

Denne rapport  
tilhører



**L&U DOK. SENTER**

L. NR. 200 8839 0019

KODE Well 31/2-3 nr 26

Returneres etter bruk

Reservoir Fluid Analysis

For

Norske Shell Exploration & Production

Well: 31/2-3

North Sea, Norway

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

Reservoir Fluid Analysis  
For  
Norske Shell Exploration & Production  
Well: 31/2-3  
North Sea, Norway

**CORE LABORATORIES UK LTD.**  
*Petroleum Reservoir Engineering*  
**ABERDEEN, SCOTLAND**

6th January, 1981

Norske Shell Exploration & Production,  
Damsle Ferusuei 43,  
P.O. Box 10,  
40-33 Forus,  
Stavanger,  
Norway.

Attention: Mr. Dave Jolly

Subject: Reservoir Fluid Analysis  
Well: 31/2-3  
North Sea, Norway  
Our File Number: RFLA 80167B

Gentlemen,

On 8th July, 1980, samples of separator gas and condensate were collected during testing of the subject well and forwarded to our Aberdeen laboratory for analysis. The results of these analyses as requested by a representative of Norske Shell Exploration & Production are presented in the following report.

The hydrocarbon composition of the separator gas was determined by routine gas chromatography. The hydrocarbon composition of the condensate liquid was determined by low temperature fractional distillation.

After correcting the quoted producing gas-condensate ratio for the factors shown on page one a corrected gas-condensate ratio of 420310 SCF/BB1 of separator condensate was calculated. Utilizing this gas-condensate ratio in conjunction with the experimentally determined hydrocarbon compositions of the separator products and the measured laboratory shrinkage of the condensate liquid, a wellstream composition was calculated. These compositions are to be found on page two. The laboratory shrinkage data may be found on page five.

The separator products were physically recombined at the above gas-condensate ratio and the resultant reservoir gas-condensate utilized for the remainder of the study.

A portion of the gas-condensate was placed in a high pressure visual cell and examined at the reservoir temperature of 154<sup>o</sup>F. At this temperature the system exhibited a retrograde dew point at 2118 psig. The pressure-volume relations are shown on page three.

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Norske Shell Exploration & Production

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The wellstream composition was used to calculate the cumulative stock tank liquid and sales gas recovery using normal two stage separation. Also calculated are the plant liquid products on the primary and secondary stage separator gases. The total plant products in the wellstream are also shown. All recoveries are based on one MMSCF of original reservoir fluid. It must be remembered in applying these data that all recoveries are based on 100 percent plant efficiency. These data may be found on page four.

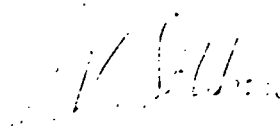
The extended hydrocarbon composition to eicosanes plus of the condensate fluid was determined by gas chromatography and this composition may be found on page six.

The extended composition to eicosanes plus of the reservoir fluid was calculated and this composition is presented on page seven.

In view of these results, the reservoir fluid would usually be considered a dry gas system, and consequently we would not normally perform a "step-wise" equilibrium (constant volume) depletion to simulate wellstream behaviour below the dew point. We will retain the samples in our laboratory pending further instructions from Norske Shell Exploration & Production.

It has been a pleasure to be of service to Norske Shell Exploration & Production. Should any questions arise concerning the data presented in this report, please do not hesitate to contact us.

Very truly yours,  
Core Laboratories U.K. Ltd.,



LKS/HG  
15 cc addressee

L. K. Sebborn,  
Laboratory Manager - RFL

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Company Norske Shell Expl. & Prod. Date Sampled 8th July, 1980  
Well 31/2-3 County North Sea  
Field State Norway

FORMATION CHARACTERISTICS

Formation Name Clean Sand  
Date First Well Completed 19.....  
Original Reservoir Pressure PSIG @ ..... Ft.  
Original Produced Gas-Liquid Ratio SCF/Bbl  
Production Rate Bbls/Day  
Separator Pressure and Temperature PSIG ..... °F.  
Liquid Gravity at 60°F ..... ° API  
Datum ..... Ft. Subsea

WELL CHARACTERISTICS

Elevation ..... Ft.  
Total Depth ..... Ft.  
Producing Interval 1435-1460 m  
Tubing Size and Depth 5 In. to 1405.6 m  
Open Flow Potential ..... MMSCF/Day  
Last Reservoir Pressure 2275 PSIG @ ..... Ft.  
Date ..... 19.....  
Reservoir Temperature 154 ° F. @ ..... Ft.  
Status of Well .....  
Pressure Gauge .....

SAMPLING CONDITIONS

Flowing Tubing Pressure ..... PSIG  
Flowing Bottom Hole Pressure ..... PSIG  
Primary Separator Pressure 325 ..... PSIG  
Primary Separator Temperature 100 ..... ° F.  
Secondary Separator Pressure ..... PSIG  
Secondary Separator Temperature ..... ° F.  
Field Stock Tank Liquid Gravity ..... ° API @ 60° F.  
Primary Separator Gas Production Rate 2082 ..... MSCF/Day  
Pressure Base 14.696 ..... PSIA  
Temperature Base 60 ..... °F.  
Compressibility Factor (F ) 1.0201 .....  
Gas Gravity (Laboratory)<sup>PV</sup> 0.606 .....  
Gas Gravity Factor (F ) 1.2846 .....  
Primary sep. Liquid Production Rate @ 100° F 49.55 ..... Bbls/Day  
Primary Separator Gas/Primary sep. Liquid Ratio 420310 ..... SCF/Bbl  
or 2.38 ..... Bbls/MMSCF  
Sampled by Flopetrol

REMARKS :

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Well 31/2-3

**Hydrocarbon Analyses of Separator Products and Calculated Well Stream**

<u>Component</u>	<u>Separator Liquid * Mol Per Cent</u>	<u>Separator Gas + Mol Per Cent</u>	<u>GPM</u>	<u>Well Stream Mol Per Cent</u>
Hydrogen Sulfide	NIL	NIL		NIL
Carbon Dioxide	0.15	0.56		0.56
Nitrogen	0.06	1.59		1.59
Methane	8.31	93.14		92.88
Ethane	1.45	3.45		3.45
Propane	0.44	0.39		0.39
iso-Butane	0.65	0.30		0.30
n-Butane	0.13	0.04		0.04
iso-Pentane	0.57	0.04		0.04
n-Pentane	0.21	0.01		0.01
Hexanes	3.11	0.15		0.16
Heptanes plus	84.92	0.33		0.58
	<u>100.00</u>	<u>100.00</u>		<u>100.00</u>

**Properties of Heptanes plus**

API gravity @ 60° F.	43.9		
Specific gravity @ 60/60° F.	0.8068		0.7375
Molecular weight	130	103	112

Calculated separator gas gravity (air=1.000) = 0.606

Calculated gross heating value for separator gas = 1050 BTU

per cubic foot of dry gas @ 14.696 psia and 60° F.

Primary separator gas collected @ 325 psig and 100 °F.

Primary separator liquid collected @ 325 psig and 100 °F.

Primary separator gas/separator liquid ratio 420310 SCF/Bbl @ 325 psig and 100° F

Primary separator liquid/stock tank liquid ratio 1.0865 Bbls @ 325 psig and 100° F per Bbl at 60° F

\* Cylinder Number: 20524/83

+ Cylinder Number: A7588

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Pressure-Volume Relations at ...154..... °F.

<u>Pressure PSIG</u>		<u>Relative Volume (1)</u>	<u>Compressibility Factor Z</u>
3000		0.7140	0.878
2500		0.8463	0.868
<u>2275</u>	Reservoir	0.9295	0.868
2200	Pressure	0.9622	0.869
<u>2118</u>	Dew Point	1.0000	0.870
2000	Pressure	1.0610	
1900		1.1200	
1800		1.1857	
1700		1.2610	
1600		1.3449	
1400		1.5497	
1200		1.8270	
1000		2.2160	
800		2.8010	
600		3.7725	

(1) Relative Volume :  $V/V_{sat}$  is barrels at indicated pressure per barrel at saturation pressure.

These analyses, opinions or interpretations are based on observations and material supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgement of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations as to the productivity, proper operation, or profitableness of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

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CALCULATED RECOVERY PER MMSCF OF ORIGINAL FLUID

Wellstream MSCF 1000

Normal Temperature Separation\*

Stock Tank liquid - Barrels	7.55
Primary Separator Gas - MSCF	987.53
Second Stage Gas - MSCF	3.70
Stock Tank Gas - MSCF	2.31

Total Plant Products in  
Primary Separator Gas - Gallons\*\*

Propane	102
Butanes (Total)	100
Pentanes Plus	75

Total Plant Products in  
Second Stage Gas - Gallons\*\*

Propane	0.50
Butanes (Total)	0.43
Pentanes Plus	0.23

Total Plant Products in  
Wellstream - Gallons\*\*

Propane	107
Butanes (Total)	111
Pentanes Plus	380

\* Recovery Bases: Primary separation at 1250 psig and 40<sup>o</sup>F  
 Second Stage at 500 psig and 40<sup>o</sup>F  
 Stock Tank at 0 psig and 27<sup>o</sup>F

\*\* Recovery assumes 100% plant efficiency



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Well 31/2-3

SEPARATOR TESTS OF Separator Liquid SAMPLE <sup>+</sup>

SEPARATOR PRESSURE PSI GAUGE	SEPARATOR TEMPERATURE °F	SEPARATOR GAS/OIL RATIO (1)	STOCK TANK GAS/OIL RATIO (1)	STOCK TANK GRAVITY API @ 60°F	SHRINKAGE FACTOR VR/VSAT (2)	FORMATION VOLUME FACTOR (3)	SPECIFIC GRAVITY OF FLASHED GAS
0	65		89	44.5	0.9204	1.0865	0.841

+ Cylinder Number: 20524/83

- (1) Separator and Stock Tank Gas/Oil Ratio in cubic feet of gas @ 60°F and 14.7 PSI absolute per barrel of stock tank oil @ 60°F.
- (2) Shrinkage Factor : Vr/Vsat. is barrels of stock tank oil @ 60°F per barrel of saturated oil @ 325 PSI gauge and 100 F.
- (3) Formation Volume Factor : Vsat/Vr is barrels of saturated oil @ 325 PSI gauge and 100 F per barrel of stock tank oil @ 60°F.

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HYDROCARBON ANALYSIS OF SEPARATOR LIQUID SAMPLE

<u>Component:</u>	<u>Mol Percent:</u>	<u>Weight Percent:</u>
Hydrogen Sulphide	NIL	NIL
Carbon Dioxide	0.15	0.06
Nitrogen	0.06	0.02
Methane	8.31	1.15
Ethane	1.45	0.38
Propane	0.44	0.17
Iso-Butane	0.65	0.33
N-Butane	0.13	0.07
Iso-Pentane	0.57	0.35
N-Pentane	0.21	0.13
Hexanes	3.11	2.30
Methyl Cyclopentane	2.76	1.94
Benzene	NIL	NIL
Cyclohexane	4.17	2.93
Heptanes	3.73	3.13
Methyl Cyclohexane	9.62	7.91
Toluene	0.78	0.59
Octanes	7.95	7.61
Ethylbenzene	1.17	1.04
Meta and Para Xylene	4.36	3.88
Orthoxylene	0.59	0.52
Nonanes	7.29	7.83
1, 2, 4 Trimethylbenzene	3.04	3.06
Decanes	10.40	12.38
Undecanes	10.67	13.16
Dodecanes	4.78	6.45
Tridecanes	4.80	7.04
Tetradecanes	3.51	5.60
Pentadecanes	2.51	4.32
Hexadecanes	1.00	1.86
Heptadecanes	0.83	1.64
Octadecanes	0.44	0.92
Nonadecanes	0.26	0.56
Eicosanes plus	0.26	0.67
	<u>100.00</u>	<u>100.00</u>

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HYDROCARBON ANALYSIS OF WELLSTREAM SAMPLE

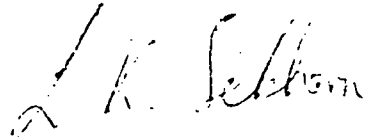
<u>Component:</u>	<u>Mol Percent:</u>
Hydrogen Sulphide	NIL
Carbon Dioxide	0.56
Nitrogen	1.59
Methane	92.88
Ethane	3.45
Propane	0.39
Iso-Butane	0.30
N-Butane	0.04
Iso-Pentane	0.04
N-Pentane	0.01
Hexanes	0.16
Methyl Cyclopentane	0.05
Benzene	NIL
Cyclohexane	0.06
Heptanes	0.07
Methyl Cyclohexane	0.06
Toluene	TRACE
Octanes	0.05
Ethylbenzene	TRACE
Meta and Para Xylene	0.03
Orthoxylene	TRACE
Nonanes	0.05
1, 2, 4 Trimethylbenzene	0.02
Decanes	0.05
Undecanes	0.04
Dodecanes	0.02
Tridecanes	0.02
Tetradecanes	0.02
Pentadecanes	0.02
Hexadecanes	0.01
Heptadecanes	0.01
Octadecanes	TRACE
Nonadecanes	TRACE
Eicosanes plus	<u>TRACE</u>
	100.00

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Norske Shell Exploration & Production  
RFLA 80167B

Core Laboratories U.K. Ltd.,  
Reservoir Fluid Analysis,

A handwritten signature in cursive script, appearing to read 'L. K. Sebborn'.

L. K. Sebborn,  
Laboratory Manager - RFL