

PHILLIPS PETROLEUM COMPANY
RESEARCH AND DEVELOPMENT DEPARTMENT
RESERVOIR ENGINEERING LABORATORY
BARTLESVILLE, OKLAHOMA

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Norway/Prod/Eldfisk 2/7-6X
Norwegian Sector, North Sea -
Companion Separator Analysis &
Sulfur Contents RL-251-G-27-73
WFB-69-73

Mr. O. D. Thomas
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In response to Mr. S. A. Siemens' request by telephone on September 7, 1973, compositional analyses, including sulfur contents, were made on companion separator samples from DST No. 1 - Flow No. 3, DST No. 3 - Flow No. 2 and DST No. 4 - Flow No. 4 of the Eldfisk 2/7-6X well, Norwegian Sector, North Sea. These samples were taken in "F" type containers.

A pressure base of 14.696 psia and an atmospheric pressure of 14.696 psia were used in calculating the composite well streams. F_g and F_{pv} factors, based on the attached gas analyses, were used to recalculate the gas volumes for the gas-oil ratios.

The compositions of the composite well streams have been calculated, and the results are attached as computer output sheets. Pertinent information concerning sampling conditions is also attached.

W. F. Buce

W. F. Buce
262 RB #1, Ext. 3538

WFB:rw

Attachments

cc: R & D Files (EX-4-3-8)
B. M. Boyce (6)
W. L. Culbertson (2)
J. G. Erdman
R. V. Smith (r) RLC
W. F. Buce

Drill Stem Test Number	1, Flow No. 3	3, Flow No. 2
Hour Gas Sampled	2152	1333
Hour Liquid Sampled	2313	1318
Date Sampled	5-24-73	5-31-73
Producing Formation	Danian	Danian
Elevation RKB, feet	-	-
Perforated Interval, feet	9,755-9,800	9,820-10,020
Source of Sample	Separator	Separator
Separator Temperature, °F	54	131
Separator Pressure, psig	200	975
Pressure in Containers, psig	200	975
Oil Produced, bbl/d	288	4,372.8
Gas Produced, Mcf/d	476.447	6,581.196
Gas/Liquid Ratio (scf/bbl)	1,654	1,515
Gravity Stock Tank Liquid, °API @ 60°F	33.6	35.9
Sample Container Numbers on "F" Type Containers	Gas: G111 & Oil: L120	Gas: G141 & Oil: L155
F _g Factor Determined from Analysis	1.1966	1.2012
F _{pv} Factor Determined from Analysis	1.023	1.068
Total Sulfur Content for Gas, wt %	<1 ppm	-
Sulfur Content in C ₅ + for Liquid, wt %	0.21	0.23
Tester	Hodges-Baker Tool	Hodges-Baker Tool

Drill Stem Test Number	4, Flow No. 4
Hour Gas Sampled	1853
Hour Liquid Sampled	1855
Date Sampled	6-4-73
Producing Formation	Danian
Elevation RKB, feet	-
Perforated Interval, feet	9,560-9,700
Source of Sample	Separator
Separator Temperature, °F	121
Separator Pressure, psig	985
Pressure in Containers, psig	985
Oil Produced, bbl/d	4,759.2
Gas Produced, Mcf/d	9,646.683
Gas/Liquid Ratio (scf/bbl)	2,027
Gravity Stock Tank Liquid, °API @ 60°F	36.2
Sample Container Numbers on "F" Type Containers	Gas: G65 & Oil: L105
F _g Factor Determined from Analysis	1.1885
F _{pv} Factor Determined from Analysis	1.0719
Total Sulfur Content for Gas, wt %	-
Sulfur Content in C ₅ + for Liquid, wt %	0.20
Tester	Hodges-Baker Tool

ANALYSIS OF SEPARATOR PRODUCTS AND CALCULATED WELL STREAM

ELDFISK 2/7-6X, NORWEGIAN SECTOR, NORTH SEA
 DST NO. 1, FLOW NO. 3 DEPTH: 9755-9800 FEET

COMPONENT	SEPARATOR LIQUID MOL PER CENT	SEPARATOR GAS MOL PER CENT	CALCULATED COMPOSITE WELL STREAM MOL PER CENT
HELIUM		<0.02	<0.02
CARBON DIOXIDE	0.63	3.89	2.97
NITROGEN	0.30	0.14	0.18
HYDROGEN SULFIDE	0.0	0.0	0.0
METHANE	6.20	82.11	60.74
ETHANE	3.80	8.39	7.10
PROPANE	5.46	3.62	4.14
ISO-BUTANE	1.36	0.37	0.65
N-BUTANE	5.04	0.92	2.08
ISO-PENTANE	1.88	0.17	0.65
N-PENTANE	3.26	0.21	1.07
HEXANE	7.94	0.11	2.31
HEPTANES PLUS	64.13	0.07	18.11
	100.00	100.00	100.00

PROPERTIES OF HEPTANES PLUS

SPECIFIC GRAVITY	0.8648	0.7819	0.8648
MOLECULAR WEIGHT	236.8	109.1	236.4

GAS PROPERTIES

GAS COMPRESSIBILITY FACTOR (Z)		0.9438
SEPARATOR GAS GRAVITY (AIR=1.0000)		0.6987
GRUSS HEATING VALUE/SCF	DRY	1138.7 BTU
AT 14.696 AND 60. F	WET	1118.9 BTU

MULTISTAGE FLASH RECOMBINATION CALCULATIONS

CASE IDENTIFICATION FLOFISK 2/7-6X, NORWEGIAN SECTOR, NORTH SEA
 DST NO.1, FLOW NO.3 DEPTH:9755-9800 FEET

COMPOSITION OF FLOW STREAM, MOLE FRACTIONS

COMPONENT	WELL STREAM	STAGE 1		STAGE 2		STAGE 3		STAGE 4	
	ATMOS. PSIA	TEMP. F	PRES. PSIA	TEMP. F	PRES. PSIA	TEMP. F	PRES. PSIA	TEMP. F	PRES. PSIA
	14.696	54.0	214.70	0.0	0.0	0.0	0.0	0.0	0.0
		LIQ.	GAS	LIQ.	GAS	LIQ.	GAS	LIQ.	GAS
CO2	0.02975	0.0063	0.0389	0.0	0.0	0.0	0.0	0.0	0.0
N2	0.00183	0.0030	0.0014	0.0	0.0	0.0	0.0	0.0	0.0
H2S	0.00000	0.0000	0.0000	0.0	0.0	0.0	0.0	0.0	0.0
METHANE	0.60723	0.0620	0.8210	0.0	0.0	0.0	0.0	0.0	0.0
ETHANE	0.07101	0.0330	0.0839	0.0	0.0	0.0	0.0	0.0	0.0
PROPANE	0.04140	0.0546	0.0362	0.0	0.0	0.0	0.0	0.0	0.0
ISOBUTANE	0.00649	0.0136	0.0037	0.0	0.0	0.0	0.0	0.0	0.0
N-BUTANE	0.02080	0.0504	0.0092	0.0	0.0	0.0	0.0	0.0	0.0
ISOPENTANE	0.00650	0.0188	0.0017	0.0	0.0	0.0	0.0	0.0	0.0
N-PENTANE	0.01070	0.0326	0.0021	0.0	0.0	0.0	0.0	0.0	0.0
HEXANE	0.02315	0.0794	0.0011	0.0	0.0	0.0	0.0	0.0	0.0
C7+	0.18115	0.6413	0.0007	0.0	0.0	0.0	0.0	0.0	0.0
HELIUM	<0.0002		<0.0002						
MOLES	1.00000	0.28166	0.71834	0.0	0.0	0.0	0.0	0.0	0.0

AVG. MW	62.779	171.040	20.241	0.0	0.0	0.0	0.0	0.0	0.0
C7PLUS MW	236.448	236.800	109.123	0.0	0.0	0.0	0.0	0.0	0.0
SPEC. GRAV.		0.8348	0.6987	0.0	0.0	0.0	0.0	0.0	0.0
C7PLUS SG	0.8648	0.8648	0.7819	0.0	0.0	0.0	0.0	0.0	0.0
SCF OF GAS			272.62		0.0		0.0		0.0
GAS DEN(LBS/CUFT)			0.8303		0.0		0.0		0.0
BBL OF LIQUID		0.16480		0.0		0.0		0.0	
LIQ DEN(LBS/CUFT)		52.0652		0.0		0.0		0.0	
				0.0		0.0		0.0	
GOR(SCF/BBL)		1654.2		0.0	0.0	0.0	0.0	0.0	0.0

COMBINED GOR(SCF/BBL) 1654.2
 API 60 DEG F 38.5221

ELDFISK 2/7-6X, NORWEGIAN SECTOR, NORTH SEA
 DST NO. 1, FLOW NO. 3 DEPTH: 9755-9800 FEET
 MULTISTAGE FLASH RECOMBINATION CALCULATIONS

GALLONS PER MCF FOR EACH GAS STREAM

FRACTION	STAGE 1	STAGE 2	STAGE 3	STAGE 4
C3	0.9566	0.0	0.0	0.0
C4	0.4116	0.0	0.0	0.0
C5+	0.2141	0.0	0.0	0.0
TOTAL GPM FOR EACH STAGE	1.6224	0.0	0.0	0.0
TOTAL GPM FOR ALL STAGES	1.6224			
AVERAGE GAS GRAVITY ALL STAGES	0.6987			

HEATING VALUES FOR EACH GAS STREAM

(14.696 PSIA AND 60 F)

BTU/SCF. GROSS - DRY	1138.7	0.0	0.0	0.0
BTU/SCF. GROSS - WET	1118.9	0.0	0.0	0.0

VAPORIZATION EQUILIBRIUM RATIO

K VALUES

COMPONENT	STAGE 1	STAGE 2	STAGE 3	STAGE 4
C12	6.18095	0.0	0.0	0.0
N2	0.44737	0.0	0.0	0.0
H2S	*****	0.0	0.0	0.0
C1	12.24637	0.0	0.0	0.0
C2	2.20979	0.0	0.0	0.0
C3	0.66325	0.0	0.0	0.0
I-C4	0.27434	0.0	0.0	0.0
N-C4	0.18285	0.0	0.0	0.0
I-C5	0.08811	0.0	0.0	0.0
N-C5	0.06472	0.0	0.0	0.0
C6	0.01386	0.0	0.0	0.0
C7+	0.00112	0.0	0.0	0.0

GAS COMPRESSIBILITY FACTORS (Z)

0.94877

ANALYSIS OF SEPARATOR PRODUCTS AND CALCULATED WELL STREAM

ELDFISK 2/7-6X, NORWEGIAN NORTH SEA
 DST NO. 3, FLOW NO. 2, DEPTH: 9820-10020 FEET

COMPONENT	SEPARATOR LIQUID MOL PER CENT	SEPARATOR GAS MOL PER CENT	CALCULATED COMPOSITE WELL STREAM MOL PER CENT
HELIUM		20.02	20.02
CARBON DIOXIDE	1.40	3.79	3.02
NITROGEN	0.25	0.20	0.22
HYDROGEN SULFIDE	0.0	0.0	0.0
METHANE	19.14	83.31	62.60
ETHANE	6.50	7.66	7.29
PROPANE	5.97	3.08	4.01
ISO-BUTANE	1.11	0.33	0.58
N-BUTANE	3.67	0.84	1.75
ISO-PENTANE	1.09	0.18	0.47
N-PENTANE	1.81	0.25	0.75
HEXANE	5.32	0.18	1.84
HEPTANES PLUS	53.74	0.18	17.47
	100.00	100.00	100.00

PROPERTIES OF HEPTANES PLUS

SPECIFIC GRAVITY	0.8637	0.7809	0.8637
MOLECULAR WEIGHT	237.0	110.9	236.1

GAS PROPERTIES

GAS COMPRESSIBILITY FACTOR (Z)		0.8716
SEPARATOR GAS GRAVITY (AIR=1.0000)		0.6937
GROSS HEATING VALUE/SCF DRY		1133.4 BTU
AT 14.696 AND 60. F WET		1113.7 BTU

ELDFISK 2/7-6X, NORWEGIAN NORTH SEA
 DST NO. 3, FLOW NO. 2, DEPTH: 9820-10020 FEET
 MULTISTAGE FLASH RECOMBINATION CALCULATIONS

GALLONS PER MCF FOR EACH GAS STREAM

FRACTION	STAGE 1	STAGE 2	STAGE 3	STAGE 4
C3	0.8472	0.0	0.0	0.0
C4	0.3721	0.0	0.0	0.0
C5+	0.3126	0.0	0.0	0.0
TOTAL GPM FOR EACH STAGE	1.5319	0.0	0.0	0.0
TOTAL GPM FOR ALL STAGES	1.5319			
AVERAGE GAS GRAVITY ALL STAGES	0.6937			

HEATING VALUES FOR EACH GAS STREAM

(14.696 PSIA AND 60 F)

BTU/SCF. GROSS - DRY	1133.4	0.0	0.0	0.0
BTU/SCF. GROSS - WET	1113.7	0.0	0.0	0.0

VAPORIZATION EQUILIBRIUM RATIO

K VALUES

COMPONENT	STAGE 1	STAGE 2	STAGE 3	STAGE 4
CO2	2.71439	0.0	0.0	0.0
N2	0.77647	0.0	0.0	0.0
H2S	*****	0.0	0.0	0.0
C1	4.35706	0.0	0.0	0.0
C2	1.17950	0.0	0.0	0.0
C3	0.51531	0.0	0.0	0.0
I-C4	0.29676	0.0	0.0	0.0
N-C4	0.22830	0.0	0.0	0.0
I-C5	0.16300	0.0	0.0	0.0
N-C5	0.13797	0.0	0.0	0.0
C6	0.03437	0.0	0.0	0.0
C7+	0.00339	0.0	0.0	0.0

GAS COMPRESSIBILITY FACTORS (Z)

0.87165

ANALYSIS OF SEPARATOR PRODUCTS AND CALCULATED WFL STREAM

EIDFISK 2/7-6X, NORWEGIAN SECTOR, NORTH SEA
 DST NO. 4, FLOW NO. 4, DEPTH: 9560-9700 FEET

COMPONENT	SEPARATOR LIQUID MOL PER CENT	SEPARATOR GAS MOL PER CENT	CALCULATED COMPOSITE WFL STREAM MOL PER CENT
HELIUM		<0.02	<0.02
CARBON DIOXIDE	1.54	4.60	3.77
NITROGEN	0.13	0.08	0.09
HYDROGEN SULFIDE	0.0	0.0	0.0
METHANE	17.57	82.20	64.79
ETHANE	6.29	7.61	7.26
PROPANE	6.43	3.22	4.08
ISO-BUTANE	1.30	0.36	0.62
N-BUTANE	4.56	0.95	1.92
ISO-PENTANE	1.39	0.22	0.53
N-PENTANE	2.38	0.31	0.87
HEXANE	6.34	0.23	1.88
HEPTANES PLUS	52.07	0.22	14.19
	100.00	100.00	100.00

PROPERTIES OF HEPTANES PLUS

SPECIFIC GRAVITY	0.8604	0.7823	0.8604
MOLECULAR WEIGHT	227.9	110.3	226.6

GAS PROPERTIES

GAS COMPRESSIBILITY FACTOR (Z)		0.8542
SEPARATOR GAS GRAVITY (AIR=1.0000)		0.7086
GROSS HEATING VALUE/SCF DRY		1138.7 BTU
AT 14.696 AND 60. F WET		1118.9 BTU

MULTISTAGE FLASH RECOMBINATION CALCULATIONS

GALLONS PER MCF FOR EACH GAS STREAM

ELDFISK 2/7-6X, NORWEGIAN SECTOR, NORTH SEA, DST NO. 4, FLOW NO. 4, DEPTH: 9560-9700 FEET

FRACTION	STAGE 1	STAGE 2	STAGE 3	STAGE 4
C3	0.8858	0.0	0.0	0.0
C4	0.4182	0.0	0.0	0.0
C5+	0.3866	0.0	0.0	0.0
TOTAL GPM FOR EACH STAGE	1.6905	0.0	0.0	0.0
TOTAL GPM FOR ALL STAGES			1.6905	
AVERAGE GAS GRAVITY ALL STAGES			0.7086	

HEATING VALUES FOR EACH GAS STREAM

(14.696 PSIA AND 60 F)

	STAGE 1	STAGE 2	STAGE 3	STAGE 4
BTU/SCF, GROSS - DRY	1138.7	0.0	0.0	0.0
BTU/SCF, GROSS - WET	1118.9	0.0	0.0	0.0

VAPORIZATION EQUILIBRIUM RATIO

K VALUES

COMPONENT	STAGE 1	STAGE 2	STAGE 3	STAGE 4
CO2	2.98442	0.0	0.0	0.0
N2	0.62698	0.0	0.0	0.0
H2S	*****	0.0	0.0	0.0
C1	4.67501	0.0	0.0	0.0
C2	1.21110	0.0	0.0	0.0
C3	0.50070	0.0	0.0	0.0
I-C4	0.27739	0.0	0.0	0.0
N-C4	0.20896	0.0	0.0	0.0
I-C5	0.15706	0.0	0.0	0.0
N-C5	0.13109	0.0	0.0	0.0
C6	0.03660	0.0	0.0	0.0
C7+	0.00424	0.0	0.0	0.0

GAS COMPRESSIBILITY FACTORS (Z)

0.85421