0.05	0.07
Decanes	1.00	1.74
Undecanes	0.95	1.70
Dodecanes	0.84	1.65
Tridecanes	0.84	1.80
Tetradecanes	0.72	1.67
Pentadecanes	0.72	1.81
Hexadecanes	0.58	1.56
Heptadecanes	0.53	1.53
Octadecanes	0.52	1.59
Nonadecanes	0.53	1.69
Eicosanes	0.38	1.26
Heneicosanes	0.34	1.21
Docosanes	0.32	1.19
Tricosanes	0.29	1.11
Tetracosanes	0.27	1.09
Pentacosanes	0.25	1.03
Hexacosanes	0.24	1.05
Heptacosanes	0.22	0.98
Octacosanes	0.21	1.00
Nonacosanes	0.20	0.96
Triacontanes	0.20	1.02

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 3rd CARBON DIOXIDE GAS ADDITION

Components (continued)	Mole %	Weight %
Hentriacontanes	0.20	1.02
Dotriacontanes	0.17	0.89
Tritriacontanes	0.16	0.90
Tetratriacontanes	0.15	0.86
Pentatriacontanes	0.15	0.86
Hexatriacontanes plus	1.93	22.82
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	1.76	1.97	0.7321	91.4
Octanes	1.66	2.17	0.7430	106.7
Nonanes	1.27	1.86	0.7614	120.7
Decanes	1.05	1.81	0.7383	141.2

Calculated residue properties	
Heptanes plus	
Mole %	17.59
Molecular Weight (g mol-1)	289
Density at 15.6°C (g cm-3)	0.9078
Decanes plus	
Mole %	12.91
Molecular Weight (g mol-1)	356
Density at 15.6°C (g cm-3)	0.9296
Eicosanes plus	
Mole %	5.64
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	1.93
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	81.9

Statoil a.s.
15/9-19A
RFLA 980053

CONSTANT COMPOSITION EXPANSION AT 110°C
4th CO_2 GAS ADDITION - 2.324 moles of GAS : 1.000 moles of SAMPLE

Pressure (bara)		Relative Volume (1)	Relative Volume (2)	Liquid Volume % (3)	Density (g cm-3)
552.6		0.9953	1.7637		0.7731
545.7		0.9972	1.7670		0.7716
538.8		0.9991	1.7704		0.7701
535.4	**Dew point pressure**	**1.0000**	**1.7720**	**0.00**	**0.7694**
528.2		1.0017	1.7750	19.13	
526.0		1.0022	1.7759	19.92	
523.5		1.0028	1.7770	20.33	
521.6		1.0033	1.7778	20.54	
519.3		1.0038	1.7788	20.76	
500.5		1.0089	1.7878	22.74	
478.3		1.0158	1.8001	25.70	
440.3		1.0307	1.8264	31.80	
382.0		1.0639	1.8852		
322.2		1.1199	1.9846		
271.7		1.1995	2.1256		
234.6		1.2923	2.2901		
206.9		1.3942	2.4705		
185.8		1.5010	2.6597		
169.8		1.6065	2.8468		
153.9		1.7407	3.0845		
131.3		2.0085	3.5591		
109.0		2.4145	4.2785		
85.4		3.1400	5.5641		

Retrograde liquid volumes quoted include a small volume of heavy liquid deposits that accumulated following CO_2 gas addition.

(1) Relative Volume = V / Vsat ie. volume at indicated pressure per volume at bubble point pressure.
(2) Relative Volume = V / Vsat ie. volume at indicated pressure per volume of original fluid at bubble point pressure.
(3) Retrograde liquid accumulation as a percentage of volume at dew point pressure.

Statoil a.s.
15/9-19A
RFLA 980053

CALCULATED COMPOSITION OF MIXTURE FROM THE 4th CARBON DIOXIDE GAS ADDITION

Component	Mole %	Weight %
Hydrogen	0.00	0.00
Hydrogen sulphide	0.00	0.00
Carbon dioxide	70.44	46.45
Nitrogen	0.17	0.07
Methane	12.60	3.03
Ethane	1.88	0.85
Propane	1.71	1.13
i-Butane	0.24	0.21
n-Butane	0.88	0.76
neo-Pentane	0.00	0.00
i-Pentane	0.32	0.34
n-Pentane	0.51	0.55
Hexanes	0.67	0.86
Me-Cyclo-pentane	0.20	0.25
Benzene	0.17	0.20
Cyclo-hexane	0.14	0.17
Heptanes	0.54	0.82
Me-Cyclo-hexane	0.17	0.25
Toluene	0.22	0.30
Octanes	0.61	1.04
Ethyl-benzene	0.11	0.17
Meta/Para-xylene	0.10	0.15
Ortho-xylene	0.06	0.09
Nonanes	0.50	0.96
Tri-Me-benzene	0.03	0.05
Decanes	0.60	1.28
Undecanes	0.57	1.25
Dodecanes	0.51	1.22
Tridecanes	0.51	1.32
Tetradecanes	0.43	1.23
Pentadecanes	0.43	1.34
Hexadecanes	0.35	1.15
Heptadecanes	0.32	1.13
Octadecanes	0.31	1.18
Nonadecanes	0.32	1.24
Eicosanes	0.23	0.93
Heneicosanes	0.20	0.89
Docosanes	0.19	0.88
Tricosanes	0.17	0.82
Tetracosanes	0.16	0.81
Pentacosanes	0.15	0.76
Hexacosanes	0.14	0.78
Heptacosanes	0.13	0.72
Octacosanes	0.13	0.73
Nonacosanes	0.12	0.71
Triacontanes	0.12	0.75

Statoil a.s.
15/9-19A
RFLA 980053

COMPOSITION RESIDUE PROPERTIES FROM THE 4th CARBON DIOXIDE GAS ADDITION

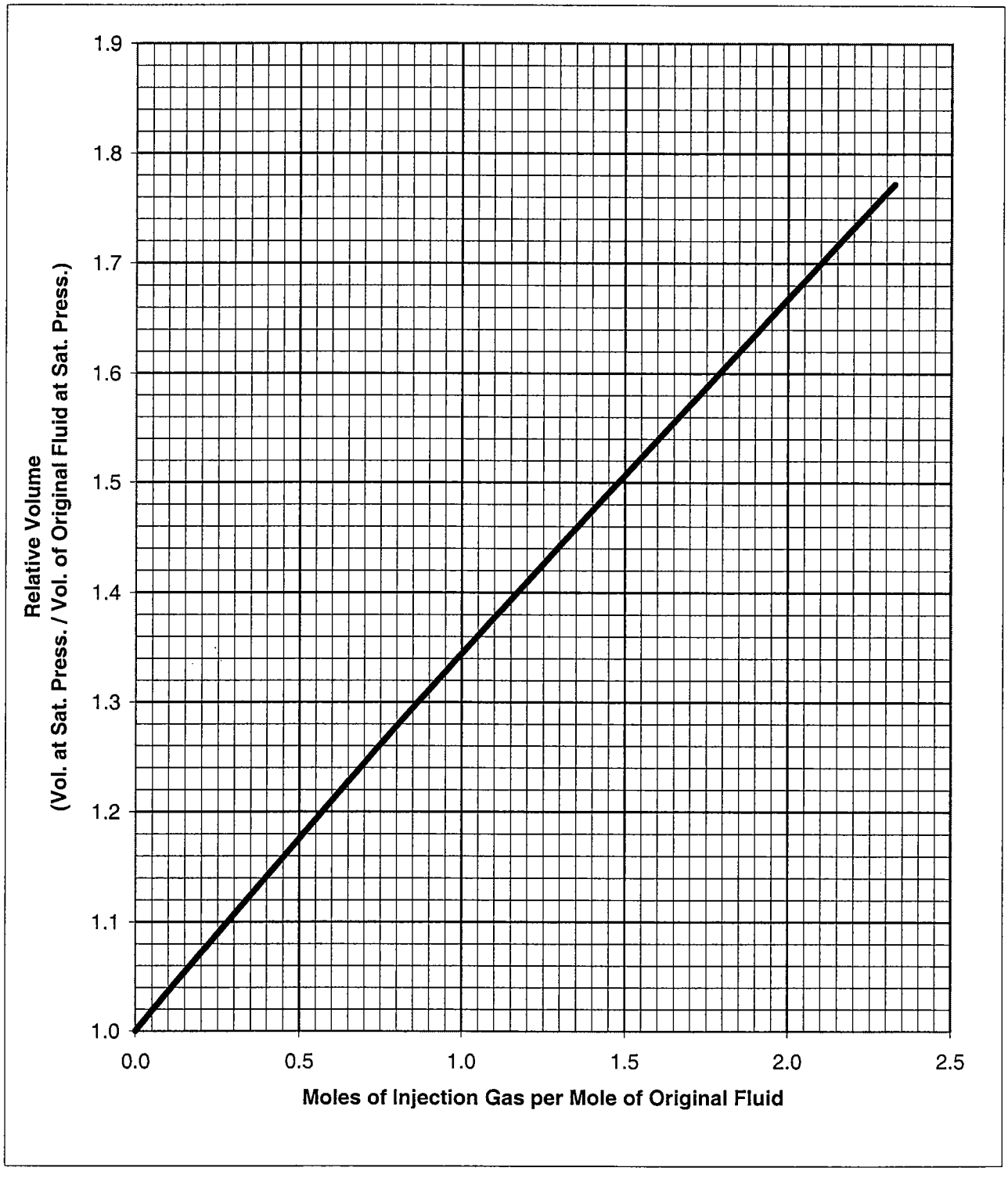
Components (continued)	Mole %	Weight %
Hentriacontanes	0.12	0.76
Dotriacontanes	0.10	0.66
Tritriacontanes	0.10	0.66
Tetratriacontanes	0.09	0.64
Pentatriacontanes	0.09	0.63
Hexatriacontanes plus	1.16	16.83
Totals :	100.00	100.00

Grouped Data	Mole %	Weight %	Density at 15.6°C (g cm-3)	Molecular weight (g mol-1)
Heptanes	1.06	1.44	0.7314	91.5
Octanes	1.00	1.59	0.7432	106.7
Nonanes	0.76	1.37	0.7609	120.7
Decanes	0.63	1.33	0.7380	141.3

Calculated residue properties	
Heptanes plus	
Mole %	10.58
Molecular Weight (g mol-1)	289
Density at 15.6°C (g cm-3)	0.9078
Decanes plus	
Mole %	7.76
Molecular Weight (g mol-1)	356
Density at 15.6°C (g cm-3)	0.9296
Eicosanes plus	
Mole %	3.39
Molecular Weight (g mol-1)	570
Density at 15.6°C (g cm-3)	0.9885
Hexatriacontanes plus	
Mole %	1.16
Molecular Weight (g mol-1)	968
Density at 15.6°C (g cm-3)	1.0736
Whole sample properties	
Average mole weight (g mol-1)	66.8

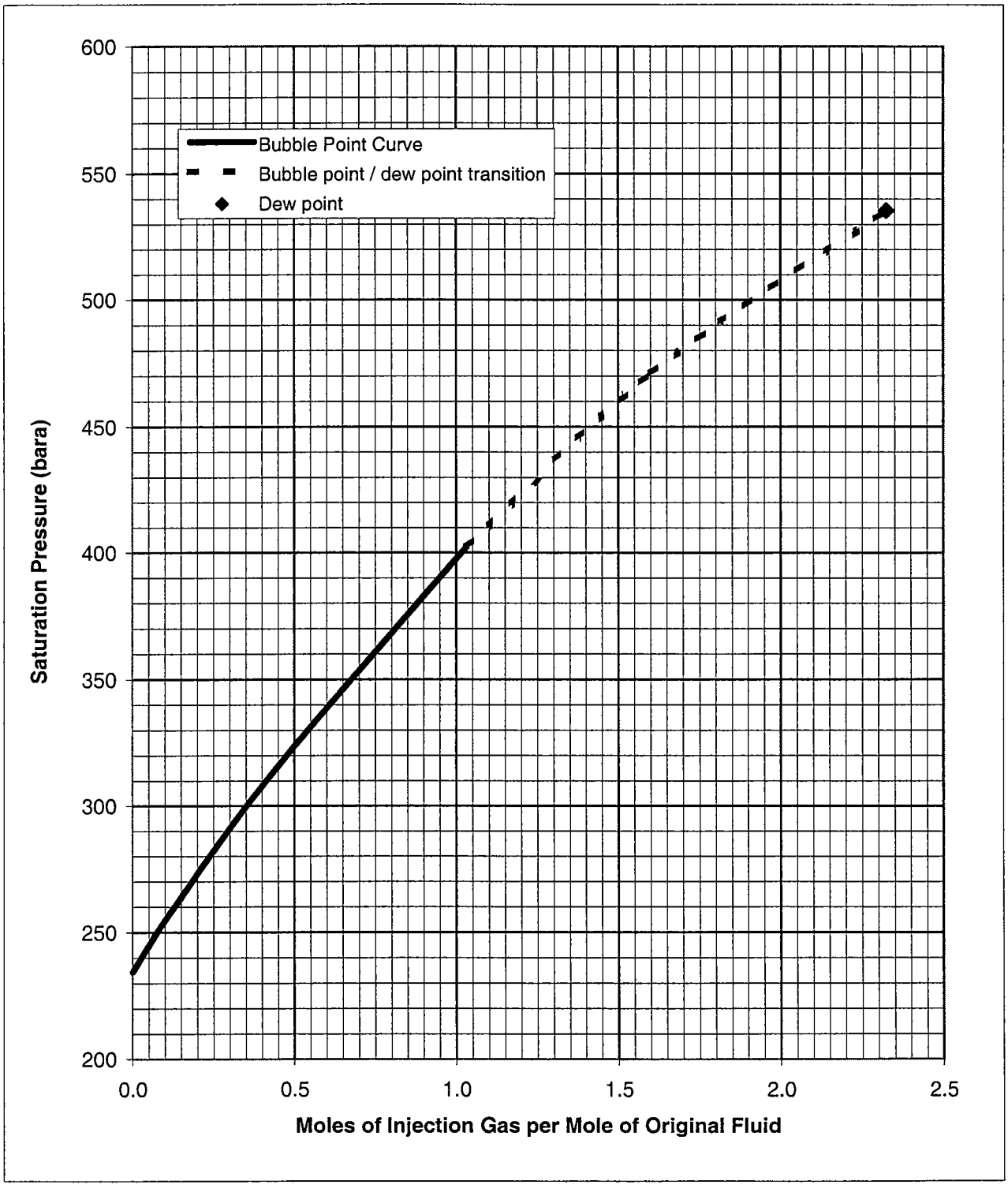
Statoil a.s.
15/9-19A
RFLA 980053

RELATIVE VOLUME v MOLES OF CO2 INJECTION GAS FROM THE SOLUBILITY-SWELLING TEST AT 110°C



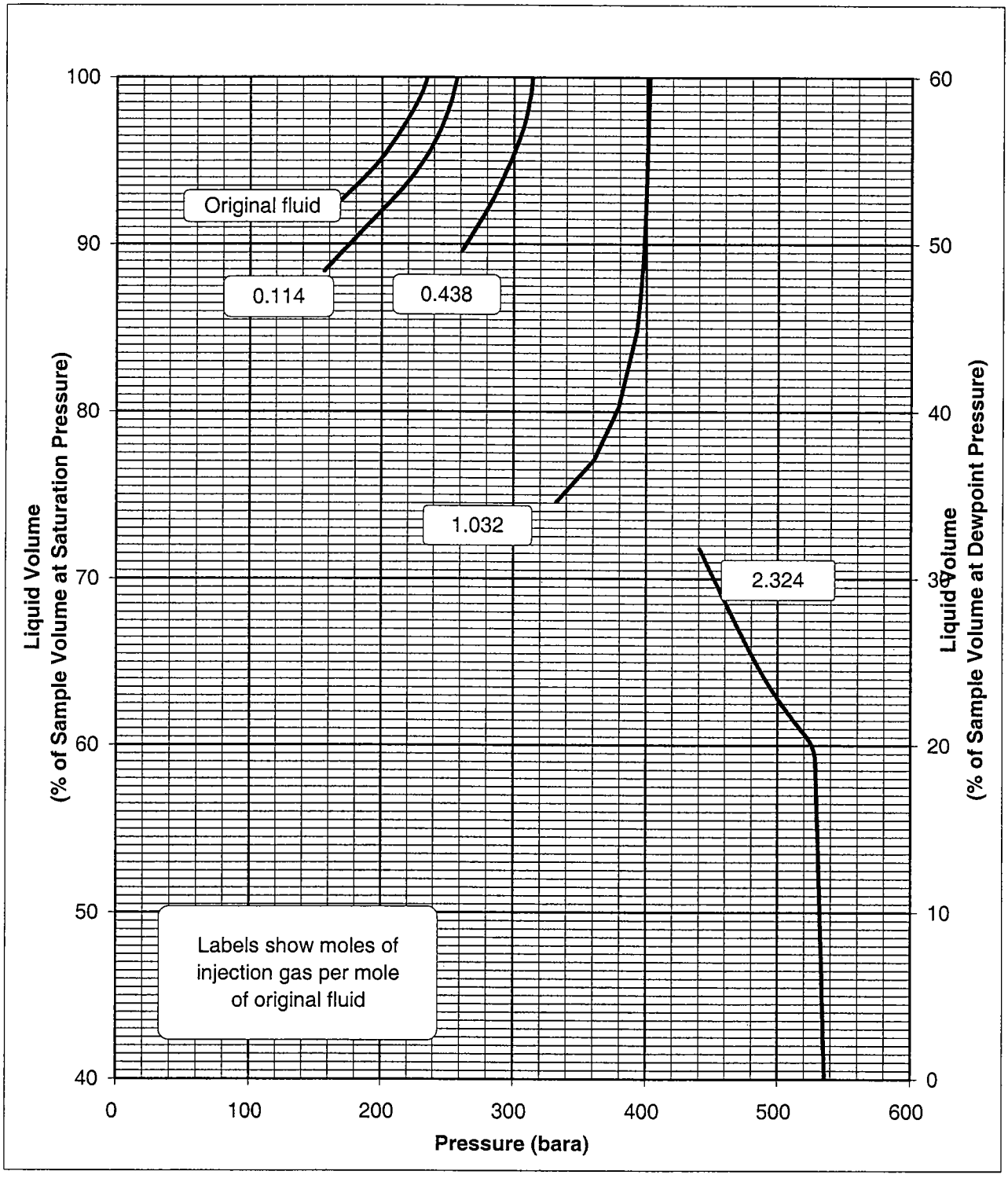
Statoil a.s.
15/9-19A
RFLA.980053

SATURATION PRESSURE v MOLES OF CO2 INJECTION GAS FROM THE SOLUBILITY-SWELLING TEST AT 110°C



Statoil a.s.
15/9-19A
RFLA 980053

LIQUID VOLUME% v PRESSURE
FROM THE CO2 SOLUBILITY-SWELLING TESTS AT 110°C



Section E
Appendix

CORELAB

CORE LABORATORIES (U.K.) LIMITED
Advanced Technology Centre

Statoil a.s.
15/9-19A
RFLA 980053

DATA USED IN GAS COMPOSITIONAL CALCULATIONS

Component		Mole Weight (g mole-1)	Density (g cm-3 at 15.6°C)	Component		Mole Weight (g mole-1)	Density (g cm-3 at 15.6°C)
Hydrogen	*	2.016	N/A	33DMC5	*	100.20	0.6954
Oxygen/(Argon)	**	31.999	1.1410	Cyclohexane	*	84.16	0.7827
Nitrogen (Corrected)	**	28.013	0.8086	2MC6/23DMC5	*	100.20	0.6917
Methane	**	16.043	0.2997	11DMCYC5/3MC6	*	99.20	0.7253
Carbon Dioxide	**	44.010	0.8172	t13DMCYC5	*	98.19	0.7528
Ethane	**	30.070	0.3558	c13DMCYC5/3EC5	*	99.20	0.7262
Hydrogen Sulphide	**	34.080	0.8006	t12DMCYC5	*	98.19	0.7554
Propane	**	44.097	0.5065	Heptanes (nC7)	*	100.20	0.6875
i-Butane	**	58.123	0.5623	22DMC6	*	114.23	0.6994
n-Butane	**	58.123	0.5834	MCYC6	*	98.19	0.7740
Neo-Pentane	*	72.15	0.5968	ECYC5	*	98.19	0.7704
i-Pentane	**	72.150	0.6238	223TMC5/24&25DMC6	*	114.23	0.7060
n-Pentane	**	72.150	0.6305	ctc124TMCYC5	*	112.21	0.7511
22DMC4	*	86.18	0.6529	ctc123TMCYC5	*	112.21	0.7574
23DMC4/CYC5	*	78.16	0.7129	Toluene	*	92.14	0.8734
2MC5	*	86.18	0.6572	Octanes (nC8)	*	114.23	0.7063
3MC5	*	86.18	0.6682	E-Benzene	*	106.17	0.8735
Hexanes (nC6)	*	86.18	0.6631	M/P-Xylene	*	106.17	0.8671
22DMC5	*	100.20	0.6814	O-Xylene	*	106.17	0.8840
M-C-Pentane	*	84.16	0.7533	Nonanes (nC9)	*	128.26	0.7212
24DMC5	*	100.20	0.6757	Decanes	***	134	0.778
223TMC4	*	100.20	0.6947	Undecanes	***	147	0.789
Benzene	*	78.11	0.8820	Dodecanes	***	161	0.800

Data Source Refs :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds

** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96

*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655
Predicting Phase Behaviour of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi

Note :
The gas mole % compositions were calculated from the measured weight % compositions using the most detailed analysis results, involving as many of the above components as were identified. The reported component mole % compositions were then sub-grouped into the generic carbon number components.

Statoil a.s.
15/9-19A
RFLA 980053

DATA USED IN LIQUID COMPOSITIONAL CALCULATIONS

Component		Mole Weight (g mole-1)	Density (g cm-3 at 15.6°C)	Component		Mole Weight (g mole-1)	Density (g cm-3 at 15.6°C)
Hydrogen	*	2.016	N/A	Undecanes	***	147	0.789
Hyd. sulphide	**	34.080	0.8006	Dodecanes	***	161	0.800
Carbon Dioxide	**	44.010	0.8172	Tridecanes	***	175	0.811
Nitrogen	**	28.013	0.8086	Tetradecanes	***	190	0.822
Methane	**	16.043	0.2997	Pentadecanes	***	206	0.832
Ethane	**	30.070	0.3558	Hexadecanes	***	222	0.839
Propane	**	44.097	0.5065	Heptadecanes	***	237	0.847
i-Butane	**	58.123	0.5623	Octadecanes	***	251	0.852
n-Butane	**	58.123	0.5834	Nonadecanes	***	263	0.857
i-Pentane	**	72.150	0.6238	Eicosanes	***	275	0.862
n-Pentane	**	72.150	0.6305	Heneicosanes	***	291	0.867
Hexanes	**	86.177	0.6634	Docosanes	***	305	0.872
Me-cyclo-pentane	*	84.16	0.7533	Tricosanes	***	318	0.877
Benzene	*	78.11	0.8820	Tetracosanes	***	331	0.881
Cyclo-hexane	*	84.16	0.7827	Pentacosanes	***	345	0.885
Heptanes	**	100.204	0.6874	Hexacosanes	***	359	0.889
Me-cyclo-hexane	*	98.19	0.7740	Heptacosanes	***	374	0.893
Toluene	*	92.14	0.8734	Octacosanes	***	388	0.896
Octanes	**	114.231	0.7061	Nonacosanes	***	402	0.899
Ethyl-benzene	*	106.17	0.8735	Triacontanes	***	416	0.902
Meta/Para-xylene	*	106.17	0.8671	Hentriacontanes	***	430	0.906
Ortho-xylene	*	106.17	0.8840	Dotriacontanes	***	444	0.909
Nonanes	**	128.258	0.7212	Tritriacontanes	***	458	0.912
1-2-4-T-M-benzene	*	120.19	0.8797	Tetratriacontanes	***	472	0.914
Decanes	**	142.285	0.7334	Pentatriacontanes	***	486	0.917
				Hexatriacontanes	***	500	0.919

Data Source Refs :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds

** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96

*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655
Predicting Phase Behaviour of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi

Note :
The residue mole weight and density values (eg heptanes plus, undecanes plus, eicosanes plus) are calculated so that the calculated average mole weights and densities correspond with the measured values. This can lead to anomalous residue mole weights and densities where the Katz and Firoozabadi values may not be suitable for the isomer groups detected.

Statoil a.s.
15/9-19A
RFLA 980053

Core Laboratories (U.K.) Limited
Reservoir Fluid Analysis

Report prepared by

Neil Tosh
PVT Laboratory Supervisor

Report approved by

Ewan Thomson
Technical Sales Engineer