



SECTOR FOR RESERVOIR TECHNOLOGY

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Title PVT analysis Well 15/9-19SR DST 1 Bottom hole and separator samples		
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Key words

Abstract <p>Quality check and compositional analyses were performed on two bottom hole samples and one set of separator samples. The bubble point pressure of the bottom hole samples were 273.2 bar (BHS #1) and 273.8 bar (BHS #2) at reservoir temperature (106°C).</p> <p>For BHS #2, the density and viscosity at the bubble point were measured to 0.701 g/cm³ and 0.547 cP. The oil formation volume factors at the bubble point were 1.505 m³/Sm³ (single flash) and 1.557 m³/Sm³ (differential vaporization). Total gas-oil ratios were 159.1 Sm³/Sm³ (single flash) and 169.0 Sm³/Sm³ (diff. vap.).</p>

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INTRODUCTION

The present report gives the results of PVT and compositional analysis of two bottom hole samples and one set of separator samples from well 15/9-19-SR test 1.

The quality of the bottom hole samples was checked by determining the bubble point pressure at reservoir temperature. The bubble points were found to be 273.2 bar (BHS # 1) and 273.8 bar (BHS # 2).

The composition of the bottom hole samples was determined by a single flash to atmospheric conditions followed by gas-chromatographic analysis of the stabilized oil and gas. Mathematical recombination of the oil and gas compositions according to the measured gas-oil ratio then gave the final reservoir fluid composition.

The quality of the separator samples was checked by measuring the bubble point pressure of the separator liquid at separator temperature, and the opening pressure of the gas bottle.

The composition of the separator samples was determined by single flash of the separator oil to standard conditions, followed by compositional analysis of flash oil, flash gas and separator gas by gas chromatography.

Reservoir fluid composition was determined by mathematical recombination of separator oil and gas compositions according to the gas-oil ratio from the test.

On the basis of a comparison of the compositions of the bottom hole samples and the mathematically recombined separator samples, BHS # 2 was chosen for further analysis.

Different portions of the sample were transferred to a PVT cell for differential vaporization analysis and to a rolling ball viscosimeter for viscosity measurements.

An extended composition of reservoir fluid to C20 plus is calculated using single flash data and additional data from the distillation report.

SAMPLING DATA¹

Field	Sleipner, Theta Vest
Well	15/9-19-SR
Test	1
Producing zone	Hugin
Interval tested	4316.0-4338.0 m MD RKB
Reservoir fluid	Oil
Static bottom hole conditions	
Reservoir pressure ²	328 bar
Reservoir temperature ²	106 °C
BHS # 1	
Bottle no.	TS-61-04
Sampling depth	3885.16 m MD RKB
BHS chamber no.	PSTE-T 078811
Date of sampling	19.04.93
Time of sampling	-
BHS # 2	
Bottle no.	TS-29-06
Sampling depth	3888.72 m MD RKB
BHS chamber no.	PSTE-T 178821
Date of sampling	19.04.93
Time of sampling	10:28

¹ Data from Schlumberger sampling sheet.

² Data supplied by DDB PE.

WELL : 15/9-19-SR
 DST : 1
 BOTTLE: TS-29-06

CONSTANT MASS EXPANSION AT 106.0 °C

PRESSURE BAR	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
398.3	0.9776	1.61E-04	
382.7	0.9803	1.66E-04	
362.5	0.9836	1.73E-04	
341.9	0.9871	1.79E-04	
322.7	0.9906	1.85E-04	
302.5	0.9944	1.92E-04	
282.2	0.9984	1.98E-04	
Pb = 273.8	1.0000	2.00E-04	
265.8	1.0068		4.43
255.0	1.0169		4.35
236.7	1.0375		4.18
210.6	1.0771		3.89
175.5	1.1577		3.55
135.8	1.3201		3.17
98.8	1.6237		2.84
69.7	2.1350		2.58
FOR P < Pb	Y = 1.892 + 9.58E-03 x P		
FOR P > Pb	V/Vb = 1.06783 - 2.9501E-04xP + 1.7264E-07xPxP		

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-29-06

COMPOSITION OF RESERVOIR FLUID
 (Single flash to ambient conditions)

	STABILIZED OIL	EVOLVED GAS	RECOMBINED FLUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
Nitrogen	0.00	0.71	0.13	28.0	0.46
Carbondioxide	0.00	7.65	2.15	44.0	4.95
Methane	0.25	67.10	6.88	16.0	43.50
Ethane	0.26	9.34	1.82	30.1	6.14
Propane	0.96	7.60	2.29	44.1	5.26
i-Butane	0.29	0.91	0.39	58.1	0.69
n-Butane	1.61	3.21	1.52	58.1	2.65
i-Pentane	1.11	0.82	0.66	72.2	0.92
n-Pentane	2.18	1.15	1.08	72.2	1.51
Hexanes	4.46	0.81	1.75	84.6	2.10
Heptanes	8.36	0.52	2.97	91.5	3.29
Octanes	8.92	0.14	3.37	105.5	3.24
Nonanes	6.75	0.02	2.82	119.7	2.39
Decanes plus	64.86	0.00	72.20	320.0	22.90
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	240.5	25.63			101.48

Gas oil ratio	=	159.1	Sm ³ /Sm ³ STO
Flash formation volume factor of bubble point liquid	=	1.505	m ³ /Sm ³ STO
Density at bubble point	=	0.701	g/cm ³
Density of stabilized oil	=	0.883	g/cm ³ at 15°C
Gas gravity (air=1)	=	0.885	
Density of C10+	=	0.916	g/cm ³
<i>Density at 328 bar</i>		<i>0.708</i>	<i>g/cm³</i>

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-29-06

DETAILED COMPOSITION OF RESERVOIR FLUID TO C10 PLUS

	WEIGHT%	MOL WT	MOL%	DENSITY g/cm ³ 15°C
Nitrogen	0.127	28.01	0.461	
Carbondioxide	2.147	44.01	4.951	
Methane	6.876	16.04	43.504	
Ethane	1.818	30.07	6.136	
Propane	2.285	44.10	5.259	
i-Butane	0.393	58.12	0.687	
n-Butane	1.516	58.12	2.648	
i-Pentane	0.656	72.15	0.923	
n-Pentane	1.077	72.15	1.514	
C6 Paraffines	1.610	86.20	1.895	0.663
C6 Naphtenes	0.139	70.11	0.202	0.750
C6 Total	1.749	84.65	2.097	0.669
C7 Paraffines	1.302	100.20	1.319	0.688
C7 Naphtenes	1.229	88.61	1.407	0.761
C7 Aromates	0.434	78.10	0.564	0.884
C7 Total	2.965	91.45	3.290	0.742
C8 Paraffines	1.388	114.20	1.233	0.706
C8 Naphtenes	1.331	104.57	1.291	0.771
C8 Aromates	0.650	92.10	0.717	0.871
C8 Total	3.369	105.48	3.241	0.759
C9 Paraffines	1.320	128.29	1.044	0.721
C9 Naphtenes	0.728	121.28	0.609	0.791
C9 Aromates	0.774	106.20	0.740	0.873
C9 Total	2.822	119.68	2.393	0.776
Decanes plus	72.198	319.98	22.897	0.916
	-----		-----	
	100.000		100.000	

	Component Group	Weight%	Mol%
Benzene	C7 Aromates	0.434	0.564
Toluene	C8 Aromates	0.650	0.716
Xylenes	C9 Aromates	0.460	0.440
MeCyclopentane	C7 Naphtenes	0.480	0.579
Cyclohexane	C7 Naphtenes	0.316	0.381
MeCyclohexane	C8 Naphtenes	0.534	0.552

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-29-06

DETAILED COMPOSITION OF RESERVOIR FLUID TO C20 PLUS

	WEIGHT%	MOL WT	MOL%	DENSITY g/cm ³ 15°C
Nitrogen	0.127	28.01	0.461	
Carbondioxide	2.147	44.01	4.951	
Methane	6.876	16.04	43.504	
Ethane	1.818	30.07	6.136	
Propane	2.285	44.10	5.259	
i-Butane	0.393	58.12	0.687	
n-Butane	1.516	58.12	2.648	
i-Pentane	0.656	72.15	0.923	
n-Pentane	1.077	72.15	1.514	
C6 Paraffines	1.610	86.20	1.895	0.663
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C8 Paraffines	1.388	114.20	1.233	0.706
C8 Naphtenes	1.331	104.57	1.291	0.771
C8 Aromates	0.650	92.10	0.717	0.871
C8 Total	3.369	105.48	3.241	0.759
C9 Paraffines	1.320	128.29	1.044	0.721
C9 Naphtenes	0.728	121.28	0.609	0.791
C9 Aromates	0.774	106.20	0.740	0.873
C9 Total	2.822	119.68	2.393	0.776
C10 fraction	2.088	132.34	1.605	0.792
C11 fraction	2.418	143.40	1.715	0.793
C12 fraction	2.671	155.90	1.742	0.810
C13 fraction	2.530	170.40	1.510	0.821
C14 fraction	2.406	183.10	1.336	0.831
C15 fraction	2.346	195.30	1.221	0.839
C16 fraction	2.159	208.60	1.052	0.849
C17 fraction	2.316	223.00	1.056	0.852
C18 fraction	2.295	239.30	0.975	0.855
C19 fraction	2.183	252.30	0.880	0.863
C20 plus	48.787	505.90	9.806	0.957
	-----		-----	
	100.000		100.000	

WELL :15/9-19-SR
 DST :1
 BOTTLE:TS-29-06

DIFFERENTIAL VAPORIZATION AT 106.0 °C

PRESSURE BAR	OIL FORM VOL FACT Bod	SOLUTION GOR Rs	GAS FORM VOL FACT Bg	RES OIL DENSITY g/cm ³	COMPR FACTOR Z	GAS VISCOSITY cP
273.8	1.557	169.0		0.698		
255.0	1.525	156.4	4.68E-03	0.705	0.897	0.0251
230.8	1.483	140.5	5.13E-03	0.715	0.891	0.0233
200.8	1.438	122.6	5.78E-03	0.725	0.872	0.0213
160.7	1.381	99.8	7.24E-03	0.740	0.874	0.0186
120.7	1.329	78.7	9.76E-03	0.754	0.885	0.0165
81.7	1.278	58.6	1.48E-02	0.768	0.907	0.0149
51.6	1.240	43.2	2.40E-02	0.780	0.930	0.0138
25.2	1.201	28.7	5.12E-02	0.791	0.970	0.0127
1.0	1.080			0.823		
1.0*	1.000			0.889		

* At 15 °C

** Estimated according to Lee et. al.

Bod : Volume of oil at P and T per volume
 of residual oil at 15 °C and atm P

Rsd : Standard m³ gas per m³ residual oil
 at 15 °C and atm P

Bg : m³ gas at T and P per standard m³ gas

WELL :15/9-19-SR
 DST :1
 BOTTLE:TS-29-06

DIFFERENTIAL VAPORIZATION AT 106.0 °C

(Molecular composition of differentially liberated gas, mol%)

P/Bar	255.0	230.8	200.8	160.7	120.7	81.7	51.6	25.2	1.0
N2	1.36	1.28	1.22	1.06	0.74	0.55	0.31	0.12	0.00
CO2	6.70	6.76	6.85	7.12	7.42	8.13	8.96	10.14	5.93
C1	76.96	76.60	77.18	77.47	76.63	74.71	70.22	60.05	20.53
C2	6.39	6.52	6.49	6.59	7.17	8.02	9.77	13.23	13.55
C3	4.29	4.37	4.21	4.11	4.42	4.92	6.25	9.59	19.59
i-C4	0.47	0.48	0.45	0.42	0.46	0.47	0.60	0.94	2.84
n-C4	1.57	1.60	1.48	1.37	1.43	1.51	1.91	3.02	11.25
i-C5	0.43	0.43	0.39	0.35	0.35	0.35	0.43	0.66	3.54
n-C5	0.63	0.64	0.57	0.51	0.49	0.50	0.60	0.92	5.49
C6	0.58	0.60	0.53	0.45	0.42	0.40	0.46	0.67	5.72
C7	0.45	0.52	0.44	0.37	0.33	0.31	0.35	0.50	5.85
C8	0.15	0.18	0.17	0.15	0.12	0.12	0.12	0.14	3.49
C9	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	1.39
C10+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84
	----	----	----	----	----	----	----	----	----
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Molwt	22.52	22.69	22.42	22.23	22.38	22.83	24.05	26.97	50.27
Gravity	0.778	0.783	0.774	0.768	0.773	0.788	0.830	0.931	1.735

WELL :15/9-19-SR
 DST :1
 BOTTLE:TS-29-06

DIFFERENTIAL VAPORIZATION AT 106.0 °C
 (Molecular composition of residual oil)

COMPONENT	MOL%	
Nitrogen	0.00	
Carbondioxide	0.00	
Methane	0.04	
Ethane	0.15	
Propane	0.77	
i-Butane	0.24	
n-Butane	1.29	
i-Pentane	0.87	
n-Pentane	1.65	
Hexanes	3.50	
Heptanes	7.13	
Octanes	8.18	
Nonanes	6.45	
Decanes+	69.73	

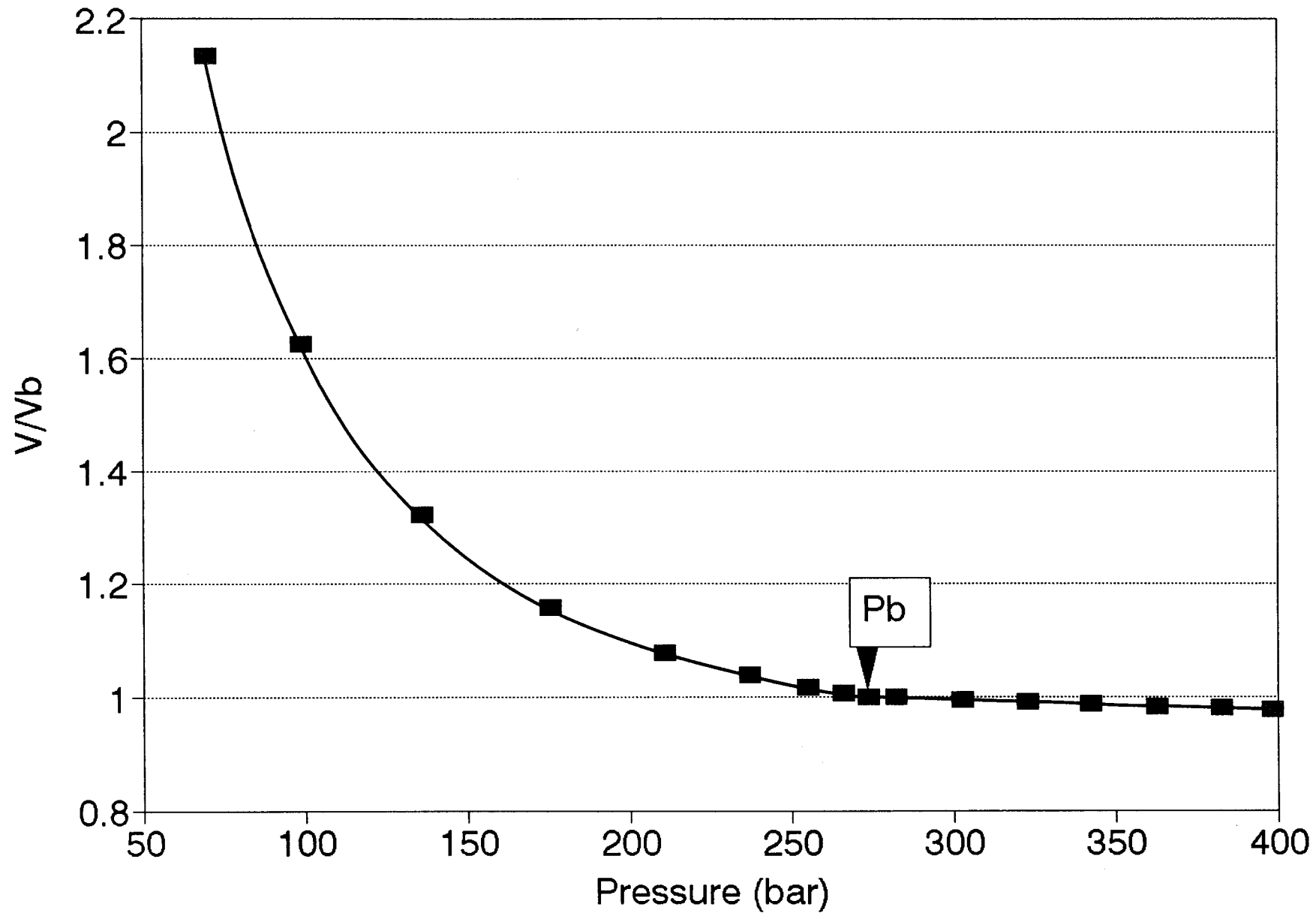
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Density at 15 °C	0.889	g/cm ³
Mole weight	257.6	

WELL : 15/9-19-SR
DST : 1
BOTTLE: TS-29-06

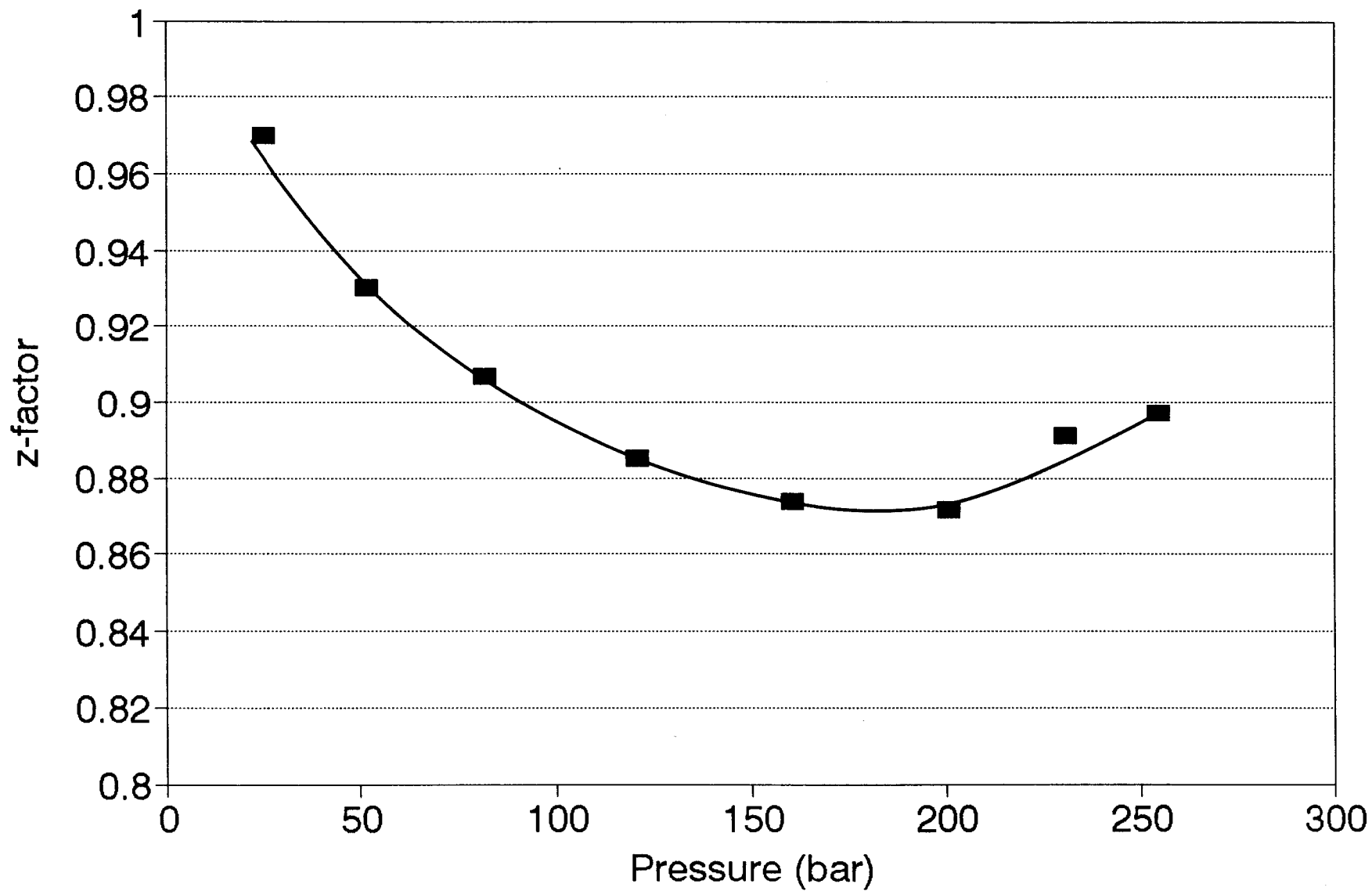
VISCOSITY OF RESERVOIR FLUID AT 106.0 °C

PRESSURE bar	VISCOSITY cP
360.0	0.604
340.0	0.593
320.0	0.578
300.0	0.565
280.0	0.551
Pb = 273.8	0.547
240.0	0.555
220.0	0.597
200.0	0.638
170.0	0.708
130.0	0.829
91.0	1.007
50.0	1.229
21.0	1.467
1.0	2.306

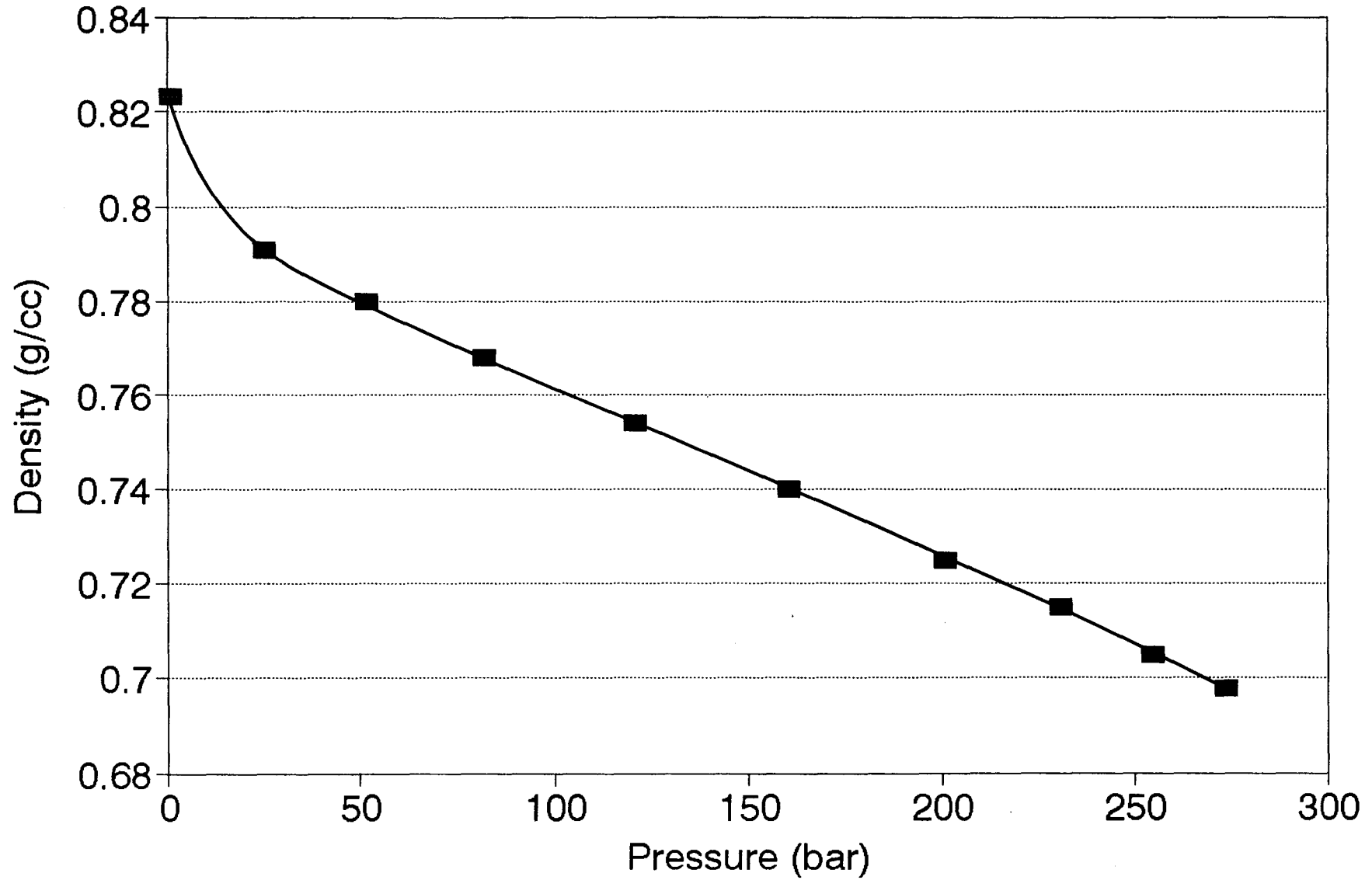
Constant mass expansion at 106 °C



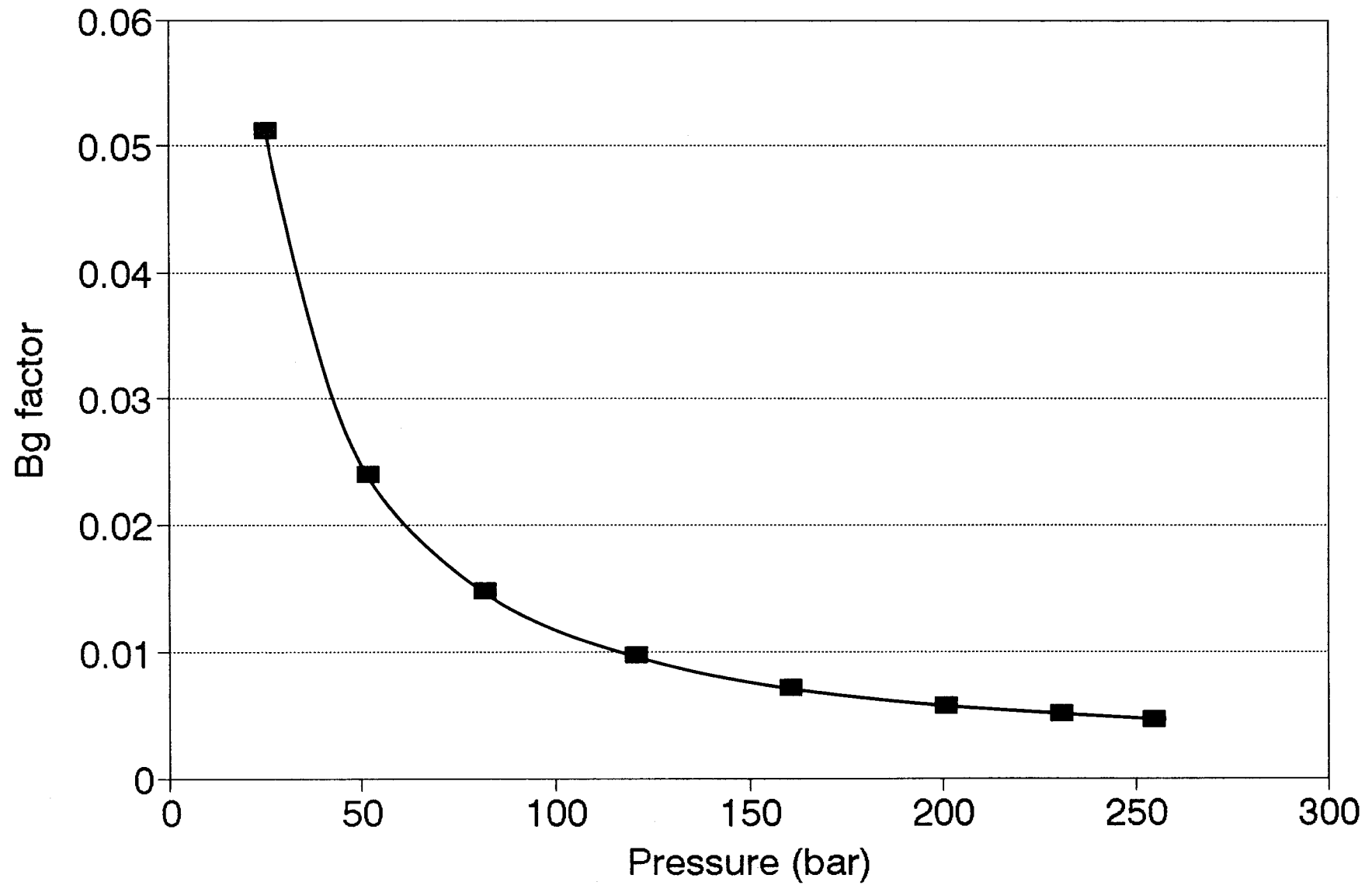
Differential vaporization at 106 °C compressibility factor



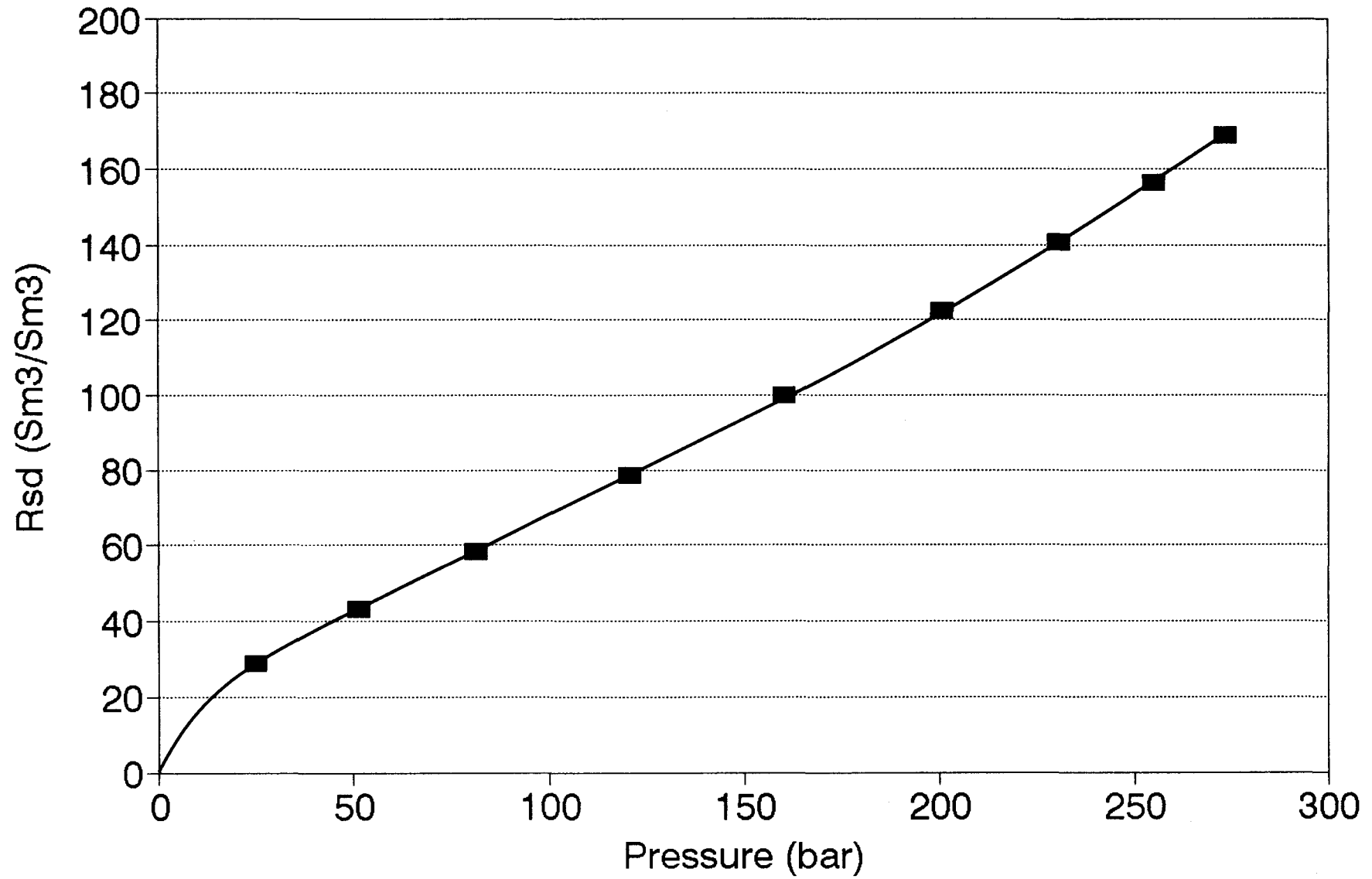
Differential vaporization at 106 °C
reservoir oil density



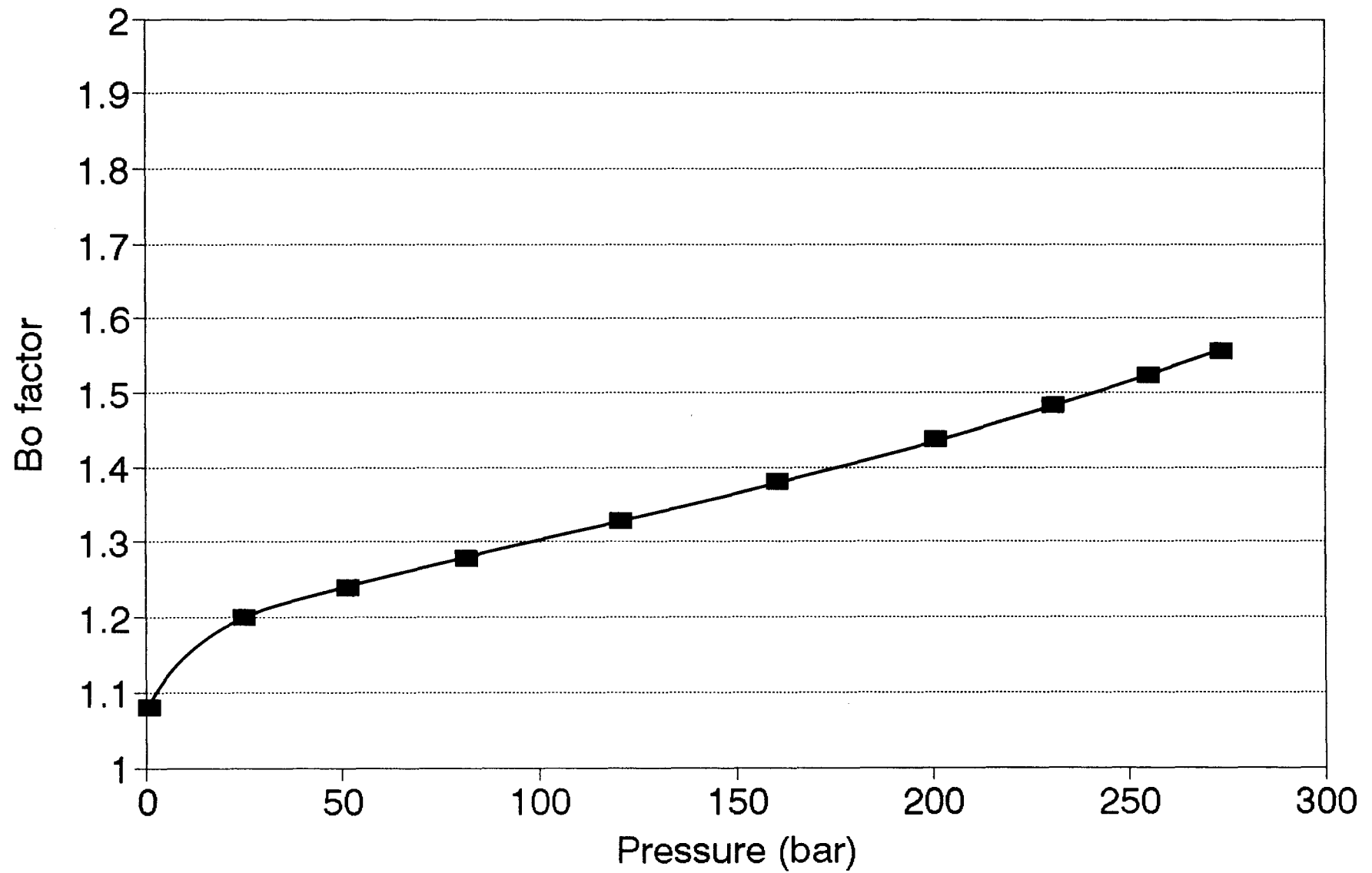
Differential vaporization at 106 °C gas formation volume factor



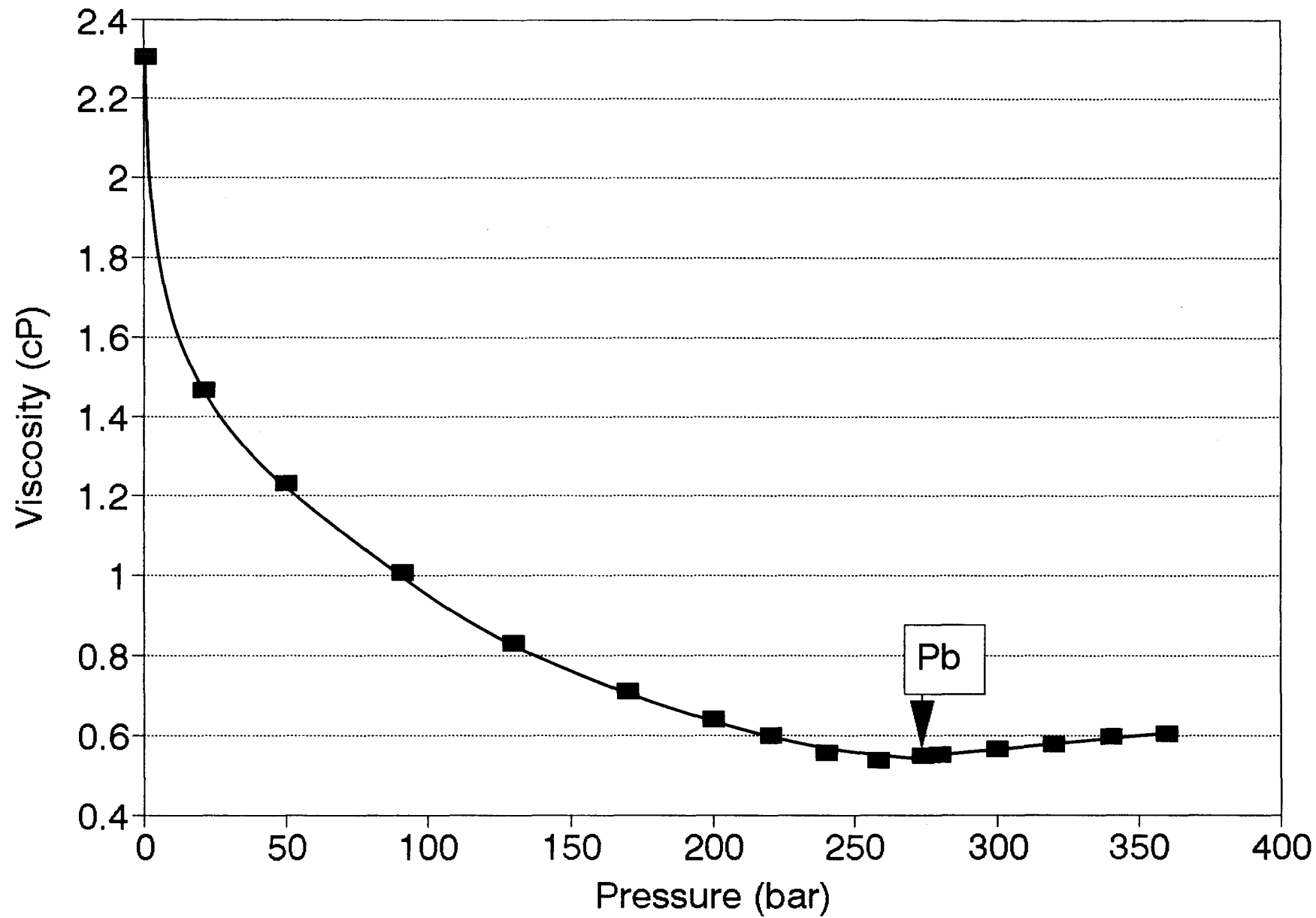
Differential vaporization at 106 °C solution GOR



Differential vaporization at 106 °C oil formation volume factor



Viscosity of reservoir fluid at 106 °C



WELL : 15/9-19-SR
 DST : 1
 BOTTLE: TS-61-04

CONSTANT MASS EXPANSION AT 106.0 °C

PRESSURE BAR	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
400.8	0.9776	1.47E-04	
381.8	0.9804	1.56E-04	
361.6	0.9836	1.66E-04	
342.4	0.9868	1.75E-04	
322.7	0.9903	1.85E-04	
302.6	0.9942	1.94E-04	
282.3	0.9981	2.03E-04	
Pb = 273.2	1.0000	2.08E-04	
256.3	1.0152		4.33
238.1	1.0354		4.17
210.5	1.0765		3.89
175.4	1.1569		3.55
135.1	1.3208		3.19
98.0	1.6351		2.81
69.5	2.1431		2.56

FOR P < Pb Y = 1.893 + 9.52E-03 x P

FOR P > Pb V/Vb = 1.07532 - 3.4391E-04xP + 2.4964E-07xPxP

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-61-04

COMPOSITION OF RESERVOIR FLUID
 (Single flash to ambient conditions)

	STABILIZED OIL	EVOLVED GAS	RECOMBINED FLUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
Nitrogen	0.00	0.71	0.13	28.0	0.46
Carbondioxide	0.00	7.66	2.13	44.0	4.94
Methane	0.23	67.27	6.82	16.0	43.43
Ethane	0.25	9.26	1.78	30.1	6.06
Propane	0.97	7.63	2.27	44.1	5.26
i-Butane	0.30	0.90	0.39	58.1	0.69
n-Butane	1.68	3.20	1.51	58.1	2.66
i-Pentane	1.15	0.80	0.65	72.2	0.92
n-Pentane	2.23	1.11	1.07	72.2	1.51
Hexanes	4.47	0.77	1.73	84.6	2.08
Heptanes	8.26	0.53	2.93	91.5	3.28
Octanes	8.74	0.14	3.30	105.5	3.20
Nonanes	6.64	0.02	2.78	119.7	2.37
Decanes plus	65.08	0.00	72.51	320.0	23.15
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	240.9	25.55			102.15

Gas oil ratio	=	157.0	Sm ³ /Sm ³ STO
Flash formation volume factor of bubble point liquid	=	1.500	m ³ /Sm ³ STO
Density at bubble point	=	0.702	g/cm ³
Density of stabilized oil	=	0.883	g/cm ³ at 15°C
Gas gravity (air=1)	=	0.882	
Density of C10+	=	0.915	g/cm ³

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-61-04

DETAILED COMPOSITION OF RESERVOIR FLUID TO C10 PLUS

	WEIGHT%	MOL WT	MOL%	DENSITY g/cm ³ 15°C
Nitrogen	0.126	28.01	0.459	
Carbondioxide	2.127	44.01	4.938	
Methane	6.819	16.04	43.428	
Ethane	1.783	30.07	6.057	
Propane	2.271	44.10	5.260	
i-Butane	0.393	58.12	0.690	
n-Butane	1.512	58.12	2.658	
i-Pentane	0.650	72.15	0.921	
n-Pentane	1.067	72.15	1.511	
C6 Paraffines	1.589	86.20	1.884	0.663
C6 Naphtenes	0.138	70.11	0.201	0.750
C6 Total	1.727	84.65	2.084	0.669
C7 Paraffines	1.292	100.20	1.318	0.688
C7 Naphtenes	1.213	88.62	1.398	0.761
C7 Aromates	0.429	78.10	0.562	0.884
C7 Total	2.935	91.47	3.277	0.741
C8 Paraffines	1.358	114.20	1.215	0.706
C8 Naphtenes	1.305	104.57	1.275	0.771
C8 Aromates	0.637	92.10	0.707	0.871
C8 Total	3.300	105.47	3.196	0.759
C9 Paraffines	1.304	128.29	1.039	0.721
C9 Naphtenes	0.709	121.28	0.597	0.791
C9 Aromates	0.767	106.20	0.737	0.873
C9 Total	2.780	119.66	2.373	0.776
Decanes plus	72.509	319.99	23.147	0.915
	-----		-----	
	100.000		100.000	

	Component Group	Weight%	Mol%
Benzene	C7 Aromates	0.429	0.562
Toluene	C8 Aromates	0.637	0.707
Xylenes	C9 Aromates	0.462	0.444
MeCyclopentane	C7 Naphtenes	0.474	0.576
Cyclohexane	C7 Naphtenes	0.312	0.378
MeCyclohexane	C8 Naphtenes	0.524	0.545

SAMPLING DATA¹

Field	Sleipner, Theta Vest
Well	15/9-19-SR
Test	1
Interval tested, perforations	4316-4338 mRKB
Producing zone	Hugin
Reservoir fluid	Oil
Static bottom hole conditions	
Reservoir pressure ²	328 bar
Reservoir temperature ²	106 °C
Date of sampling	20.04.93
Time of sampling	04:05-04:25
Type of sample	Separator
Oil bottle	TS-55-08
Gas bottles	A-14629 A-16259
Separator conditions	
Separator pressure	59.4 bar
Separator temperature	63.5 °C
Dynamic bottom hole conditions	
Flowing pressure	
Flowing temperature	
Well head conditions	
Well head pressure	118.7 bar
Well head temperature	28.2 °C
Flow rates ³	
Separator gas rate	65346 Sm ³ /D
Separator oil rate	740.3 m ³ /D
Gas-oil ratio	88.3 Sm ³ /m ³
Gas gravity	0.788
z-factor	0.855
From separator gas composition:	
Gas gravity	0.743
z-factor	0.902
Corrected gas-oil ratio	88.5 Sm ³ /m ³

- 1) Data from Schlumberger Well Test Report and sampling sheets.
- 2) Data from Statoil, DDS PE.
- 3) Average values between 01:00 and 05:00 from Schlumberger Well Test report.

WELL : 15/9-19-SR
DST : 1
BOTTLE: TS-55-08

BUBBLE POINT OF SEPARATOR LIQUID AT 63.5 °C

	PRESSURE BAR	REL VOL V/Vb
	200.0	0.9856
	181.7	0.9873
	162.0	0.9892
	141.9	0.9912
	121.9	0.9932
	102.0	0.9953
	82.1	0.9974
	62.1	0.9997
Pb =	59.2	1.0000
	57.6	1.0108
	56.3	1.0216
	53.6	1.0432
	49.1	1.0867
	42.6	1.1732
	34.0	1.3480
	25.0	1.6976
	16.7	2.3984

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-55-08

COMPOSITION OF SEPARATOR LIQUID
 (Single flash to ambient conditions)

	STABILIZED OIL	EVOLVED GAS	RECOMBINED FLUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
Nitrogen	0.00	0.17	0.01	28.0	0.06
Carbondioxide	0.00	8.58	0.73	44.0	2.78
Methane	0.12	47.44	1.48	16.0	15.45
Ethane	0.36	14.83	0.91	30.1	5.05
Propane	1.85	16.20	1.71	44.1	6.50
i-Butane	0.55	1.90	0.34	58.1	0.99
n-Butane	2.92	6.32	1.40	58.1	4.02
i-Pentane	1.62	1.32	0.66	72.2	1.52
n-Pentane	2.95	1.68	1.10	72.2	2.54
Hexanes	4.91	0.93	1.83	84.7	3.62
Heptanes	8.28	0.51	3.15	91.5	5.76
Octanes	8.30	0.10	3.56	105.5	5.64
Nonanes	6.12	0.01	2.96	119.6	4.14
Decanes plus	62.02	0.00	80.17	320.0	41.93
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	232.6	31.33			167.35

Gas oil ratio	=	42.7	Sm ³ /Sm ³ STO
Flash formation volume factor of bubble point liquid	=	1.167	m ³ /Sm ³ STO
Density at bubble point	=	0.800	g/cm ³
Density of stabilized oil	=	0.877	g/cm ³ at 15°C
Gas gravity (air=1)	=	1.082	
Density of C10+	=	0.915	g/cm ³

WELL : 15/9-19-SR
 TEST : 1
 BOTTLE: TS-55-08

DETAILED COMPOSITION OF SEPARATOR LIQUID TO C10 PLUS

	WEIGHT%	MOL WT	MOL%	DENSITY g/cm ³ 15°C
Nitrogen	0.009	28.01	0.056	
Carbondioxide	0.731	44.01	2.779	
Methane	1.481	16.04	15.451	
Ethane	0.908	30.07	5.052	
Propane	1.713	44.10	6.501	
i-Butane	0.342	58.12	0.986	
n-Butane	1.397	58.12	4.022	
i-Pentane	0.657	72.15	1.525	
n-Pentane	1.095	72.15	2.541	
C6 Paraffines	1.686	86.20	3.274	0.663
C6 Naphtenes	0.146	70.10	0.348	0.750
C6 Total	1.832	84.65	3.621	0.669
C7 Paraffines	1.380	100.20	2.306	0.688
C7 Naphtenes	1.306	88.71	2.464	0.761
C7 Aromates	0.462	78.10	0.989	0.884
C7 Total	3.148	91.49	5.759	0.742
C8 Paraffines	1.467	114.20	2.150	0.706
C8 Naphtenes	1.401	104.57	2.243	0.771
C8 Aromates	0.687	92.10	1.249	0.871
C8 Total	3.556	105.48	5.642	0.759
C9 Paraffines	1.383	128.30	1.805	0.721
C9 Naphtenes	0.756	121.30	1.043	0.791
C9 Aromates	0.819	106.20	1.290	0.873
C9 Total	2.958	119.64	4.137	0.776
Decanes plus	80.172	320.00	41.928	0.915
	-----		-----	
	100.000		100.000	

	Component Group	Weight%	Mol%
Benzene	C7 Aromates	0.462	0.989
Toluene	C8 Aromates	0.687	1.249
Xylenes	C9 Aromates	0.491	0.775
MeCyclopentane	C7 Naphtenes	0.507	1.008
Cyclohexane	C7 Naphtenes	0.333	0.662
MeCyclohexane	C8 Naphtenes	0.562	0.957

WELL : 15/9-19-SR
 DST : 1
 BOTTLE : A-14629

DETAILED COMPOSITION OF SEPARATOR GAS TO C10 PLUS

	WEIGHT%	MOL WT	MOL%
Nitrogen	1.288	28.01	0.990
Carbondioxide	15.427	44.01	7.546
Methane	57.965	16.04	77.789
Ethane	10.536	30.07	7.542
Propane	8.076	44.10	3.942
i-Butane	0.926	58.12	0.343
n-Butane	2.780	58.12	1.030
i-Pentane	0.687	72.15	0.205
n-Pentane	0.924	72.15	0.276
C6 Paraffines	0.645	86.18	0.161
C6 Naphthenes	0.064	70.14	0.020
C6 Total	0.709	84.43	0.181
C7 Paraffines	0.169	100.21	0.036
C7 Naphthenes	0.228	86.61	0.057
C7 Aromates	0.090	78.13	0.025
C7 Total	0.486	89.03	0.118
C8 Paraffines	0.039	114.23	0.007
C8 Naphthenes	0.077	101.30	0.016
C8 Aromates	0.041	92.14	0.010
C8 Total	0.157	101.55	0.033
C9 Paraffines	0.011	128.25	0.002
C9 Naphthenes	0.005	117.54	0.001
C9 Aromates	0.009	106.17	0.002
C9 Total	0.024	117.32	0.004
Decanes plus	0.014	140.00	0.002
	-----		-----
	100.000		100.000

	Component Group	Weight%	Mol%
Benzene	C7 Aromates	0.090	0.025
Toluene	C8 Aromates	0.041	0.010
Xylenes	C9 Aromates	0.004	0.001
MeCyclopentane	C7 Naphthene	0.125	0.032
Cyclohexane	C7 Naphthene	0.057	0.015
MeCyclohexane	C8 Naphthene	0.046	0.010

Gas molecular weight 21.53 Gas gravity 0.743

Opening pressure : 57.0 bar at 55.0 °C

WELL : 15/9-19-SR
DST : 1

COMPOSITION OF RESERVOIR FLUID

	SEPARATOR LIQUID	SEPARATOR GAS	RECOMBINED FLUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
Nitrogen	0.06	0.99	0.13	28.0	0.47
Carbondioxide	2.78	7.55	2.08	44.0	4.87
Methane	15.45	77.79	6.65	16.0	42.82
Ethane	5.05	7.54	1.79	30.1	6.14
Propane	6.50	3.94	2.30	44.1	5.38
i-Butane	0.99	0.34	0.40	58.1	0.70
n-Butane	4.02	1.03	1.52	58.1	2.71
i-Pentane	1.52	0.21	0.66	72.2	0.95
n-Pentane	2.54	0.28	1.08	72.2	1.55
Hexanes	3.62	0.18	1.73	84.6	2.11
Heptanes	5.76	0.12	2.90	91.4	3.28
Octanes	5.64	0.03	3.25	105.5	3.18
Nonanes	4.14	0.00	2.69	119.6	2.32
Decanes plus	41.93	0.00	72.84	320.0	23.52
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	167.4	21.53			103.33
MOL RATIO	56.10	43.90			100.00
MASS RATIO	90.85	9.15			100.00
GAS OIL RATIO	88.5	Sm ³ gas/m ³ separator oil			

Separator gas sample :A-14629
Separator liquid sample:TS-55-08

WELL : 15/9-19-SR
DST : 1

DETAILED COMPOSITION OF RESERVOIR FLUID TO C10 PLUS

	WEIGHT%	MOL WT	MOL%	DENSITY g/cm ³ 15°C
Nitrogen	0.126	28.01	0.466	
Carbondioxide	2.075	44.01	4.872	
Methane	6.647	16.04	42.820	
Ethane	1.788	30.07	6.145	
Propane	2.295	44.10	5.377	
i-Butane	0.396	58.12	0.703	
n-Butane	1.523	58.12	2.708	
i-Pentane	0.660	72.15	0.945	
n-Pentane	1.080	72.15	1.546	
C6 Paraffins	1.591	86.20	1.907	0.663
C6 Naphthenes	0.138	70.11	0.204	0.750
C6 Total	1.729	84.65	2.111	0.669
C7 Paraffins	1.270	100.20	1.309	0.688
C7 Naphthenes	1.207	88.67	1.407	0.761
C7 Aromatics	0.428	78.10	0.566	0.884
C7 Total	2.905	91.45	3.282	0.742
C8 Paraffins	1.337	114.20	1.209	0.706
C8 Naphthenes	1.280	104.55	1.265	0.771
C8 Aromatics	0.628	92.10	0.705	0.871
C8 Total	3.245	105.46	3.180	0.759
C9 Paraffins	1.258	128.30	1.013	0.721
C9 Naphthenes	0.687	121.29	0.585	0.791
C9 Aromatics	0.744	106.20	0.724	0.873
C9 Total	2.690	119.64	2.323	0.776
Decanes plus	72.841	319.99	23.521	0.915
	-----		-----	
	100.000		100.000	

	Component Group	Weight%	Mol%
Benzene	C7 Aromatics	0.428	0.566
Toluene	C8 Aromatics	0.628	0.705
Xylenes	C9 Aromatics	0.447	0.435
MeCyclopentane	C7 Naphthene	0.472	0.580
Cyclohexane	C7 Naphthene	0.308	0.378
MeCyclohexane	C8 Naphthene	0.515	0.542

APPENDIX

A BRIEF DESCRIPTION OF ANALYTICAL METHODS

PVT analysis of reservoir oil were performed in a Ruska high pressure window cell connected to a ROP high pressure mercury pump. The cell are placed in a thermostatic silicone oil bath. The cell and pump volumes are calibrated with mercury. Pressure measurements were performed by HBM pressure transducers connected to a HBM amplifier. The transducers were calibrated routinely with a dead weight tester.

Single flash of reservoir fluid to 20 °C and atmospheric pressure was performed in a flash separator. Gas volumes were measured by a Ruska Gasometer. Gas samples for compositional analysis were collected in a glass bulb. The oil from the flash was collected in a glass bottle and weighed.

Gas chromatographic analysis of stabilized oil to get a detailed composition up to C10 plus, was done on a Hewlett Packard 5880 GC with a Chrompack Sil 5 column (50 m x 0.23 mm i.d., 0.4 um filmthickness). The oven temperature program was:

10 °C 2 min
3 °C/min to 115 °C
10 °C/min to 300 °C
300 °C 60 min
Injector (split) : 300 °C
Detector (FID) : 350 °C
Internal standard : iso-Octane

Gas chromatographic analysis of gas to get a detailed composition up to C10 plus including N₂, O₂ and CO₂ was done on a Hewlett Packard 5880 GC with a combination of packed and capillary columns. Columns were molecular sieve 13X, Porapak R and Chrompack Sil 5 column (25 m x 0.23 mm i.d., 0.4 um filmthickness). The GC are calibrated routinely with a calibration gas (Norsk Hydro A/S) containing hydrocarbons (C1 to C4) and nitrogen and carbondioxide.

Carrier gas was helium (25 ml/min).

The oven temperature program was:

-30 °C 6 min
6 °C/min to 160 °C
160 °C 10 min
Injector (split) : 250 °C
Detector (FID) : 300 °C
Detector (TCD) : 200 °C

Molecular weight of stabilized oil is determined by freezing point depression of benzene (Cryette, Precision Instr.). Precision of the method is about 1.5 %.

Densities of stabilized oil are measured using a Paar DMA 62 frequency densitometer, thermostated at 15 °C. Precision of the method is +/- 0.0002 g/cm³.

Viscosity measurements were performed in a ROP viscosimeter, calibrated with viscosity standards from Cannon Instr. Corp. and some selected pure hydrocarbons. Precision of the method is about 3%.