Schlumberger

Fluid Analysis on Macondo Samples

BP

Field: Mississippi Canyon 252
Well: OCS-G 32306 # 1

Reservoir Sample Analysis Report

Prepared for
Ms. Kelly McAughan and Dr. Yun Wang
BP

Standard Conditions Used:
Pressure: 15.025 psia
Temperature: 60°F

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EXECUTIVE SUMMARY

Introduction

Oilphase-DBR was contacted by Ms. Kelly McAughan of BP with a request to conduct Preliminary Analysis on down hole samples collected from the Macondo prospect located in the Gulf of Mexico. The samples were collected using Schlumberger's single phase down hole chamber's called Single Phase Multi sample Chamber (SPMC) and other chambers called Multisample Production Sample Receptacle (MPSR) at various depths. Subsequently after discussions with Ms. McAughan, Dr. Yung Wang and Mr. David Epps of BP, the testing conditions were finalized. All measurements were conducted using proprietary equipments developed at Oilphase-DBR, a division of Schlumberger.

The work was conducted on four samples, originally collected in SPMC's and shipped to the Oilphase-DBR Houston Lab for restoration and transfer to single phase sample bottles (SSB) at reservoir conditions. Subsequently, an MPSR sourced sample in a third party bottle was also received, for additional work, at the Oilphase DBR's Houston lab.

Sample Inventory

The samples collected from the well OCS-G 32306 # 1 located in the Mississippi Canyon 252 field in the Gulf of Mexico were sent to Oilphase-DBR in Houston, Texas. The samples were used for Preliminary and PVT Analysis. The measurement details are in the following text. Samples remaining in the sample bottles after measurements are stored in Oilphase-DBR storage unless otherwise instructed. The volume used are presented in Table 2. Initial volume data in the sample bottle transferred offshore has been extracted from the Oilphase DBR field report or the third party chain of custody document where available.

Completed Scope of Work

- Measure opening pressure of the received sample chambers at ambient temperature.
- Restoration of the SPMC samples at reservoir temperature by rocking for one day.
- Transfer of the SPMC samples at reservoir temperature to single phase sample bottle.
- The following work was completed on the SPMC sourced sample cylinder containing oil:
  - Single stage flash on the sample was conducted.
  - Gas-Liquid Ratio (GLR) was measured for the sample, the resulting STO was used for measurement of density , molecular weight and composition.
  - Flashed gas was analyzed for composition.
- Restoration of the MPSR sourced sample received in third party chamber, at reservoir temperature for five days.
- The following work was completed on the MPSR sourced sample cylinder containing oil:
  - Constant Mass Expansion was conducted at 243°F.
  - Density of the fluid was measured at 15015 psia, 14015 psia, 10015 psia and 9015 psia all at 243°F.
  - Constant Mass Expansion was conducted at 100°F.
  - Density of the fluid was measured at 10013 psia at 100°F.
  - Subsequently on client request fluid composition was determined.
  - Following fluid composition dtermination, multi stage separation test (MSST) was performed.

Detailed results of the selected samples

The following bullets summarizes the results of the analyses conducted on the reservoir fluid samples:

- The zero flash GOR range of the oil samples from a depth of 18124 ft MD collected during the Modular Dynamics Testing (MDT) was determined to range from 2988 - 3000 scf/stb. The STO density ranged from 0.851 - 0.852 g/cc.
  - The oil based mud filtrate contamination range of the oil samples from a depth of 18124 ft MD collected during the MDT was determined to range from 0.53 - 0.57 wt% on live oil basis. The STO basis oil based mud contamination ranged from 0.86 - 0.92 wt%.
- The zero flash GOR range of the oil samples from a depth of 18086 ft MD collected during the MDT was determined to range from 3051 - 3142 scf/stb. The STO density ranged from 0.851 - 0.852 g/cc.
  - The oil based mud filtrate contamination range of the oil samples from a depth of 18086 ft MD collected during the MDT was determined to range from 0.50 - 0.51 wt% on live oil basis. The STO basis oil based mud contamination ranged from 0.81 - 0.85 wt%.
- The zero flash GOR range of the oil sample 1.18 from a depth of 18142 ft MD, collected during the MDT, was determined to be 2945 scf/stb. The STO density was determined to be 0.852 g/cc.
  - The oil based mud filtrate contamination range of the oil samples from a depth of 18142 ft MD collected during the MDT was determined to range from 0.56 - 0.56 wt% on live oil basis. The STO basis oil based mud contamination ranged from 0.89 - 0.89 wt%.
- Subsequently, sample 1.18 from a depth of 18142 ft MD, received from a third party facility, was used for a partial PVT study including contant mass expansion test and separation test.
  - The PVT study results are summarized in following Tables.

Temperature (°F)	Psat (psia)	Density @ Pi (g/cc)	Density @ Pb (g/cc)
243	6348	0.589	0.534
100	6235	0.644	0.600

FLASHING OPERATION	CUMULATIVE GOR (scf/stb)	API GRAVITY	Gas Relative Density (air=1)	FVF at Pres/Tres	FVF at Psat/Tres
Zero Flash	2945	34.6	0.792	2.303	2.539
DL Flash @ Tres	-	-	-	-	-
Separator Test	2442	37.4	0.703	2.143	2.262

Sequence of Events

The major events along with the dates are presented below.
The samples were received in April 19th, 2010
Quotes were provided and the initial work was approved for action on April 22nd 2010.
PVT Test scope was added and approved for action on April 29th, 2010.
Preliminary test data was provided on May 5th, 2010
Preliminary data with added test results was provided on May 8th, 2010
PVT Test scope was increased and approved for action on May 11th, 2010.
AOP and Wax tests were completed on May 28th 2010. The results are reported in a separate document.
Additonal compositonal and PVT work was added on May 24th 2010

RESULTS AND DISCUSSIONS

Fluids Preparation and Analysis

Five reservoir fluid samples were transferred to Oilphase DBR Houston Lab in April 2010. These samples were received in Schlumberger's single phase sample chambers and a third party bottle. The well and formation data with their respective reservoir conditions for the samples are summarized in Table 1. A quality check of all the samples were conducted by measuring their opening pressures and the results are summarized in Table 2. After restoration and homogenization of the single phase samples, validation tests including gas liquid ratio, flash gas and oil composition and stock tank liquid density were conducted to evaluate the validity. The reservoir fluid and stock-tank liquid properties for the sample is presented in Table 3 and Table 4.

Reservoir Fluid Analysis

The four single phase samples were validated by conducting a single stage flash to recover the stock tank oil and flashed gas. The flashed gas and oil was subjected to chromatography and the composition of the fluids was determined. Subsequently the molecular weight and density of the stock tank oil was also measured. The compositions are presented in Tables 6, 7, 9, 10, 12, 13, 15, 16, 18 and 19. Following the compositional analysis, the base oil, used in the drilling mud formulation, and the oil based mud filtrate composition were also analyzed and the oil based mud filtrate free fluid properties were estimated for the reservoir fluids. These are presented in Tables 5, 8, 11, 14, 17 and 20. The base oil and filtrate compositions are summarized in Tables 21 and 22. Next the third party chamber was used for PVT measurements. The results of the PVT tests are summarized in Tables 23 - 28.

Table 1: Well and Sample Identification

Client:	BP
Job#	201000053
Field:	Mississippi Canyon 252
Well:	OCS-G 32306 # 1

Sample ID	Chamber #	Chamber Volume	Sampling Date	Opening Pres. in the field	Reservoir Conditions		
					Pressure	Temperature	Depth
		(cc)		(psia/°F)	(psia)	(°F)	(ft MD)
1.06	SPMC 477	250	4/12/10 13:22	13000 / 86	11,850	236	18124
1.07	SPMC 520	250	4/12/10 13:32	13000 / 75	11,850	236	18124
1.13	SPMC 484	250	4/12/10 15:45	13000 / 75	11,841	237	18086
1.14	SPMC 552	250	4/12/10 15:59	13200 / 75	11,841	237	18086
1.18	MPSR 1268	450	4/12/10 23:07	-	11,856	236	18142

Note: Reservoir Temperature data provided in the table above is extracted from the initial field report. Subsequently reservoir temperature was corrected to 243°F for the PVT and flow assurance studies.

Table 2: Sampling and Transfer Summary

Sample ID	Chamber #	Opening conditions in the field	Transfer Cylinder ID	Closing conditions in the field	Opening conditions in the O-DBR Lab	Transfer Live Sample Volume	Remaining Live Sample Volume
		(psia/°F)		(psia/°F)	(psia/°F)	(cc @ Pres/Tres)	(cc @ Pres/Tres)
1.06	SPMC 477	13000 / 86	SSB 9038-MA	13000 / 86	13000 / 69	225	212
1.07	SPMC 520	13000 / 75	SSB 9168-MA	13000 / 75	12500 / 69	190	87
1.13	SPMC 484	13000 / 75	SSB 9642-MA	13000 / 75	13000 / 69	230	217
1.14	SPMC 552	13200 / 75	SSB 8085-MA	13200 / 75	13000 / 69	235	222
1.18	MPSR 1268	-	20D127	-	-		190*

* Volume indicated for cylinder ID 20D127 is volume used for tests since initial volume is not known.

Table 3: Reservoir Fluid Properties

Sample ID	Cylinder #	Depth	Zero Flash GOR*	Zero Flash Equilibrium Conditions	Saturation Pressure at Tres	Molar Mass of monophasic fluid	Monophasic fluid*** OBM contamination
		(ft MD)	(scf/bbl)	(psia / °F)	(psia)		% (w/w)
1.06	SSB 9038-MA	18124	2,988	14.61 / 68.3	-	51.4	0.6
1.07	SSB 9168-MA	18124	3,000	14.60 / 68.7	-	51.4	0.5
1.13	SSB 9642-MA	18,086	3,142	14.61 / 69.0	-	50.6	0.5
1.14	SSB 8085-MA	18,086	3,051	14.61 / 69.1	-	51.0	0.5
1.18	20D127	18,142	2,945	14.66 / 74.6	6348	52.1	0.6

* Flashed gas volume (scf) per barrel of stock tank liquid @ 60°F

** Calculated from water or oil-based mud contamination in STL

Table 4: Stock-Tank Properties

Sample ID	Cylinder #	Depth	STO Properties				Comments
			Molar Mass	Density	API	OBM Contamination	
		(ft MD)		(g/cc)		% (w/w)	
1.06	SSB 9038-MA	18124	211	0.852	34.6	0.9	
1.07	SSB 9168-MA	18124	212	0.851	34.7	0.9	
1.13	SSB 9642-MA	18,086	207	0.851	34.7	0.8	
1.14	SSB 8085-MA	18,086	211	0.852	34.7	0.8	
1.18	20D127	18,142	216	0.852	34.6	0.9	

Table 5: Estimated Oil Based Mud Contamination Free Fluid Properties

Sample ID	Cylinder #	GOR		STO MW		STO density / API	
		Before Correction	After Correction	Before Correction	After Correction	Before Correction	After Correction
		(scf/bbl)				(g/cc) / °API	(g/cc) / °API
1.06	SSB 9038-MA	2,988	3,018	211	211	0.852 / 34.6	0.852 / 34.5
1.07	SSB 9168-MA	3,000	3,028	212	212	0.851 / 34.7	0.852 / 34.6
1.13	SSB 9642-MA	3,142	3,171	207	207	0.851 / 34.7	0.852 / 34.6
1.14	SSB 8085-MA	3,051	3,078	211	211	0.852 / 34.7	0.852 / 34.5
1.18	20D127	2,945	2,974	216	216	0.852 / 34.6	0.852 / 34.5

Table 6: C36+ Composition, GOR, °API, by Zero-Flash (Sample 1.06)

Sample 1.06; Cylinder SSB 9038-MA; Depth 18124 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
	(g/mole)	WT %	MOLE %	WT %	MOLE %	WT %	MOLE %
Carbon Dioxide	44.01	2.11	1.09	0.00	0.00	0.79	0.92
Hydrogen Sulfide	34.08	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	28.01	0.46	0.37	0.00	0.00	0.17	0.31
Methane	16.04	55.32	78.49	0.00	0.00	20.75	66.53
Ethane	30.07	10.11	7.65	0.00	0.00	3.79	6.49
Propane	44.10	10.34	5.34	0.06	0.26	3.91	4.56
I - Butane	58.12	2.71	1.06	0.04	0.16	1.04	0.92
N - Butane	58.12	5.99	2.35	0.20	0.72	2.37	2.10
I - Pentane	72.15	2.64	0.83	0.27	0.78	1.16	0.82
N - Pentane	72.15	3.01	0.95	0.50	1.47	1.44	1.03
C6	84.00	3.22	0.87	1.67	4.19	2.25	1.38
M-C-Pentane	84.16	0.65	0.18	0.56	1.41	0.60	0.36
Benzene	78.11	0.19	0.05	0.18	0.49	0.18	0.12
Cyclohexane	84.16	0.68	0.18	0.54	1.35	0.59	0.36
C7	96.00	1.12	0.27	2.64	5.79	2.07	1.11
M-C-Hexane	98.19	0.46	0.11	1.28	2.74	0.97	0.51
Toluene	92.14	0.21	0.05	0.64	1.47	0.48	0.27
C8	107.00	0.43	0.09	4.10	8.08	2.72	1.31
E-Benzene	106.17	0.01	0.00	0.17	0.34	0.11	0.05
M/P-Xylene	106.17	0.04	0.01	0.90	1.78	0.58	0.28
O-Xylene	106.17	0.01	0.00	0.34	0.67	0.21	0.10
C9	121.00	0.18	0.03	3.75	6.54	2.41	1.03
C10	134.00	0.07	0.01	5.12	8.06	3.23	1.24
C11	147.00	0.04	0.01	4.17	5.98	2.62	0.92
C12	161.00	0.01	0.00	3.83	5.02	2.40	0.77
C13	175.00	0.00	0.00	4.00	4.82	2.50	0.73
C14	190.00	0.00	0.00	3.44	3.82	2.15	0.58
C15	206.00	0.00	0.00	3.64	3.73	2.28	0.57
C16	222.00			3.22	3.06	2.01	0.47
C17	237.00			2.77	2.47	1.73	0.38
C18	251.00			2.86	2.40	1.79	0.37
C19	263.00			2.54	2.04	1.59	0.31
C20	275.00			2.30	1.76	1.44	0.27
C21	291.00			2.05	1.48	1.28	0.23
C22	305.00			1.91	1.32	1.20	0.20
C23	318.00			1.76	1.17	1.10	0.18
C24	331.00			1.64	1.05	1.03	0.16
C25	345.00			1.48	0.91	0.93	0.14
C26	359.00			1.44	0.84	0.90	0.13
C27	374.00			1.37	0.77	0.86	0.12
C28	388.00			1.31	0.71	0.82	0.11
C29	402.00			1.27	0.67	0.80	0.10
C30	416.00			1.23	0.62	0.77	0.10
C31	430.00			1.17	0.57	0.73	0.09
C32	444.00			1.11	0.53	0.70	0.08
C33	458.00			1.04	0.48	0.65	0.07
C34	472.00			1.04	0.46	0.65	0.07
C35	486.00			1.02	0.44	0.64	0.07
C36+	750.00			23.43	6.59	14.64	1.00
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
MW			22.76		210.84		51.43
MOLE RATIO			0.8476		0.1524		

Table 7: Calculated Fluid Properties

Sample 1.06; Cylinder SSB 9038-MA; Depth 18124 ft MD

Properties	Flashed Gas		Flashed Liquid		Monophasic Fluid	
Cn+ Composition	Mass %	Mole %	Mass %	Mole %	Mass %	Mole %
C7+	4.10	1.00	97.26	92.42	62.32	14.93
C12+	0.01	0.00	72.88	47.72	45.54	7.28
C20+	-	-	46.57	20.38	29.10	3.11
C30+	-	-	30.04	9.70	18.77	1.48
C36+	-	-	23.43	6.59	14.64	1.00
Molar Mass						
C7+	94		222		215	
C12+	163		322		322	
C20+	-		482		482	
C30+	-		653		653	
C36+	-		750		750	
Density						
C7+	-		0.864		-	
C12+	-		0.900		0.900	
C20+	-		0.945		0.945	
C30+			0.986		0.986	
C36+			1.01		1.01	
Fluid at 60°F			0.852			
Gas Gravity (Air = 1)	0.786					
Dry Gross Heat Content (BTU/scf)	1,338					
Wet Gross Heat Content (BTU/scf)	1,315					

OBM Contamination Level (wt%)	0.9	STO Basis
	0.6	Live Oil Basis

Stock Tank Oil Properties at Standard Conditions:

	Measured	Calculated	C36+ Properties	
MW	217	211	750	
Density (g/cm3)	0.852	0.857	1.01	

Single Stage Flash Data

	Original STO	De-Contaminated
GOR (scf/stb)	2988	3018
STO Density (g/cm3)	0.852	0.852
STO API Gravity	34.6	34.5
OBM Density (g/cm3) @60°F	0.788	

Figure 1: Stock Tank Oil Chromatogram (Sample 1.06)
Sample 1.06; Cylinder SSB 9038-MA; Depth 18124 ft MD

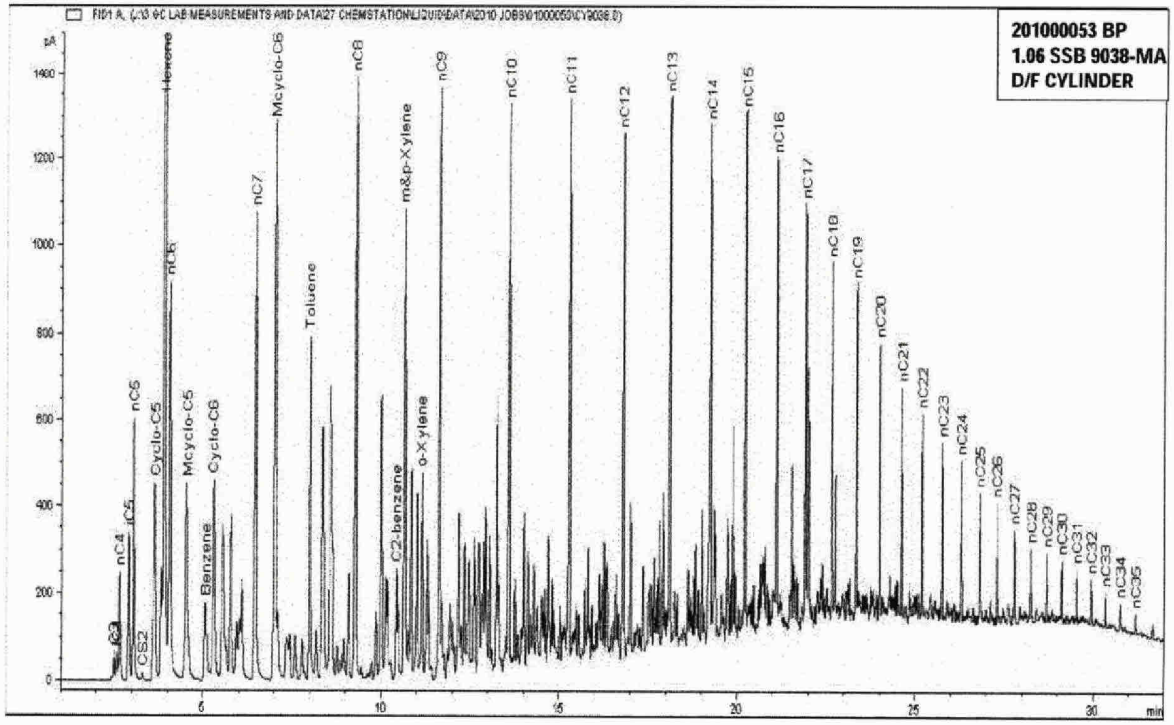


Figure 2: k-Plot for Equilibrium Check (Sample 1.06)
Sample 1.06; Cylinder SSB 9038-MA; Depth 18124 ft MD

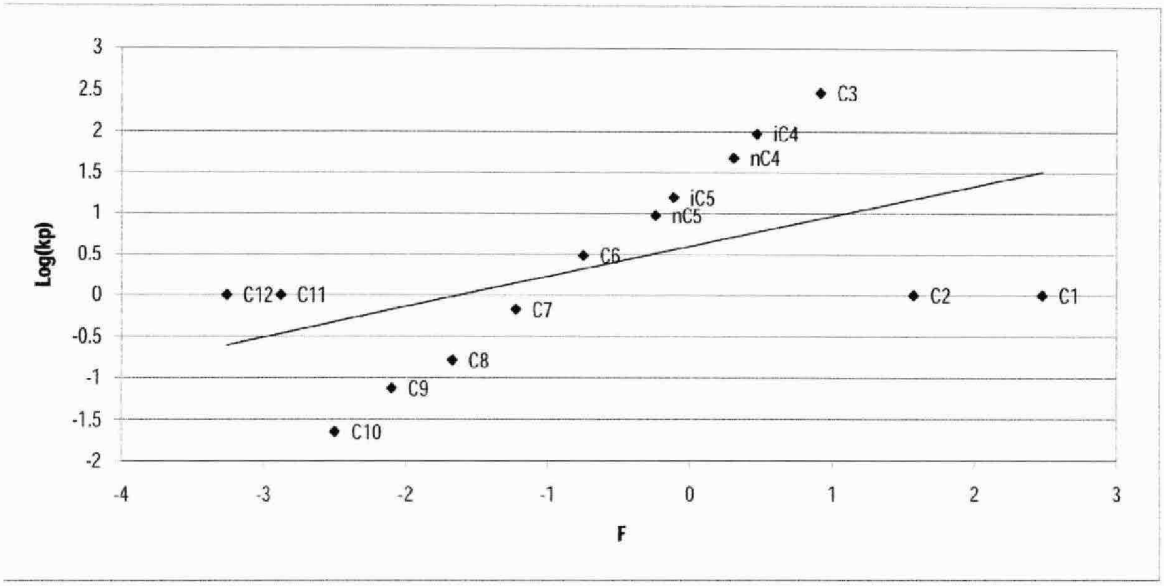


Table 8: Estimated OBM Contamination Free Fluid Compositions (mole %)

Sample 1.06; Cylinder SSB 9038-MA; Depth 18124 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
				Before Correction	After Correction	Before Correction	After Correction
Carbon Dioxide	44.01	1.09		0.00	0.00	0.92	0.92
Hydrogen Sulfide	34.08	0.00		0.00	0.00	0.00	0.00
Nitrogen	28.01	0.37		0.00	0.00	0.31	0.31
Methane	16.04	78.49		0.00	0.00	66.53	66.62
Ethane	30.07	7.65		0.00	0.00	6.49	6.49
Propane	44.10	5.34		0.26	0.27	4.56	4.57
I - Butane	58.12	1.06		0.16	0.16	0.92	0.93
N - Butane	58.12	2.35		0.72	0.72	2.10	2.10
I - Pentane	72.15	0.83		0.78	0.78	0.82	0.83
N - Pentane	72.15	0.95		1.47	1.48	1.03	1.03
C6	84.00	0.87		4.19	4.22	1.38	1.38
M-C-Pentane	84.16	0.18		1.41	1.42	0.36	0.37
Benzene	78.11	0.05		0.49	0.49	0.12	0.12
Cyclohexane	84.16	0.18		1.35	1.37	0.36	0.36
C7	96.00	0.27		5.79	5.84	1.11	1.11
M-C-Hexane	98.19	0.11		2.74	2.76	0.51	0.51
Toluene	92.14	0.05		1.47	1.48	0.27	0.27
C8	107.00	0.09		8.08	8.15	1.31	1.31
E-Benzene	106.17	0.00		0.34	0.34	0.05	0.05
M/P-Xylene	106.17	0.01		1.78	1.80	0.28	0.28
O-Xylene	106.17	0.00		0.67	0.67	0.10	0.10
C9	121.00	0.03		6.54	6.60	1.03	1.03
C10	134.00	0.01		8.06	8.13	1.24	1.24
C11	147.00	0.01		5.98	6.04	0.92	0.92
C12	161.00	0.00		5.02	5.06	0.77	0.77
C13	175.00	0.00		4.82	4.86	0.73	0.74
C14	190.00	0.00		3.82	3.85	0.58	0.58
C15	206.00	0.00		3.73	3.32	0.57	0.50
C16	222.00	0.00		3.06	2.88	0.47	0.44
C17	237.00			2.47	2.52	0.38	0.38
C18	251.00			2.40	2.23	0.37	0.34
C19	263.00			2.04	1.99	0.31	0.30
C20	275.00			1.76	1.78	0.27	0.27
C21	291.00			1.48	1.50	0.23	0.23
C22	305.00			1.32	1.33	0.20	0.20
C23	318.00			1.17	1.18	0.18	0.18
C24	331.00			1.05	1.06	0.16	0.16
C25	345.00			0.91	0.92	0.14	0.14
C26	359.00			0.84	0.85	0.13	0.13
C27	374.00			0.77	0.78	0.12	0.12
C28	388.00			0.71	0.72	0.11	0.11
C29	402.00			0.67	0.67	0.10	0.10
C30	416.00			0.62	0.63	0.10	0.10
C31	430.00			0.57	0.58	0.09	0.09
C32	444.00			0.53	0.53	0.08	0.08
C33	458.00			0.48	0.48	0.07	0.07
C34	472.00			0.46	0.47	0.07	0.07
C35	486.00			0.44	0.45	0.07	0.07
C36+	750.00			6.59	6.64	1.00	1.01
Total		100.00		100.00	100.00	100.00	100.00
MW		22.76		210.84	210.73	51.43	51.21
MOLE RATIO		0.8476		0.1524			
		0.8487			0.1513		

Table 9: C36+ Composition, GOR, °API, by Zero-Flash (Sample 1.07)

Sample 1.07; Cylinder SSB 9168-MA; Depth 18124 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
	(g/mole)	WT %	MOLE %	WT %	MOLE %	WT %	MOLE %
Carbon Dioxide	44.01	2.09	1.08	0.00	0.00	0.79	0.92
Hydrogen Sulfide	34.08	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	28.01	0.45	0.37	0.00	0.00	0.17	0.31
Methane	16.04	55.22	78.49	0.00	0.00	20.79	66.63
Ethane	30.07	10.07	7.64	0.00	0.00	3.79	6.48
Propane	44.10	10.29	5.32	0.06	0.29	3.91	4.56
I - Butane	58.12	2.69	1.06	0.05	0.17	1.04	0.92
N - Butane	58.12	5.95	2.34	0.21	0.75	2.37	2.10
I - Pentane	72.15	2.62	0.83	0.27	0.81	1.16	0.83
N - Pentane	72.15	2.99	0.95	0.46	1.36	1.42	1.01
C6	84.00	3.22	0.87	1.58	3.98	2.19	1.34
M-C-Pentane	84.16	0.66	0.18	0.55	1.40	0.59	0.36
Benzene	78.11	0.19	0.05	0.18	0.49	0.18	0.12
Cyclohexane	84.16	0.70	0.19	0.54	1.35	0.60	0.36
C7	96.00	1.17	0.28	2.56	5.66	2.04	1.09
M-C-Hexane	98.19	0.50	0.12	1.29	2.78	0.99	0.52
Toluene	92.14	0.23	0.06	0.60	1.38	0.46	0.26
C8	107.00	0.50	0.11	3.97	7.87	2.66	1.28
E-Benzene	106.17	0.01	0.00	0.17	0.34	0.11	0.05
M/P-Xylene	106.17	0.06	0.01	0.89	1.78	0.58	0.28
O-Xylene	106.17	0.01	0.00	0.33	0.66	0.21	0.10
C9	121.00	0.23	0.04	3.68	6.45	2.38	1.01
C10	134.00	0.09	0.02	5.03	7.97	3.17	1.22
C11	147.00	0.04	0.01	4.11	5.92	2.57	0.90
C12	161.00	0.01	0.00	3.77	4.97	2.36	0.75
C13	175.00	0.00	0.00	3.95	4.79	2.46	0.72
C14	190.00	0.00	0.00	3.42	3.81	2.13	0.58
C15	206.00	0.00	0.00	3.63	3.74	2.26	0.56
C16	222.00			3.21	3.07	2.00	0.46
C17	237.00			2.79	2.50	1.74	0.38
C18	251.00			2.89	2.44	1.80	0.37
C19	263.00			2.60	2.10	1.62	0.32
C20	275.00			2.36	1.82	1.47	0.28
C21	291.00			2.13	1.55	1.33	0.23
C22	305.00			2.06	1.43	1.28	0.22
C23	318.00			1.81	1.21	1.13	0.18
C24	331.00			1.75	1.12	1.09	0.17
C25	345.00			1.59	0.98	0.99	0.15
C26	359.00			1.56	0.92	0.97	0.14
C27	374.00			1.53	0.87	0.96	0.13
C28	388.00			1.40	0.77	0.88	0.12
C29	402.00			1.43	0.76	0.89	0.11
C30	416.00			1.36	0.70	0.85	0.11
C31	430.00			1.30	0.64	0.81	0.10
C32	444.00			1.23	0.59	0.77	0.09
C33	458.00			1.17	0.54	0.73	0.08
C34	472.00			1.13	0.51	0.70	0.08
C35	486.00			1.10	0.48	0.69	0.07
C36+	750.00			22.29	6.30	13.89	0.95
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
MW			22.80		212.07		51.41
MOLE RATIO			0.8489		0.1511		

Table 10: Calculated Fluid Properties

Sample 1.07; Cylinder SSB 9168-MA; Depth 18124 ft MD

Properties	Flashed Gas		Flashed Liquid		Monophasic Fluid	
Cn+ Composition	Mass %	Mole %	Mass %	Mole %	Mass %	Mole %
C7+	4.41	1.07	97.37	92.64	62.37	14.91
C12+	0.01	0.00	73.47	48.59	45.81	7.34
C20+	-	-	47.21	21.18	29.43	3.20
C30+	-	-	29.58	9.75	18.44	1.47
C36+	-	-	22.29	6.30	13.89	0.95
Molar Mass						
C7+	94		223		215	
C12+	164		321		321	
C20+	-		473		473	
C30+	-		643		643	
C36+	-		750		750	
Density						
C7+	-		0.864		-	
C12+	-		0.898		0.898	
C20+	-		0.942		0.942	
C30+			0.983		0.983	
C36+			1.01		1.01	
Fluid at 60°F			0.851			
Gas Gravity (Air = 1)	0.787					
Dry Gross Heat Content (BTU/scf)	1,340					
Wet Gross Heat Content (BTU/scf)	1,317					

OBM Contamination Level (wt%)	0.9	STO Basis
	0.5	Live Oil Basis

Stock Tank Oil Properties at Standard Conditions:

	Measured	Calculated		C36+ Properties	
MW	210	212		750	
Density (g/cm3)	0.851	0.857		1.01	

Single Stage Flash Data

	Original STO		De-Contaminated	
GOR (scf/stb)	3000		3028	
STO Density (g/cm3)	0.851		0.852	
STO API Gravity	34.7		34.6	
OBM Density (g/cm3) @60°F	0.788			

Figure 3: Stock Tank Oil Chromatogram (Sample 1.07)

Sample 1.07; Cylinder SSB 9168-MA; Depth 18124 ft MD

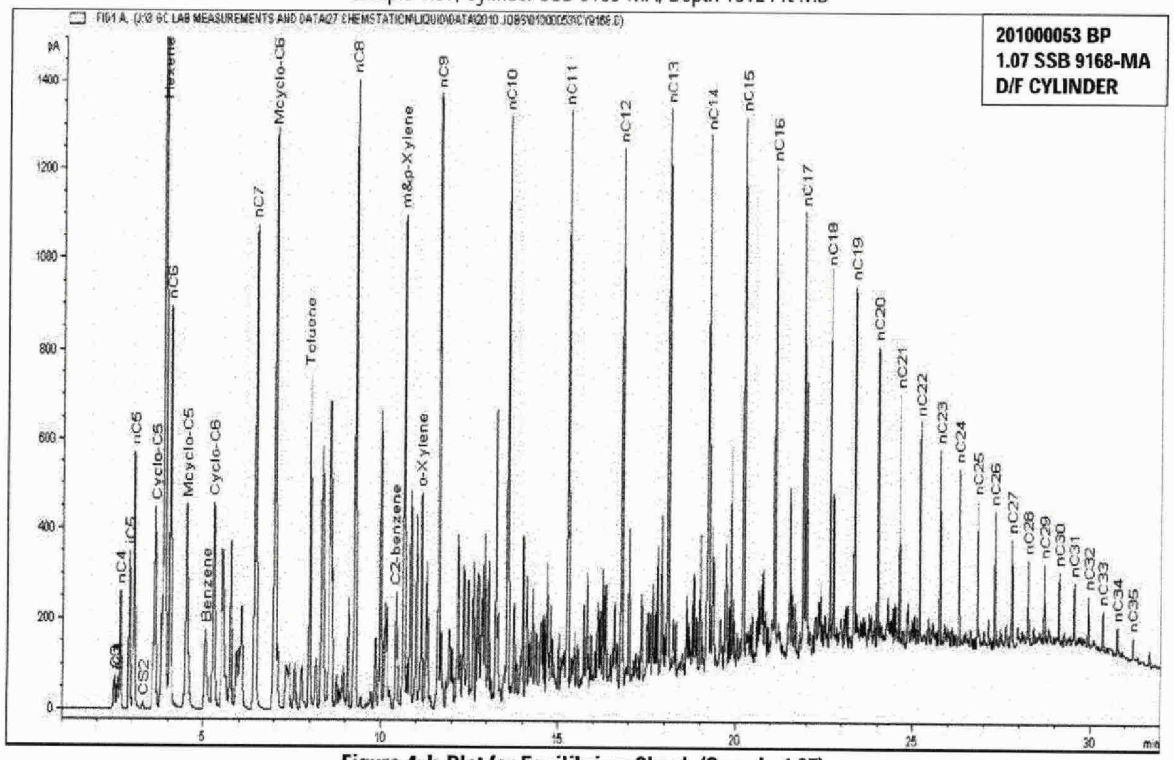


Figure 4: k-Plot for Equilibrium Check (Sample 1.07)

Sample 1.07; Cylinder SSB 9168-MA; Depth 18124 ft MD

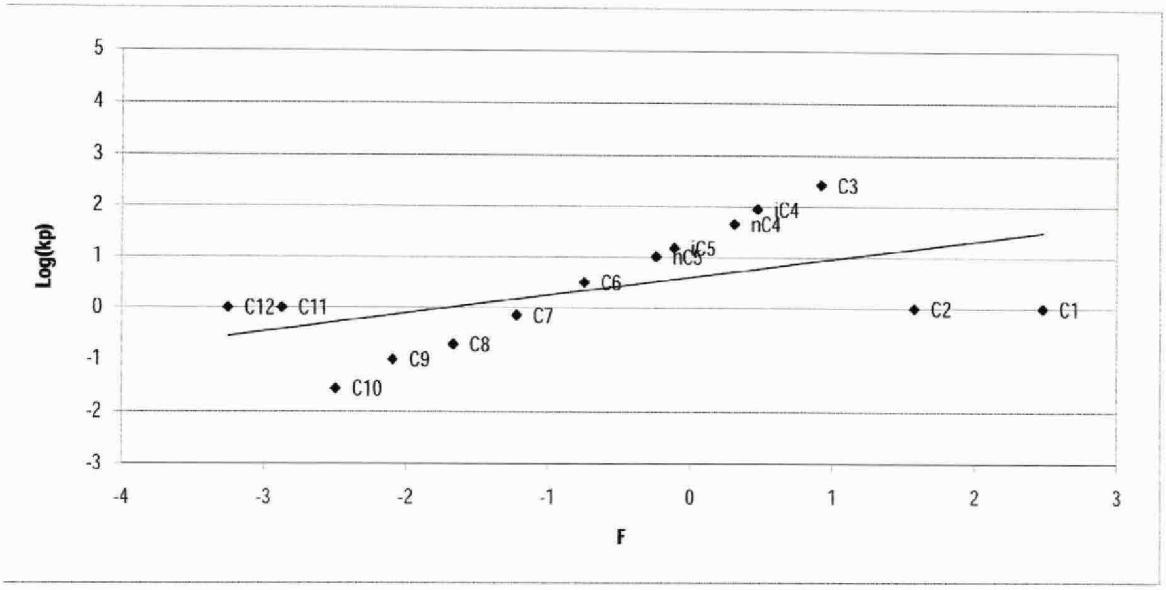


Table 11: Estimated OBM Contamination Free Fluid Compositions (mole %)

Sample 1.07; Cylinder SSB 9168-MA; Depth 18124 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
				Before Correction	After Correction	Before Correction	After Correction
Carbon Dioxide	44.01	1.08		0.00	0.00	0.92	0.92
Hydrogen Sulfide	34.08	0.00		0.00	0.00	0.00	0.00
Nitrogen	28.01	0.37		0.00	0.00	0.31	0.31
Methane	16.04	78.49		0.00	0.00	66.63	66.71
Ethane	30.07	7.64		0.00	0.00	6.48	6.49
Propane	44.10	5.32		0.29	0.29	4.56	4.56
I - Butane	58.12	1.06		0.17	0.18	0.92	0.92
N - Butane	58.12	2.34		0.75	0.75	2.10	2.10
I - Pentane	72.15	0.83		0.81	0.81	0.83	0.83
N - Pentane	72.15	0.95		1.36	1.37	1.01	1.01
C6	84.00	0.87		3.98	4.01	1.34	1.34
M-C-Pentane	84.16	0.18		1.40	1.41	0.36	0.36
Benzene	78.11	0.05		0.49	0.49	0.12	0.12
Cyclohexane	84.16	0.19		1.35	1.36	0.36	0.36
C7	96.00	0.28		5.66	5.71	1.09	1.09
M-C-Hexane	98.19	0.12		2.78	2.81	0.52	0.52
Toluene	92.14	0.06		1.38	1.39	0.26	0.26
C8	107.00	0.11		7.87	7.94	1.28	1.28
E-Benzene	106.17	0.00		0.34	0.35	0.05	0.05
M/P-Xylene	106.17	0.01		1.78	1.79	0.28	0.28
O-Xylene	106.17	0.00		0.66	0.66	0.10	0.10
C9	121.00	0.04		6.45	6.50	1.01	1.01
C10	134.00	0.02		7.97	8.03	1.22	1.22
C11	147.00	0.01		5.92	5.97	0.90	0.90
C12	161.00	0.00		4.97	5.01	0.75	0.75
C13	175.00	0.00		4.79	4.83	0.72	0.72
C14	190.00	0.00		3.81	3.84	0.58	0.58
C15	206.00	0.00		3.74	3.33	0.56	0.50
C16	222.00	0.00		3.07	2.91	0.46	0.44
C17	237.00			2.50	2.56	0.38	0.38
C18	251.00			2.44	2.28	0.37	0.34
C19	263.00			2.10	2.04	0.32	0.31
C20	275.00			1.82	1.84	0.28	0.28
C21	291.00			1.55	1.56	0.23	0.23
C22	305.00			1.43	1.44	0.22	0.22
C23	318.00			1.21	1.22	0.18	0.18
C24	331.00			1.12	1.13	0.17	0.17
C25	345.00			0.98	0.99	0.15	0.15
C26	359.00			0.92	0.93	0.14	0.14
C27	374.00			0.87	0.88	0.13	0.13
C28	388.00			0.77	0.77	0.12	0.12
C29	402.00			0.76	0.76	0.11	0.11
C30	416.00			0.70	0.70	0.11	0.11
C31	430.00			0.64	0.65	0.10	0.10
C32	444.00			0.59	0.59	0.09	0.09
C33	458.00			0.54	0.55	0.08	0.08
C34	472.00			0.51	0.51	0.08	0.08
C35	486.00			0.48	0.48	0.07	0.07
C36+	750.00			6.30	6.35	0.95	0.95
Total		100.00		100.00	100.00	100.00	100.00
MW		22.80		212.07	211.98	51.41	51.20
MOLE RATIO		0.8489		0.1511			
		0.8499			0.1501		

Table 12: C36+ Composition, GOR, °API, by Zero-Flash (Sample 1.13)

Sample 1.13; Cylinder SSB 9642-MA; Depth 18086 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
	(g/mole)	WT %	MOLE %	WT %	MOLE %	WT %	MOLE %
Carbon Dioxide	44.01	1.97	1.05	0.00	0.00	0.77	0.89
Hydrogen Sulfide	34.08	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	28.01	0.43	0.36	0.00	0.00	0.17	0.31
Methane	16.04	53.20	77.44	0.00	0.00	20.92	65.94
Ethane	30.07	10.38	8.06	0.00	0.00	4.08	6.87
Propane	44.10	10.19	5.39	0.06	0.30	4.04	4.64
I - Butane	58.12	2.67	1.07	0.05	0.18	1.08	0.94
N - Butane	58.12	5.81	2.33	0.21	0.76	2.41	2.10
I - Pentane	72.15	2.61	0.84	0.28	0.81	1.20	0.84
N - Pentane	72.15	2.97	0.96	0.48	1.38	1.46	1.02
C6	84.00	3.43	0.95	1.69	4.16	2.37	1.43
M-C-Pentane	84.16	0.73	0.20	0.58	1.42	0.64	0.38
Benzene	78.11	0.23	0.07	0.18	0.49	0.20	0.13
Cyclohexane	84.16	0.84	0.23	0.56	1.38	0.67	0.40
C7	96.00	1.52	0.37	2.72	5.86	2.25	1.18
M-C-Hexane	98.19	0.70	0.17	1.33	2.81	1.08	0.56
Toluene	92.14	0.38	0.10	0.66	1.48	0.55	0.30
C8	107.00	0.86	0.19	4.22	8.15	2.90	1.37
E-Benzene	106.17	0.03	0.01	0.18	0.34	0.12	0.06
M/P-Xylene	106.17	0.13	0.03	0.96	1.87	0.63	0.30
O-Xylene	106.17	0.03	0.01	0.35	0.68	0.22	0.11
C9	121.00	0.52	0.10	3.87	6.61	2.55	1.07
C10	134.00	0.25	0.04	5.28	8.15	3.30	1.25
C11	147.00	0.11	0.02	4.28	6.01	2.64	0.91
C12	161.00	0.02	0.00	3.90	5.01	2.38	0.75
C13	175.00	0.00	0.00	4.07	4.80	2.47	0.71
C14	190.00	0.00	0.00	3.50	3.81	2.12	0.56
C15	206.00	0.00	0.00	3.70	3.71	2.25	0.55
C16	222.00			3.25	3.03	1.97	0.45
C17	237.00			2.82	2.46	1.71	0.37
C18	251.00			2.90	2.39	1.76	0.35
C19	263.00			2.60	2.05	1.58	0.30
C20	275.00			2.36	1.78	1.43	0.26
C21	291.00			2.11	1.50	1.28	0.22
C22	305.00			1.98	1.34	1.20	0.20
C23	318.00			1.83	1.19	1.11	0.18
C24	331.00			1.70	1.06	1.03	0.16
C25	345.00			1.54	0.92	0.94	0.14
C26	359.00			1.49	0.86	0.91	0.13
C27	374.00			1.45	0.80	0.88	0.12
C28	388.00			1.36	0.73	0.83	0.11
C29	402.00			1.33	0.68	0.81	0.10
C30	416.00			1.29	0.64	0.78	0.10
C31	430.00			1.22	0.59	0.74	0.09
C32	444.00			1.16	0.54	0.70	0.08
C33	458.00			1.11	0.50	0.67	0.07
C34	472.00			1.07	0.47	0.65	0.07
C35	486.00			1.07	0.45	0.65	0.07
C36+	750.00			21.23	5.85	12.88	0.87
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
MW			23.35		206.72		50.58
MOLE RATIO			0.8515		0.1485		

Table 13: Calculated Fluid Properties

Sample 1.13; Cylinder SSB 9642-MA; Depth 18086 ft MD

Properties	Flashed Gas		Flashed Liquid		Monophasic Fluid	
Cn+ Composition	Mass %	Mole %	Mass %	Mole %	Mass %	Mole %
C7+	6.35	1.53	97.22	92.41	61.49	15.02
C12+	0.03	0.00	72.05	47.16	43.73	7.00
C20+	-	-	45.30	19.90	27.49	2.95
C30+	-	-	28.14	9.04	17.08	1.34
C36+	-	-	21.23	5.85	12.88	0.87
Molar Mass						
C7+	97		217		207	
C12+	164		316		316	
C20+	-		471		471	
C30+	-		644		644	
C36+	-		750		750	
Density						
C7+	-		0.861		-	
C12+	-		0.896		0.896	
C20+	-		0.941		0.941	
C30+			0.983		0.983	
C36+			1.01		1.01	
Fluid at 60°F			0.851			
Gas Gravity (Air = 1)	0.806					
Dry Gross Heat Content (BTU/scf)	1,371					
Wet Gross Heat Content (BTU/scf)	1,347					

OBM Contamination Level (wt%)	0.8	STO Basis
	0.5	Live Oil Basis

Stock Tank Oil Properties at Standard Conditions:

	Measured	Calculated		C36+ Properties	
MW	210	207		750	
Density (g/cm3)	0.851	0.853		1.01	

Single Stage Flash Data

	Original STO		De-Contaminated	
GOR (scf/stb)	3142		3171	
STO Density (g/cm3)	0.851		0.852	
STO API Gravity	34.7		34.6	
OBM Density (g/cm3) @60°F	0.788			

Figure 5: Stock Tank Oil Chromatogram (Sample 1.13)
Sample 1.13; Cylinder SSB 9642-MA; Depth 18086 ft MD

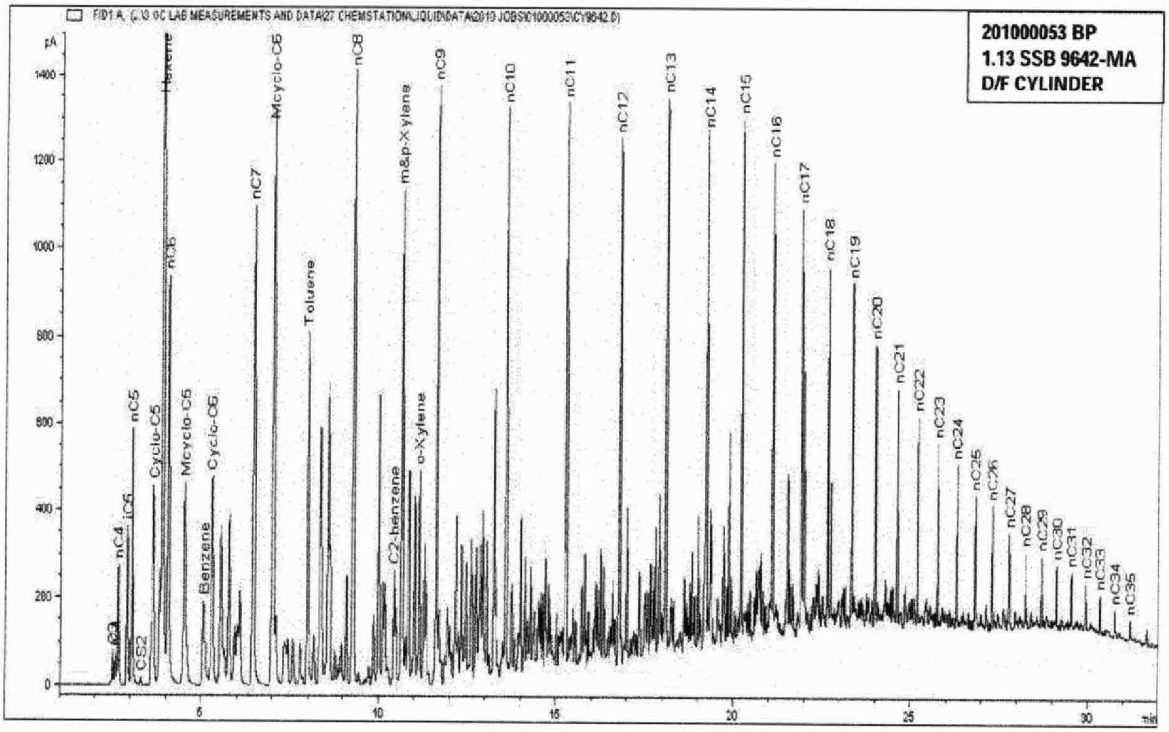


Figure 6: k-Plot for Equilibrium Check (Sample 1.13)
Sample 1.13; Cylinder SSB 9642-MA; Depth 18086 ft MD

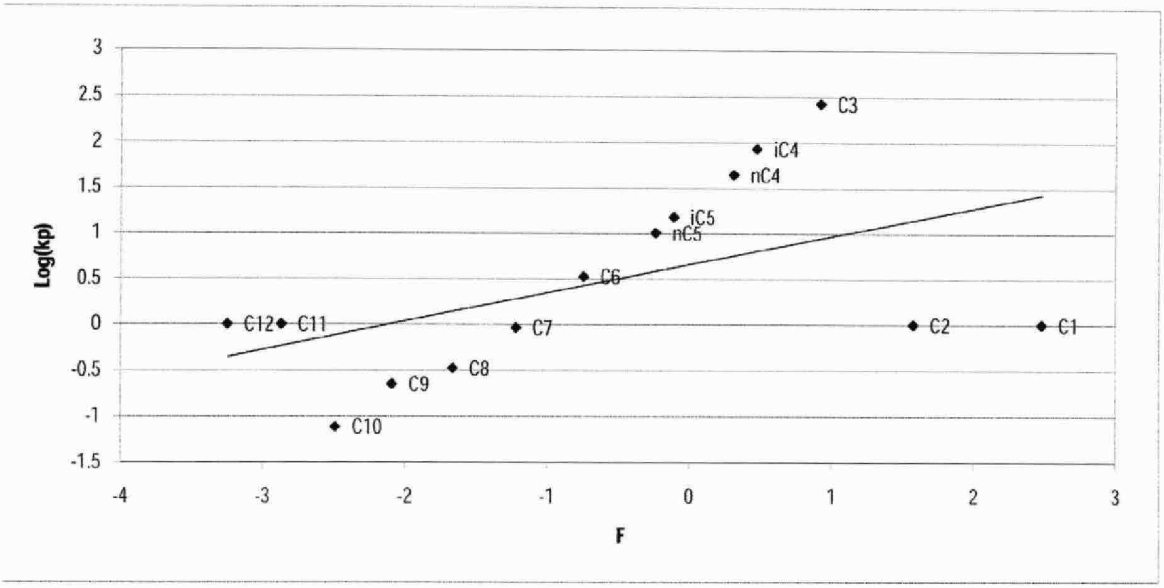


Table 14: Estimated OBM Contamination Free Fluid Compositions (mole %)

Sample 1.13; Cylinder SSB 9642-MA; Depth 18086 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
				Before Correction	After Correction	Before Correction	After Correction
Carbon Dioxide	44.01	1.05		0.00	0.00	0.89	0.89
Hydrogen Sulfide	34.08	0.00		0.00	0.00	0.00	0.00
Nitrogen	28.01	0.36		0.00	0.00	0.31	0.31
Methane	16.04	77.44		0.00	0.00	65.94	66.02
Ethane	30.07	8.06		0.00	0.00	6.87	6.87
Propane	44.10	5.39		0.30	0.30	4.64	4.64
I - Butane	58.12	1.07		0.18	0.18	0.94	0.94
N - Butane	58.12	2.33		0.76	0.77	2.10	2.10
I - Pentane	72.15	0.84		0.81	0.82	0.84	0.84
N - Pentane	72.15	0.96		1.38	1.39	1.02	1.03
C6	84.00	0.95		4.16	4.19	1.43	1.43
M-C-Pentane	84.16	0.20		1.42	1.43	0.38	0.38
Benzene	78.11	0.07		0.49	0.49	0.13	0.13
Cyclohexane	84.16	0.23		1.38	1.39	0.40	0.40
C7	96.00	0.37		5.86	5.91	1.18	1.19
M-C-Hexane	98.19	0.17		2.81	2.83	0.56	0.56
Toluene	92.14	0.10		1.48	1.49	0.30	0.30
C8	107.00	0.19		8.15	8.21	1.37	1.37
E-Benzene	106.17	0.01		0.34	0.35	0.06	0.06
M/P-Xylene	106.17	0.03		1.87	1.88	0.30	0.30
O-Xylene	106.17	0.01		0.68	0.69	0.11	0.11
C9	121.00	0.10		6.61	6.66	1.07	1.07
C10	134.00	0.04		8.15	8.22	1.25	1.25
C11	147.00	0.02		6.01	6.06	0.91	0.91
C12	161.00	0.00		5.01	5.05	0.75	0.75
C13	175.00	0.00		4.80	4.84	0.71	0.71
C14	190.00	0.00		3.81	3.84	0.56	0.57
C15	206.00	0.00		3.71	3.31	0.55	0.49
C16	222.00	0.00		3.03	2.88	0.45	0.42
C17	237.00			2.46	2.53	0.37	0.37
C18	251.00			2.39	2.23	0.35	0.33
C19	263.00			2.05	2.00	0.30	0.29
C20	275.00			1.78	1.79	0.26	0.26
C21	291.00			1.50	1.51	0.22	0.22
C22	305.00			1.34	1.35	0.20	0.20
C23	318.00			1.19	1.20	0.18	0.18
C24	331.00			1.06	1.07	0.16	0.16
C25	345.00			0.92	0.93	0.14	0.14
C26	359.00			0.86	0.87	0.13	0.13
C27	374.00			0.80	0.81	0.12	0.12
C28	388.00			0.73	0.73	0.11	0.11
C29	402.00			0.68	0.69	0.10	0.10
C30	416.00			0.64	0.65	0.10	0.10
C31	430.00			0.59	0.59	0.09	0.09
C32	444.00			0.54	0.54	0.08	0.08
C33	458.00			0.50	0.50	0.07	0.07
C34	472.00			0.47	0.47	0.07	0.07
C35	486.00			0.45	0.46	0.07	0.07
C36+	750.00			5.85	5.90	0.87	0.87
Total		100.00		100.00	100.00	100.00	100.00
MW		23.35		206.72	206.60	50.58	50.37
MOLE RATIO		0.8515		0.1485			
		0.8525			0.1475		

Table 15: C36+ Composition, GOR, °API, by Zero-Flash (Sample 1.14)

Sample 1.14; Cylinder SSB 8085-MA; Depth 18086 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
	(g/mole)	WT %	MOLE %	WT %	MOLE %	WT %	MOLE %
Carbon Dioxide	44.01	2.04	1.06	0.00	0.00	0.78	0.90
Hydrogen Sulfide	34.08	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	28.01	0.46	0.38	0.00	0.00	0.18	0.32
Methane	16.04	54.60	77.92	0.00	0.00	20.83	66.27
Ethane	30.07	10.66	8.12	0.00	0.00	4.07	6.90
Propane	44.10	10.44	5.42	0.06	0.27	4.02	4.65
I - Butane	58.12	2.72	1.07	0.05	0.17	1.07	0.94
N - Butane	58.12	5.91	2.33	0.20	0.72	2.38	2.09
I - Pentane	72.15	2.62	0.83	0.27	0.78	1.17	0.82
N - Pentane	72.15	2.96	0.94	0.45	1.32	1.41	1.00
C6	84.00	3.17	0.86	1.61	4.04	2.20	1.34
M-C-Pentane	84.16	0.64	0.18	0.56	1.40	0.59	0.36
Benzene	78.11	0.20	0.06	0.18	0.48	0.18	0.12
Cyclohexane	84.16	0.68	0.18	0.54	1.37	0.60	0.36
C7	96.00	1.13	0.27	2.64	5.80	2.06	1.10
M-C-Hexane	98.19	0.49	0.11	1.30	2.80	0.99	0.52
Toluene	92.14	0.24	0.06	0.65	1.49	0.49	0.27
C8	107.00	0.49	0.10	4.08	8.06	2.71	1.29
E-Benzene	106.17	0.03	0.01	0.17	0.34	0.12	0.06
M/P-Xylene	106.17	0.07	0.01	0.93	1.85	0.60	0.29
O-Xylene	106.17	0.01	0.00	0.34	0.68	0.22	0.10
C9	121.00	0.24	0.05	3.74	6.53	2.41	1.02
C10	134.00	0.13	0.02	5.11	8.06	3.21	1.22
C11	147.00	0.06	0.01	4.14	5.95	2.58	0.90
C12	161.00	0.02	0.00	3.79	4.97	2.35	0.74
C13	175.00	0.00	0.00	3.94	4.76	2.44	0.71
C14	190.00	0.00	0.00	3.39	3.77	2.10	0.56
C15	206.00	0.00	0.00	3.60	3.69	2.23	0.55
C16	222.00			3.17	3.02	1.96	0.45
C17	237.00			2.75	2.45	1.70	0.37
C18	251.00			2.85	2.39	1.76	0.36
C19	263.00			2.56	2.06	1.58	0.31
C20	275.00			2.33	1.79	1.44	0.27
C21	291.00			2.12	1.54	1.31	0.23
C22	305.00			2.01	1.39	1.24	0.21
C23	318.00			1.78	1.18	1.10	0.18
C24	331.00			1.72	1.10	1.06	0.16
C25	345.00			1.55	0.95	0.96	0.14
C26	359.00			1.52	0.89	0.94	0.13
C27	374.00			1.44	0.81	0.89	0.12
C28	388.00			1.37	0.74	0.85	0.11
C29	402.00			1.34	0.70	0.83	0.11
C30	416.00			1.28	0.65	0.79	0.10
C31	430.00			1.22	0.60	0.75	0.09
C32	444.00			1.14	0.54	0.71	0.08
C33	458.00			1.10	0.50	0.68	0.08
C34	472.00			1.07	0.48	0.66	0.07
C35	486.00			1.04	0.45	0.65	0.07
C36+	750.00			22.90	6.45	14.17	0.96
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
MW			22.90		211.16		51.05
MOLE RATIO			0.8505		0.1495		

Table 16: Calculated Fluid Properties

Sample 1.14; Cylinder SSB 8085-MA; Depth 18086 ft MD

Properties	Flashed Gas		Flashed Liquid		Monophasic Fluid	
Cn+ Composition	Mass %	Mole %	Mass %	Mole %	Mass %	Mole %
C7+	4.41	1.07	97.37	92.69	61.91	14.76
C12+	0.02	0.00	72.98	47.88	45.14	7.16
C20+	-	-	46.92	20.77	29.02	3.11
C30+	-	-	29.74	9.67	18.40	1.45
C36+	-	-	22.90	6.45	14.17	0.96
Molar Mass						
C7+	95		222		214	
C12+	165		322		322	
C20+	-		477		477	
C30+	-		649		649	
C36+	-		750		750	
Density						
C7+	-		0.864		-	
C12+	-		0.899		0.899	
C20+	-		0.944		0.944	
C30+			0.985		0.985	
C36+			1.01		1.01	
Fluid at 60°F			0.852			
Gas Gravity (Air = 1)	0.791					
Dry Gross Heat Content (BTU/scf)	1,346					
Wet Gross Heat Content (BTU/scf)	1,322					

OBM Contamination Level (wt%)	0.8	STO Basis
	0.5	Live Oil Basis

Stock Tank Oil Properties at Standard Conditions:

	Measured	Calculated		C36+ Properties	
MW	215	211		750	
Density (g/cm3)	0.852	0.857		1.01	

Single Stage Flash Data

	Original STO		De-Contaminated	
GOR (scf/stb)	3051		3078	
STO Density (g/cm3)	0.852		0.852	
STO API Gravity	34.7		34.5	
OBM Density (g/cm3) @60°F	0.788			

Figure 7: Stock Tank Oil Chromatogram (Sample 1.14)

Sample 1.14; Cylinder SSB 8085-MA; Depth 18086 ft MD

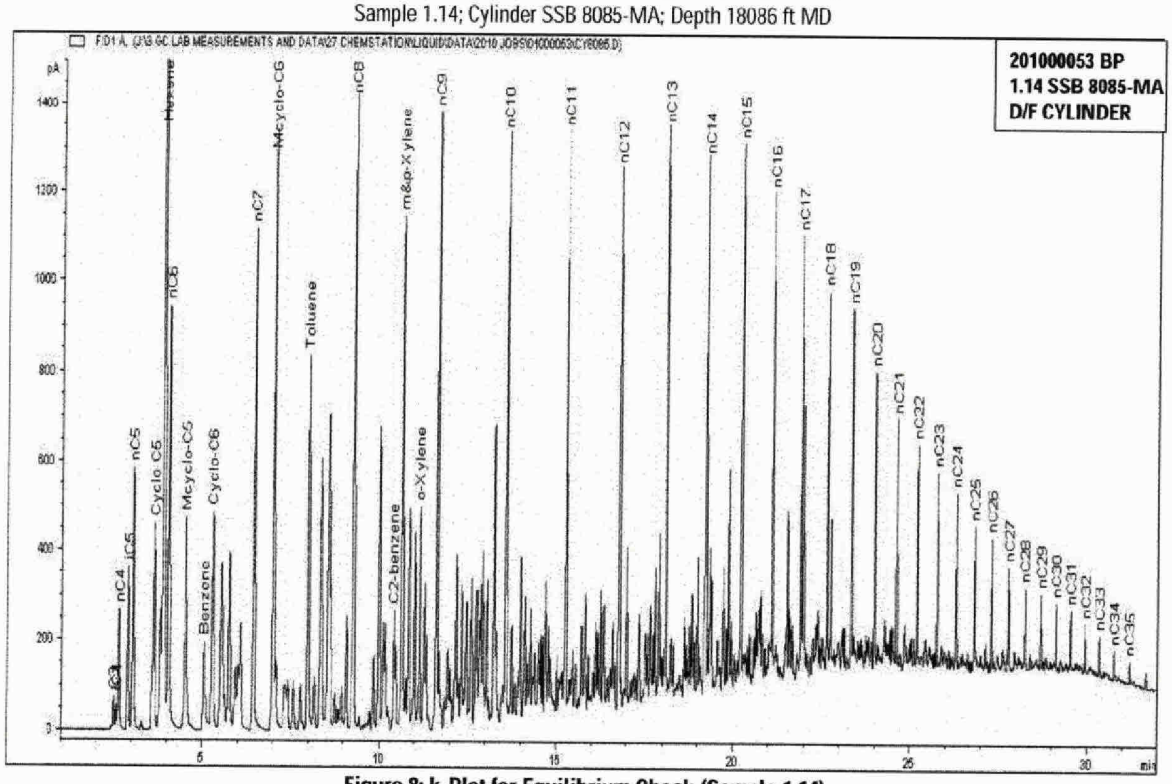


Figure 8: k-Plot for Equilibrium Check (Sample 1.14)

Sample 1.14; Cylinder SSB 8085-MA; Depth 18086 ft MD

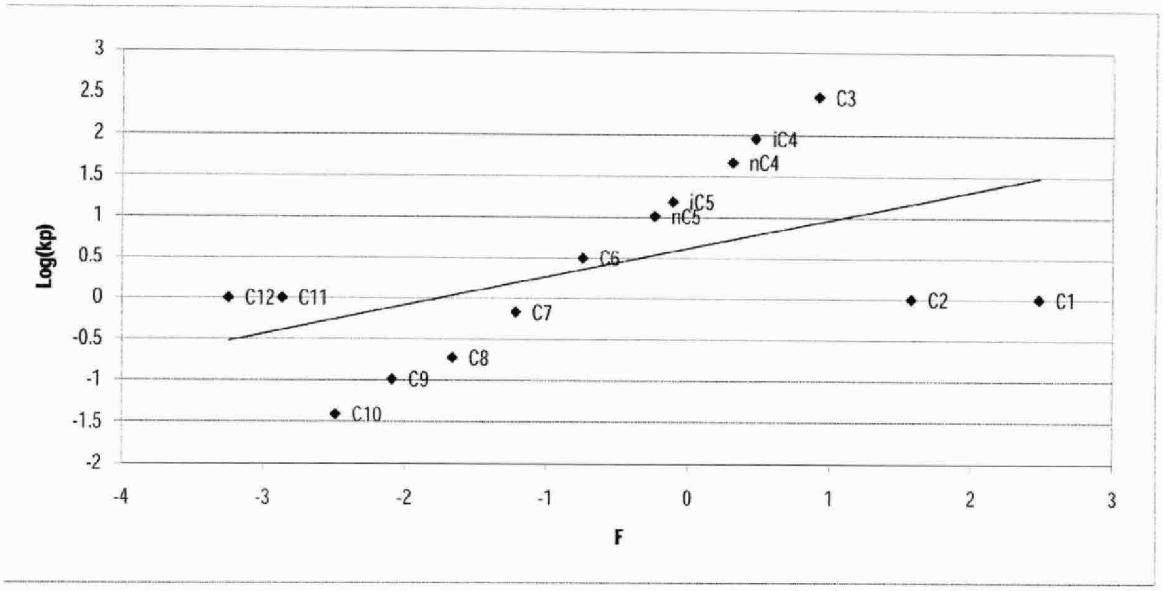


Table 17: Estimated OBM Contamination Free Fluid Compositions (mole %)

Sample 1.14; Cylinder SSB 8085-MA; Depth 18086 ft MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
				Before Correction	After Correction	Before Correction	After Correction
Carbon Dioxide	44.01	1.06		0.00	0.00	0.90	0.91
Hydrogen Sulfide	34.08	0.00		0.00	0.00	0.00	0.00
Nitrogen	28.01	0.38		0.00	0.00	0.32	0.32
Methane	16.04	77.92		0.00	0.00	66.27	66.35
Ethane	30.07	8.12		0.00	0.00	6.90	6.91
Propane	44.10	5.42		0.27	0.27	4.65	4.66
I - Butane	58.12	1.07		0.17	0.17	0.94	0.94
N - Butane	58.12	2.33		0.72	0.73	2.09	2.09
I - Pentane	72.15	0.83		0.78	0.79	0.82	0.83
N - Pentane	72.15	0.94		1.32	1.33	1.00	1.00
C6	84.00	0.86		4.04	4.07	1.34	1.34
M-C-Pentane	84.16	0.18		1.40	1.41	0.36	0.36
Benzene	78.11	0.06		0.48	0.48	0.12	0.12
Cyclohexane	84.16	0.18		1.37	1.38	0.36	0.36
C7	96.00	0.27		5.80	5.85	1.10	1.10
M-C-Hexane	98.19	0.11		2.80	2.83	0.52	0.52
Toluene	92.14	0.06		1.49	1.50	0.27	0.27
C8	107.00	0.10		8.06	8.12	1.29	1.29
E-Benzene	106.17	0.01		0.34	0.35	0.06	0.06
M/P-Xylene	106.17	0.01		1.85	1.86	0.29	0.29
O-Xylene	106.17	0.00		0.68	0.68	0.10	0.10
C9	121.00	0.05		6.53	6.58	1.02	1.02
C10	134.00	0.02		8.06	8.12	1.22	1.22
C11	147.00	0.01		5.95	6.00	0.90	0.90
C12	161.00	0.00		4.97	5.01	0.74	0.75
C13	175.00	0.00		4.76	4.79	0.71	0.71
C14	190.00	0.00		3.77	3.80	0.56	0.56
C15	206.00	0.00		3.69	3.29	0.55	0.49
C16	222.00	0.00		3.02	2.87	0.45	0.43
C17	237.00			2.45	2.53	0.37	0.38
C18	251.00			2.39	2.24	0.36	0.33
C19	263.00			2.06	2.01	0.31	0.30
C20	275.00			1.79	1.81	0.27	0.27
C21	291.00			1.54	1.55	0.23	0.23
C22	305.00			1.39	1.40	0.21	0.21
C23	318.00			1.18	1.19	0.18	0.18
C24	331.00			1.10	1.10	0.16	0.16
C25	345.00			0.95	0.96	0.14	0.14
C26	359.00			0.89	0.90	0.13	0.13
C27	374.00			0.81	0.82	0.12	0.12
C28	388.00			0.74	0.75	0.11	0.11
C29	402.00			0.70	0.71	0.11	0.11
C30	416.00			0.65	0.65	0.10	0.10
C31	430.00			0.60	0.60	0.09	0.09
C32	444.00			0.54	0.55	0.08	0.08
C33	458.00			0.50	0.51	0.08	0.08
C34	472.00			0.48	0.48	0.07	0.07
C35	486.00			0.45	0.46	0.07	0.07
C36+	750.00			6.45	6.50	0.96	0.97
Total		100.00		100.00	100.00	100.00	100.00
MW		22.90		211.16	211.08	51.05	50.85
MOLE RATIO		0.8505		0.1495			
		0.8515			0.1485		

Table 18: C36+ Composition, GOR, °API, by Zero-Flash (Sample 1.18)

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
	(g/mole)	WT %	MOLE %	WT %	MOLE %	WT %	MOLE %
Carbon Dioxide	44.01	2.04	1.06	0.00	0.00	0.76	0.90
Hydrogen Sulfide	34.08	0.00	0.00	0.00	0.00	0.00	0.00
Nitrogen	28.01	0.44	0.36	0.00	0.00	0.17	0.31
Methane	16.04	54.80	78.31	0.00	0.00	20.46	66.48
Ethane	30.07	9.99	7.62	0.00	0.00	3.73	6.47
Propane	44.10	10.23	5.32	0.09	0.45	3.88	4.58
I - Butane	58.12	2.71	1.07	0.06	0.20	1.05	0.94
N - Butane	58.12	6.00	2.37	0.20	0.73	2.36	2.12
I - Pentane	72.15	2.69	0.86	0.23	0.70	1.15	0.83
N - Pentane	72.15	3.10	0.99	0.37	1.12	1.39	1.01
C6	84.00	3.43	0.94	1.30	3.35	2.10	1.30
M-C-Pentane	84.16	0.71	0.19	0.43	1.10	0.53	0.33
Benzene	78.11	0.20	0.06	0.12	0.34	0.15	0.10
Cyclohexane	84.16	0.51	0.14	0.49	1.26	0.50	0.31
C7	96.00	1.50	0.36	2.36	5.31	2.04	1.11
M-C-Hexane	98.19	0.52	0.12	1.21	2.67	0.96	0.51
Toluene	92.14	0.26	0.06	0.51	1.20	0.42	0.24
C8	107.00	0.52	0.11	3.85	7.77	2.60	1.27
E-Benzene	106.17	0.02	0.00	0.22	0.45	0.14	0.07
M/P-Xylene	106.17	0.04	0.01	0.79	1.60	0.51	0.25
O-Xylene	106.17	0.01	0.00	0.22	0.44	0.14	0.07
C9	121.00	0.20	0.04	3.76	6.71	2.43	1.05
C10	134.00	0.05	0.01	5.05	8.15	3.18	1.24
C11	147.00	0.01	0.00	4.15	6.11	2.61	0.92
C12	161.00	0.00	0.00	3.80	5.11	2.38	0.77
C13	175.00	0.00	0.00	3.80	4.70	2.38	0.71
C14	190.00	0.00	0.00	3.54	4.02	2.22	0.61
C15	206.00	0.00	0.00	3.69	3.87	2.31	0.59
C16	222.00			3.25	3.17	2.04	0.48
C17	237.00			2.93	2.68	1.84	0.40
C18	251.00			2.94	2.53	1.84	0.38
C19	263.00			2.68	2.20	1.68	0.33
C20	275.00			2.39	1.88	1.50	0.28
C21	291.00			2.27	1.69	1.42	0.25
C22	305.00			2.07	1.47	1.30	0.22
C23	318.00			1.92	1.30	1.20	0.20
C24	331.00			1.80	1.18	1.13	0.18
C25	345.00			1.67	1.05	1.05	0.16
C26	359.00			1.62	0.98	1.02	0.15
C27	374.00			1.53	0.89	0.96	0.13
C28	388.00			1.47	0.82	0.92	0.12
C29	402.00			1.45	0.78	0.91	0.12
C30	416.00			1.38	0.72	0.87	0.11
C31	430.00			1.31	0.66	0.82	0.10
C32	444.00			1.23	0.60	0.77	0.09
C33	458.00			1.18	0.56	0.74	0.08
C34	472.00			1.13	0.52	0.71	0.08
C35	486.00			1.18	0.52	0.74	0.08
C36+	750.00			22.34	6.44	14.00	0.97
Total		**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
MW			22.93		216.23		52.12
MOLE RATIO			0.8490		0.1510		

Table 19: Calculated Fluid Properties

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

Properties	Flashed Gas		Flashed Liquid		Monophasic Fluid	
Cn+ Composition	Mass %	Mole %	Mass %	Mole %	Mass %	Mole %
C7+	4.56	1.11	97.75	93.46	62.95	15.06
C12+	0.00	0.00	74.60	50.33	46.74	7.60
C20+	-	-	47.96	22.05	30.05	3.33
C30+	-	-	29.76	10.02	18.65	1.51
C36+	-	-	22.34	6.44	14.00	0.97
Molar Mass						
C7+	94		226		218	
C12+	161		320		320	
C20+	-		470		470	
C30+	-		642		642	
C36+	-		750		750	
Density						
C7+	-		0.865		-	
C12+	-		0.898		0.898	
C20+	-		0.941		0.941	
C30+			0.983		0.983	
C36+			1.01		1.01	
Fluid at 60°F			0.852			
Gas Gravity (Air = 1)	0.792					
Dry Gross Heat Content (BTU/scf)	1,348					
Wet Gross Heat Content (BTU/scf)	1,324					

OBM Contamination Level (wt%)	0.9	STO Basis
	0.6	Live Oil Basis

Stock Tank Oil Properties at Standard Conditions:

	Measured	Calculated		C36+ Properties	
MW	212	216		750	
Density (g/cm3)	0.852	0.858		1.01	

Single Stage Flash Data

	Original STO		De-Contaminated	
GOR (scf/stb)	2945		2974	
STO Density (g/cm3)	0.852		0.852	
STO API Gravity	34.6		34.5	
OBM Density (g/cm3) @60°F	0.788			

Figure 9: Stock Tank Oil Chromatogram (Sample 1.18)

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

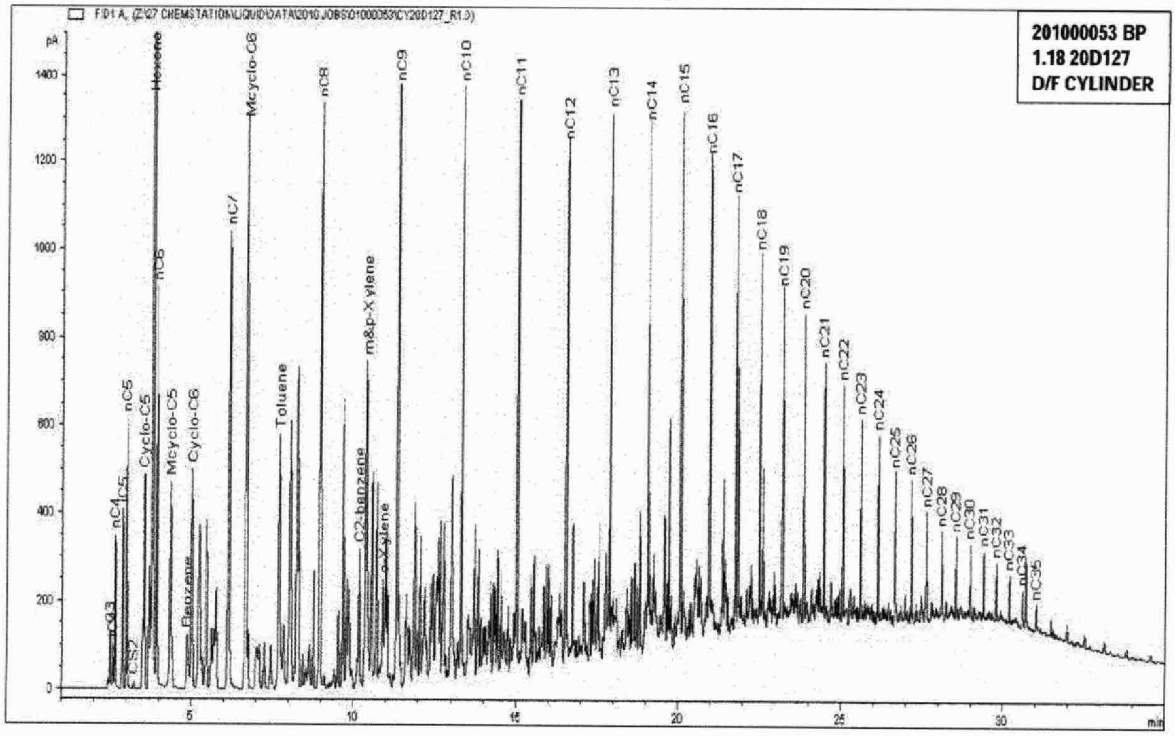


Figure 10: k-Plot for Equilibrium Check (Sample 1.18)

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

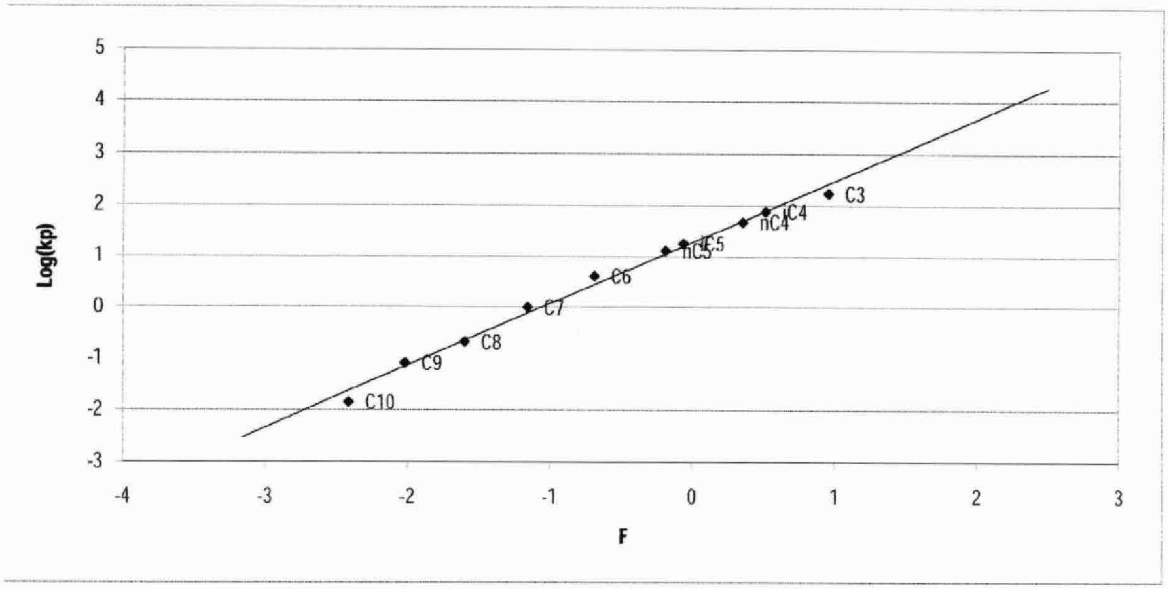


Table 20: Estimated OBM Contamination Free Fluid Compositions (mole %)

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

Component	MW	Flashed Gas		Flashed Liquid		Monophasic Fluid	
				Before Correction	After Correction	Before Correction	After Correction
Carbon Dioxide	44.01	1.06		0.00	0.00	0.90	0.90
Hydrogen Sulfide	34.08	0.00		0.00	0.00	0.00	0.00
Nitrogen	28.01	0.36		0.00	0.00	0.31	0.31
Methane	16.04	78.31		0.00	0.00	66.48	66.57
Ethane	30.07	7.62		0.00	0.00	6.47	6.47
Propane	44.10	5.32		0.45	0.45	4.58	4.59
I - Butane	58.12	1.07		0.20	0.21	0.94	0.94
N - Butane	58.12	2.37		0.73	0.74	2.12	2.12
I - Pentane	72.15	0.86		0.70	0.70	0.83	0.83
N - Pentane	72.15	0.99		1.12	1.13	1.01	1.01
C6	84.00	0.94		3.35	3.38	1.30	1.30
M-C-Pentane	84.16	0.19		1.10	1.11	0.33	0.33
Benzene	78.11	0.06		0.34	0.35	0.10	0.10
Cyclohexane	84.16	0.14		1.26	1.28	0.31	0.31
C7	96.00	0.36		5.31	5.35	1.11	1.11
M-C-Hexane	98.19	0.12		2.67	2.69	0.51	0.51
Toluene	92.14	0.06		1.20	1.21	0.24	0.24
C8	107.00	0.11		7.77	7.84	1.27	1.27
E-Benzene	106.17	0.00		0.45	0.45	0.07	0.07
M/P-Xylene	106.17	0.01		1.60	1.62	0.25	0.25
O-Xylene	106.17	0.00		0.44	0.45	0.07	0.07
C9	121.00	0.04		6.71	6.77	1.05	1.05
C10	134.00	0.01		8.15	8.22	1.24	1.24
C11	147.00	0.00		6.11	6.16	0.92	0.93
C12	161.00	0.00		5.11	5.15	0.77	0.77
C13	175.00	0.00		4.70	4.74	0.71	0.71
C14	190.00	0.00		4.02	4.06	0.61	0.61
C15	206.00	0.00		3.87	3.51	0.59	0.53
C16	222.00	0.00		3.17	3.05	0.48	0.46
C17	237.00			2.68	2.68	0.40	0.40
C18	251.00			2.53	2.37	0.38	0.36
C19	263.00			2.20	2.12	0.33	0.32
C20	275.00			1.88	1.90	0.28	0.28
C21	291.00			1.69	1.70	0.25	0.26
C22	305.00			1.47	1.48	0.22	0.22
C23	318.00			1.30	1.31	0.20	0.20
C24	331.00			1.18	1.19	0.18	0.18
C25	345.00			1.05	1.06	0.16	0.16
C26	359.00			0.98	0.99	0.15	0.15
C27	374.00			0.89	0.90	0.13	0.13
C28	388.00			0.82	0.83	0.12	0.12
C29	402.00			0.78	0.79	0.12	0.12
C30	416.00			0.72	0.72	0.11	0.11
C31	430.00			0.66	0.67	0.10	0.10
C32	444.00			0.60	0.60	0.09	0.09
C33	458.00			0.56	0.56	0.08	0.08
C34	472.00			0.52	0.52	0.08	0.08
C35	486.00			0.52	0.53	0.08	0.08
C36+	750.00			6.44	6.50	0.97	0.97
Total		100.00		100.00	100.00	100.00	100.00
MW		22.93		216.23	216.15	52.12	51.90
MOLE RATIO		0.8490		0.1510			
		0.8500			0.1500		

Table 21: Base Oil - Sample 1.22 Composition

Components	MW	Composition	
		Wt %	Mole %
Carbon Dioxide	44.01	0.00	0.00
Hydrogen Sulfide	34.08	0.00	0.00
Nitrogen	28.013	0.00	0.00
Methane	16.043	0.00	0.00
Ethane	30.07	0.00	0.00
Propane	44.097	0.00	0.03
I - Butane	58.124	0.01	0.02
N - Butane	58.124	0.00	0.02
I - Pentane	72.151	0.00	0.00
N - Pentane	72.151	0.00	0.01
C6	84	0.01	0.01
M-C-Pentane	84.16	0.00	0.00
Benzene	78.11	0.00	0.00
Cyclohexane	84.16	0.00	0.00
C7	96	0.00	0.01
M-C-Hexane	98.19	0.00	0.00
Toluene	92.14	0.00	0.00
C8	107	0.01	0.01
E-Benzene	106.17	0.00	0.00
M/P-Xylene	106.17	0.00	0.00
O-Xylene	106.17	0.00	0.00
C9	121	0.01	0.01
C10	134	0.01	0.02
C11	147	0.01	0.01
C12	161	0.01	0.02
C13	175	0.01	0.01
C14	190	0.65	0.80
C15	206	10.25	11.59
C16	222	42.94	45.05
C17	237	14.91	14.65
C18	251	24.30	22.55
C19	263	3.34	2.96
C20	275	1.00	0.85
C21	291	0.11	0.09
C22	305	0.07	0.06
C23	318	0.02	0.02
C24	331	0.02	0.02
C25	345	0.02	0.01
C26	359	0.01	0.01
C27	374	0.02	0.01
C28	388	0.06	0.03
C29	402	0.12	0.07
C30	416	0.29	0.16
C31	430	0.37	0.20
C32	444	0.39	0.20
C33	458	0.39	0.20
C34	472	0.19	0.09
C35	486	0.13	0.06
C36+	580	0.30	0.12
Total		100.00	100.00
MW Calculated (Daltons)		233	
MW Measured (Daltons)		236	
Measured Density (g/cc @ 60F)		0.788	

Figure 11: Base Oil - Sample 1.22 Chromatogram

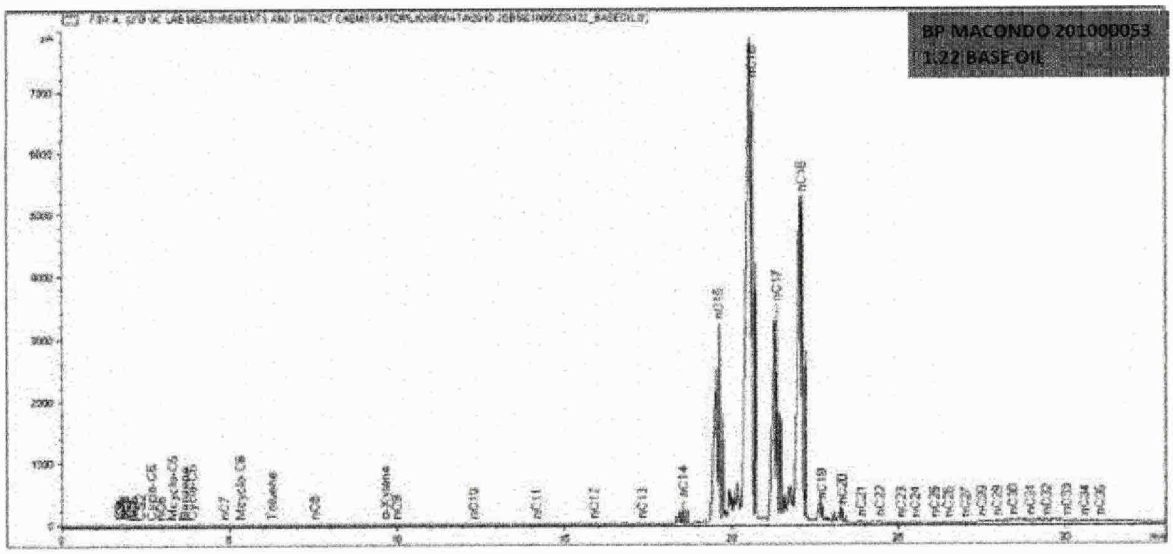


Table 22: Oil Based Mud Filtrate - Sample 1.23 Composition

Components	MW	Composition	
		Wt %	Mole %
Carbon Dioxide	44.01	0.00	0.00
Hydrogen Sulfide	34.08	0.00	0.00
Nitrogen	28.013	0.00	0.00
Methane	16.043	0.00	0.00
Ethane	30.07	0.00	0.00
Propane	44.097	0.00	0.01
I - Butane	58.124	0.00	0.00
N - Butane	58.124	0.00	0.01
I - Pentane	72.151	0.00	0.00
N - Pentane	72.151	0.00	0.00
C6	84	0.00	0.01
M-C-Pentane	84.16	0.00	0.00
Benzene	78.11	0.00	0.00
Cyclohexane	84.16	0.00	0.00
C7	96	0.00	0.00
M-C-Hexane	98.19	0.00	0.00
Toluene	92.14	0.00	0.00
C8	107	0.00	0.01
E-Benzene	106.17	0.00	0.00
M/P-Xylene	106.17	0.00	0.00
O-Xylene	106.17	0.00	0.00
C9	121	0.01	0.02
C10	134	0.02	0.04
C11	147	0.24	0.38
C12	161	0.40	0.57
C13	175	0.37	0.50
C14	190	1.05	1.28
C15	206	9.20	10.39
C16	222	42.28	44.30
C17	237	13.14	12.90
C18	251	24.38	22.60
C19	263	4.10	3.62
C20	275	1.99	1.68
C21	291	0.47	0.38
C22	305	0.24	0.19
C23	318	0.11	0.08
C24	331	0.10	0.07
C25	345	0.06	0.04
C26	359	0.05	0.03
C27	374	0.06	0.04
C28	388	0.07	0.04
C29	402	0.11	0.06
C30	416	0.19	0.10
C31	430	0.23	0.12
C32	444	0.25	0.13
C33	458	0.28	0.14
C34	472	0.14	0.07
C35	486	0.11	0.05
C36+	580	0.35	0.14
Total		100.00	100.00
MW Calculated (Daltons)		233	
MW Measured (Daltons)		235	
Measured Density (g/cc @ 60F)		0.793	

Figure 12: Oil Based Mud Filtrate - Sample 1.23 Chromatogram

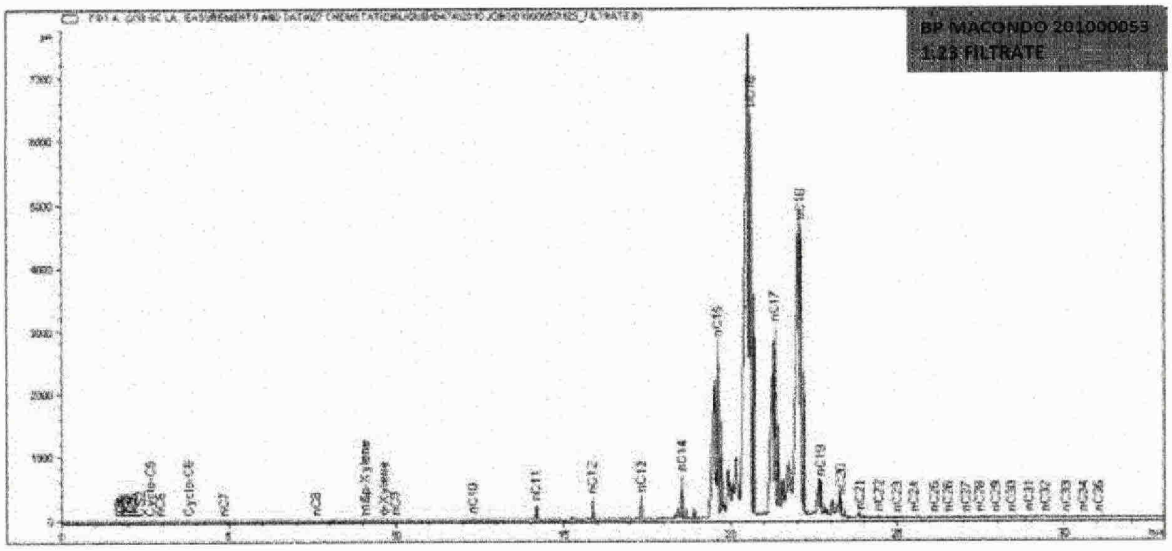


Table 23: Summary of Results of Sample 1.18

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

Reservoir Conditions:				
Pressure:	11856	psia		
Temperature:	243	°F		
Summary of Fluid Properties:				
OBM Contamination:	0.9	Wt% STO Basis		
OBM Contamination:	0.6	Wt% RF Basis		
Bubble Point Pressure				
At Tres	6,348	psia		
At 100°F	6,235	psia		
Gas-Oil Ratio				
Single-stage Flash:	2945	scf/stb		
Total Differential Liberation:	-	scf/stb		
Total Separator Flash:	2442	scf/stb		
Properties at 60°F	**STO °API**		**Gas Gravity (Average)**	
Single-stage STO:	34.6		0.792	
Differential Liberation STO:	-		-	
Separator STO:	37.4		0.703	
Properties at Reservoir Conditions				
Viscosity:	-	cP		
Compressibility (Co):	12.2	10^{-6}/psi		
Density:	0.590	g/cc		
Properties at Saturation Conditions				
Viscosity:	-	cP		
Compressibility (Co):	25.0	10^{-6}/psi		
Density:	0.534	g/cc		
Formation Volume Factor	**@Pres & Tres***		**@Psat & Tres**	
Single-stage Flash:	2.303		2.539	
Total Differential Liberation:	-		-	
Total Separator Flash:	2.143		2.262	

Note: Standard conditions are 15.025 psia and 60°F

PVT Analysis on Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

Constant Composition Expansion at Tres

The CCE study was initiated by charging a sub-sample of live reservoir fluid into the PVT cell at a reservoir temperature of 243°F and at a pressure of 15,015 psia. Sequential pressure decrease in steps and the corresponding volume changes are presented in Table 24. The pressure-volume (P-V) plots of the CCE data are presented in Figure 13. The intersection of the single-phase and two-phase lines in the P-V plot and the visual observation was used to define the bubblepoint. For the subject fluid, the bubblepoint was determined to be 6,348 psia at the reservoir temperature of 243°F. Also, calculated relative volume and oil compressibility is presented in Table 24. As seen in the table, the compressibility of this oil is 25.0 x 10e-6 1/psia at the saturation pressure.

Table 24: Constant Composition Expansion at 243°F (Sample 1.18)

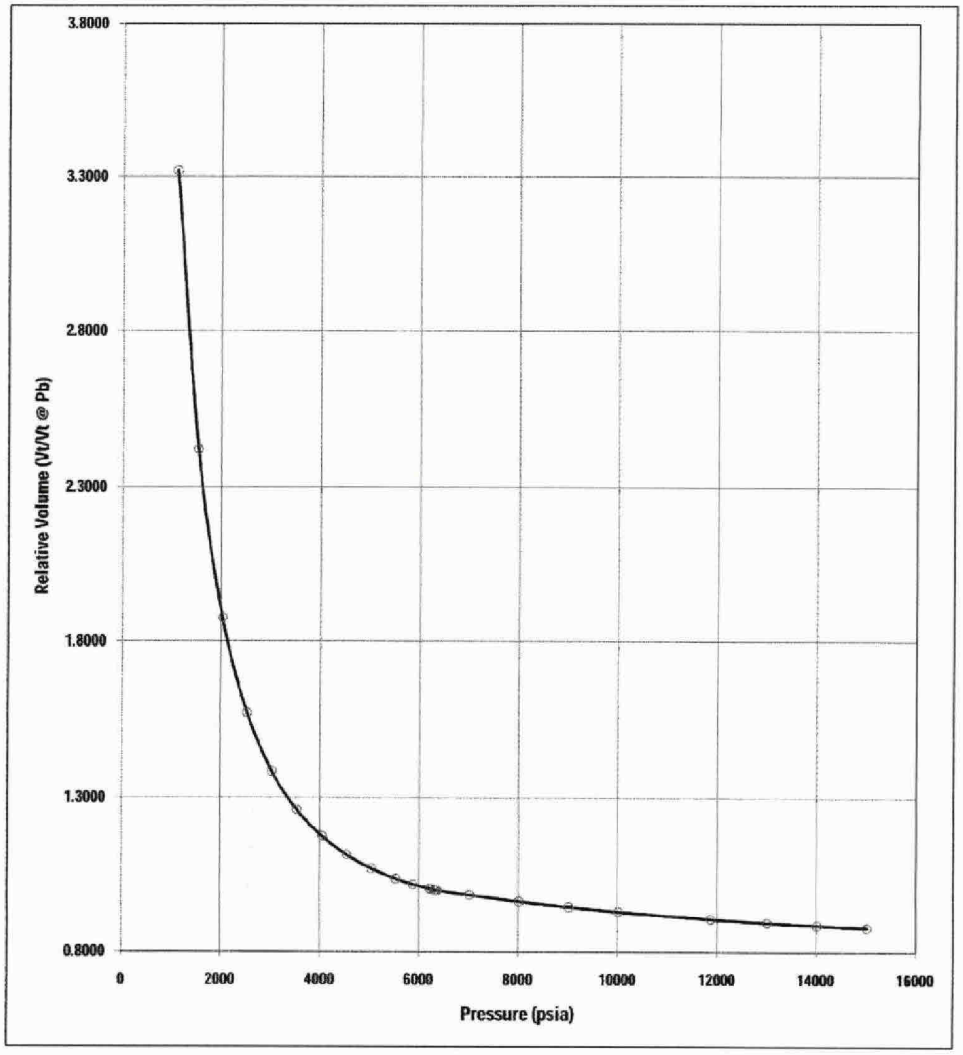
Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

	Pressure (psia)	Relative Vol (Vr=V/Vsat)	% Liquid (Vl/Vsat)	% Liquid (Vl/Vtotal)	Liquid Density* Measured Pyc Flash (g/cm3)	Liquid Density* Measured Anton Parr (g/cm3)	Compressibility (10^{-6}/psia)
1	15015	0.8783			**0.610**	**0.613**	8.4
2	14015	0.8862			**0.601**	**0.607**	9.5
3	13015	0.8951			0.598	0.598	10.7
Pi	**11871**	**0.9069**			**0.590**	**0.591**	**12.2**
5	10015	0.9303			**0.575**	**0.576**	15.4
6	9015	0.9457			**0.562**	**0.568**	17.5
7	8015	0.9635			0.555	0.556	19.9
8	7015	0.9842			0.543	0.544	22.8
9	6370	0.9995			0.535	0.536	24.9
Pb	**6348**	**1.0000**			**0.535**	**0.536**	**25.0**
10	6322	1.0000	70.7	70.7			
11	6265	1.0029	70.1	69.9			
12	6215	1.0047	69.6	69.3			
13	5880	1.0184	68.0	66.8			
14	5532	1.0369	66.9	64.5			
15	5039	1.0700	65.0	60.8			
16	4537	1.1148	64.5	57.9			
17	4037	1.1759	63.6	54.1			
18	3536	1.2607	62.5	49.6			
19	3025	1.3859	61.7	44.5			
20	2530	1.5709	60.6	38.6			
21	2027	1.8762	59.1	31.5			
22	1525	2.4202	57.7	23.9			
23	1098	3.3203	54.6	16.4			

* Liquid Densities were measured using two methods at 15000 psia, 14000 psia, 10000 psia and 9000 psia at 243°F, known volume displacement into pre-weighed cylinder and a direct read from an Anton Parr Densitometer. Densities at all other points are calculated from the values at 10000 psia.

Figure 13: Constant Composition Expansion at 243°F - Relative Volume

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD



Constant Composition Expansion 100°F

The CCE study was initiated by charging a sub-sample of live reservoir fluid into the PVT cell at a reservoir temperature of 100°F and at a pressure of 15,015 psia. Sequential pressure decrease in steps and the corresponding volume changes are presented in Table 25. The pressure-volume (P-V) plots of the CCE data are presented in Figure 14. The intersection of the single-phase and two-phase lines in the P-V plot and the visual observation was used to define the bubblepoint. For the subject fluid, the bubblepoint was determined to be 6,235 psia at the reservoir temperature of 100°F. Also, calculated relative volume and oil compressibility is presented in Table 25. As seen in the table, the compressibility of this oil is 18.9 x 10e-6 1/psia at the saturation pressure.

Table 25: Constant Composition Expansion at 100°F (Sample 1.18)

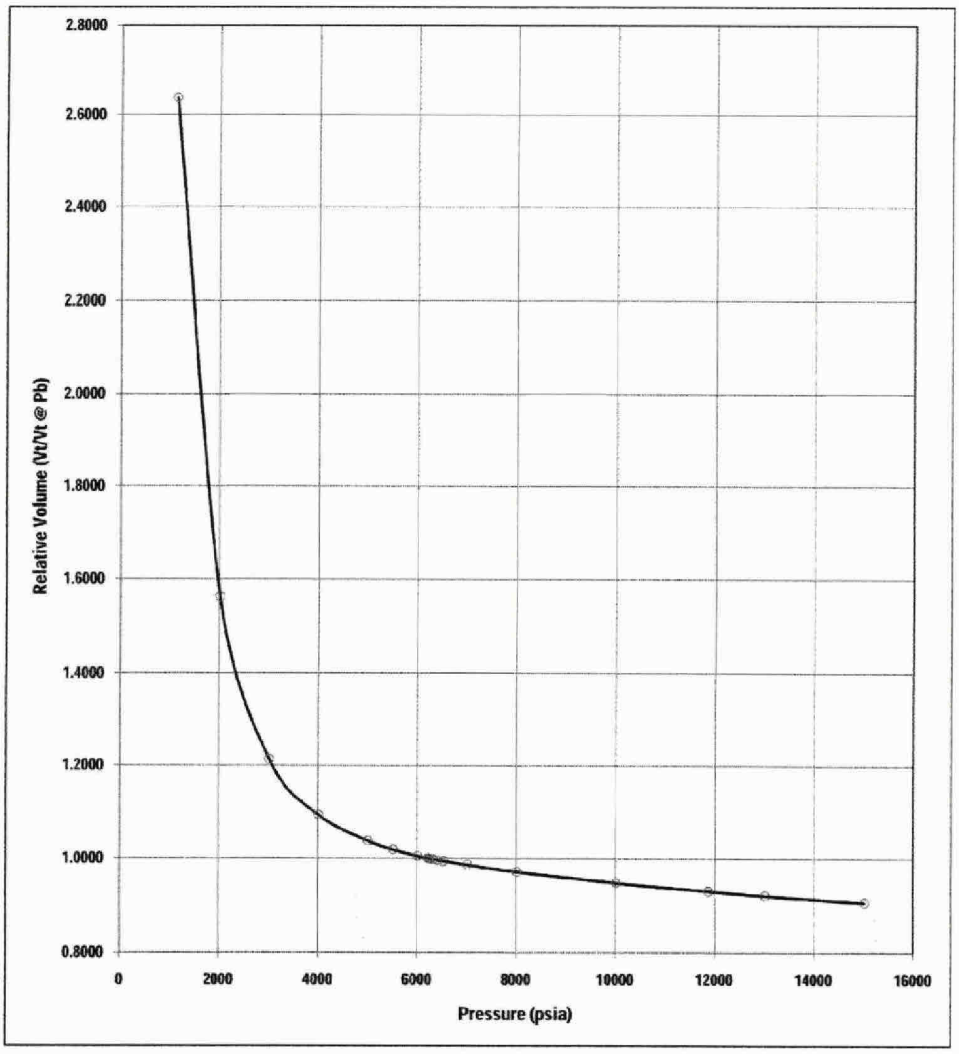
Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

	Pressure (psia)	Relative Vol (Vr=V/Vsat)	% Liquid (Vl/Vsat)	% Liquid (Vl/Vtotal)	Liquid Density* Measured Pyc Flash (g/cm3)	Liquid Density* Measured Anton Parr (g/cm3)	Compressibility (10^{-6}/psia)
1	15015	0.9072			0.661	0.662	7.85
2	13017	0.9222			0.650	0.651	8.60
Pi	**11871**	**0.9316**			**0.644**	**0.645**	**9.22**
4	10013	0.9489			**0.632**	**0.633**	10.7
5	8015	0.9720			0.617	0.618	13.6
6	7016	0.9865			0.608	0.609	16.1
7	6540	0.9944			0.603	0.604	17.7
8	6414	0.9967			0.602	0.603	18.1
9	6314	0.9985			0.600	0.602	18.5
10	6265	0.9994			0.600	0.601	18.7
Pb	**6235**	**1.0000**			**0.600**	**0.601**	**18.9**
12	6220	1.0004	79.5	79.4			
13	6015	1.0054	79.2	78.8			
14	5514	1.0196	79.5	78.0			
15	5015	1.0383	78.8	75.9			
16	4017	1.0926	77.8	71.2			
17	3015	1.2132	76.8	63.3			
18	2016	1.5632	74.7	47.8			
19	1125	2.6377	71.6	27.1			

* Liquid Densities were measured using two methods, known volume displacement into pre-weighed cylinder and a direct read from an Anton Parr Densitometer, both at 10000 psia and 100°F. Densities at all other points are calculated from the values at 10000 psia.

Figure 14: Constant Composition Expansion at 100°F - Relative Volume

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD



Multi-Stage Separation Test

Multi-stage separation test results are presented in Tables 26 - 28. The fluid properties (i.e., GOR, density and oil formation volume factor) are presented in Table 26. Multi-stage separation test conditions are:

STAGE Pb	6348 psia	243 °F
STAGE 1	1250 psia	130 °F
STAGE 2	450 psia	120 °F
STAGE 3	150 psia	120 °F
STAGE STO	15.025 psia	60 °F

As seen in Table 26, the GOR value obtained from the multi-stage separation test is 2,442 SCF/STB and the formation volume factor is 2.262. The compositional analyses of separator gas and tank gas are summarized in Table 27 and the composition of tank liquid is tabulated in Table 28. The total dry gross heat content of the separation gases is calculated to be 1,210 BTU/scf whereas the total wet gross heat content is calculated to be 1,189 BTU/scf.

With reference to the assumption made in "The Properties of Petroleum Fluids" (McCain, 1990), the assumption made in generating reservoir fluid properties from a PVT study is that at pressures below the bubblepoint, the process in the reservoir can be mimicked by differential vaporization, while the process in the wellbore is simulated by the separator test. Hence, fluid properties at pressures below saturation pressure can be calculated by combining the data from the differential vaporization and a separator test.

Generally the differential vaporization flashes that occur in the reservoir at the reservoir temperature (243°F) would liberate more gas than flashes that occur during multi-stage separation test which are conducted at variable temperatures lower than the reservoir temperature. This expectation couldnot be tested in this study since differential liberation test was not performed. It is expected that the the overall solution GOR and Bo may see a significant decrease when the differentially liberated data are combined with results of the separation test.

Table 26: Multi-Stage Separation Test Vapor & Liquid Properties

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

PROPERTY	STAGE Pb	STAGE 1	STAGE 2	STAGE 3	STAGE STO
Pressure (psia)	6348	1250	450	150	15.025
Temperature (°F)	243	130	120	120	60
Liq. Den (g/cm^3)	0.536	0.730	0.769	0.788	0.838
Vap. Gravity[a]		0.67	0.71	0.88	1.31
Vap. M_{wt}		19.4	20.7	25.4	37.9
Vap Heat Val.[b]		1161	1224	1474	2157
GOR[c]		2013	241	122	65
GOR[d]		1602	211	113	65
Sep. FVF[e]	2.262	1.256	1.144	1.087	1.000

a) Calculated, at 60°F (air=1) b) Calculated, Dry basis BTU/scf c) scf gas/bbl of oil at STD conditions
d) scf gas/bbl of oil at separator conditions e) fluid volume at sep conditions/fluid volume at STD conditions

Residual oil density at standard conditions **0.838** g/cc

Sep gas gravity (average) $S_g = \Sigma RjSgj/\Sigma R$ **0.703**
Where: R: GOR (scf gas/bbl of oil at STD conditions), j: separator stages

Sep gas gross heating value ($aL_c = \Sigma R_j * L_{cj}/\Sigma R_j$ **1210** BTU/scf (dry basis)
Where: R: GOR (scf gas/bbl of oil at STD conditions), j: separator stages

SEPARATION TEST SUMMARY	
[a]**Total Separation Test GOR**	**2442**
Separation Test STO Gravity	**37.4**
[b]**Separation Test FVF**	**2.262**

a) scf gas/bbl of condensate at STD conditions
b) Fluid volume at Psat & Tres/Fluid volume at STD

Table 27: Multi-Stage Separator Test Vapor Composition (mol %)

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

Component	MW (g/mol)	Mole %			
		STAGE 1	STAGE 2	STAGE 3	STAGE STO
Carbon Dioxide	44.01	1.03	1.29	1.53	1.12
Hydrogen Sulfide	34.08	0.00	0.00	0.00	0.00
Nitrogen	28.01	0.45	0.23	0.09	0.04
Methane	16.04	86.18	80.69	62.63	23.65
Ethane	30.07	6.45	9.56	17.24	24.02
Propane	44.10	3.41	5.17	11.68	30.53
I - Butane	58.12	0.54	0.74	1.72	5.38
N - Butane	58.12	1.11	1.47	3.24	9.81
I - Pentane	72.15	0.25	0.29	0.66	2.08
N - Pentane	72.15	0.27	0.29	0.65	2.06
C6	84.00	0.17	0.16	0.35	0.82
M-C-Pentane	84.16	0.04	0.04	0.08	0.20
Benzene	78.11	0.01	0.01	0.02	0.06
Cyclohexane	84.16	0.03	0.03	0.06	0.15
C7	96.00	0.01	0.00	0.01	0.00
M-C-Hexane	98.19	0.02	0.01	0.02	0.06
Toluene	92.14	0.01	0.01	0.01	0.02
C8	107.00	0.00	0.00	0.00	0.00
E-Benzene	106.17	0.00	0.00	0.00	0.00
M/P-Xylene	106.17	0.00	0.00	0.00	0.01
O-Xylene	106.17	0.00	0.00	0.00	0.00
C9	121.00	0.00	0.00	0.00	0.00
C10	134.00	0.00	0.00	0.00	0.00
C11	147.00	0.00	0.00	0.00	0.00
C12	161.00	0.00	0.00	0.00	0.00
C13	175.00	0.00	0.00	0.00	0.00
C14	190.00	0.00	0.00	0.00	0.00
C15	206.00	0.00	0.00	0.00	0.00
C16	222.00	0.00	0.00	0.00	0.00
C17	237.00	0.00	0.00	0.00	0.00
C18	251.00	0.00	0.00	0.00	0.00
C19	263.00	0.00	0.00	0.00	0.00
C20	275.00	0.00	0.00	0.00	0.00
C21	291.00	0.00	0.00	0.00	0.00
C22	305.00	0.00	0.00	0.00	0.00
C23	318.00	0.00	0.00	0.00	0.00
C24	331.00	0.00	0.00	0.00	0.00
C25	345.00	0.00	0.00	0.00	0.00
C26	359.00	0.00	0.00	0.00	0.00
C27	374.00	0.00	0.00	0.00	0.00
C28	388.00	0.00	0.00	0.00	0.00
C29	402.00	0.00	0.00	0.00	0.00
C30	416.00	0.00	0.00	0.00	0.00
C31	430.00	0.00	0.00	0.00	0.00
C32	444.00	0.00	0.00	0.00	0.00
C33	458.00	0.00	0.00	0.00	0.00
C34	472.00	0.00	0.00	0.00	0.00
C35	486.00	0.00	0.00	0.00	0.00
C36+	750.00	0.00	0.00	0.00	0.00
Total		**100.00**	**100.00**	**100.00**	**100.00**
MW		19.4	20.7	25.4	37.9
Relative Density (air=1)		0.67	0.71	0.88	1.31
Dry Gross Heat Content (BTU/scf)		1161	1224	1474	2157

Table 28: Multi-Stage Separator Test Residual Liquid Composition (mol %)

Sample 1.18; Cylinder 20D127; Depth 18142 ft. MD

COMPONENT	MW (g/mol)	Residual Liquid (mol %)
Carbon Dioxide	44.01	0.00
Hydrogen Sulfide	34.08	0.00
Nitrogen	28.01	0.00
Methane	16.04	0.00
Ethane	30.07	0.00
Propane	44.10	2.90
I - Butane	58.12	1.53
N - Butane	58.12	4.20
I - Pentane	72.15	2.71
N - Pentane	72.15	3.55
C6	84.00	5.78
M-C-Pentane	84.16	1.45
Benzene	78.11	0.45
Cyclohexane	84.16	1.42
C7	96.00	5.47
M-C-Hexane	98.19	2.63
Toluene	92.14	1.21
C8	107.00	6.79
E-Benzene	106.17	0.37
M/P-Xylene	106.17	1.34
O-Xylene	106.17	0.36
C9	121.00	5.60
C10	134.00	6.64
C11	147.00	4.96
C12	161.00	4.14
C13	175.00	3.80
C14	190.00	3.26
C15	206.00	3.12
C16	222.00	2.57
C17	237.00	2.17
C18	251.00	2.05
C19	263.00	1.79
C20	275.00	1.52
C21	291.00	1.37
C22	305.00	1.19
C23	318.00	1.06
C24	331.00	0.95
C25	345.00	0.85
C26	359.00	0.79
C27	374.00	0.72
C28	388.00	0.66
C29	402.00	0.63
C30	416.00	0.58
C31	430.00	0.53
C32	444.00	0.49
C33	458.00	0.45
C34	472.00	0.42
C35	486.00	0.42
C36+	750.00	5.13
Total		**100.00**
MW		188

Appendix A: Nomenclature and Definitions

API Gravity	American Petroleum Institute gravity
Bg	Gas formation volume factor
Bo	Oil formation volume factor
CCE	Constant composition Expansion
DV	Differential Vaporization
GLR	Gas Liquid Ratio
GOR	Gas Oil Ratio
LO	Live Oil
n	Number of moles
OBM	Oil Based Mud
P	Absolute pressure
Pb	Bubble point pressure
PV	Pressure-Volume Method
Pi	Initial Reservoir Pressure
R	Universal gas constant
Rs	Solution gas oil ratio
T	Temperature
V	Volume
Vr	Relative volume
STL	Stock Tank Liquid
STO	Stock Tank Oil
%, w/w	Weight Percent
Z	Gas deviation factor

Dry Gross Heating Value is defined as the total energy transferred as heat in an ideal combustion reaction at a standard temperature and pressure in which all water formed appears as liquid. Wet Gross Heating Value is defined as the total energy transferred as heat in an ideal combustion reaction of water saturated gas at a standard temperature and pressure in which all water formed appears as liquid.

Molar masses, densities and critical values of pure components are from CRC handbook of Chemistry and Physics and those of pseudo components are from Katz data.

Gas viscosity is calculated from the correlation of Carr, Kobayashi and Burrows as given in the "Phase Behavior of Oilfield Hydrocarbon Systems" by M.B. Standing

Compressibility in constant mass study is obtained from mathematical derivation of relative volume.

Gas gravity is calculated from composition using the perfect gas equation (Gas deviation factor, Z=1)

The Stiff and Davis Stability Index is an extension of the Langlier Index and is used as an indicator of the calcium carbonate scaling tendencies of oil field brine.

- A positive index indicates scaling tendencies.
- A negative index indicates corrosive tendencies.

An index of zero indicates the water is in chemical equilibrium and will neither deposit nor dissolve calcium carbonates.

Appendix B: Molecular Weights and Densities Used

Components	MOLE WT	Gross HC	Density
		(Btu/scf)	(g/cc)
CO2	44.01	0	0.827
H2S	34.08	638	0.993
N2	28.013	0	0.808
C1	16.043	1012	0.300
C2	30.07	1773	0.356
C3	44.097	2521	0.508
I-C4	58.124	3258	0.567
N-C4	58.124	3269	0.586
I-C5	72.151	4009	0.625
N-C5	72.151	4017	0.631
C6	84	4765	0.685
MCYC-C5	84.16	3772	0.753
BENZENE	78.11	3749	0.884
CYCL-C6	84.16	4490	0.781
C7	96	5513	0.722
MCYCL-C6	98.19	4490	0.773
TOLUENE	92.14	4484	0.871
C8	107	6261	0.745
C2-BENZEN	106.17	5232	0.870
M&P-XYLEN	106.17	5218	0.866
O-XYLENE	106.17	5220	0.884
C9	121	7029	0.764
C10	134	7758	0.778
C11	147	8011	0.789
C12	161	8750	0.800
C13	175	9501	0.811
C14	190	10306	0.822
C15	206	11165	0.832
C16	222	12024	0.839
C17	237	12816	0.847
C18	251	13565	0.852
C19	263	14206	0.857
C20	275	14842	0.862
C21	291	15701	0.867
C22	305	16452	0.872
C23	318	17142	0.877
C24	331	17835	0.881
C25	345	18573	0.885
C26	359	19331	0.889
C27	374	20132	0.893
C28	388	20881	0.896
C29	402	21627	0.899
C30	416	22054	0.902
C31	430	22803	0.906
C32	444	23817	0.909
C33	458	24298	0.912
C34	472	25041	0.914
C35	486	26112	0.917

Appendix C: EQUIPMENT

Fluid Preparation and Validation

The opening pressure of the cylinder is measured using a Heise pressure gauge soon after the sample arrives in the laboratory. Subsequently, the sample bottle is pressurized to the reservoir pressure using water-glycol mixture at the bottom side of the piston cylinder. Custom made heating jacket is wrapped around the cylinder to heat the sample bottle to the reservoir temperature. The sample bottle is then placed into a rocking stand and rocked for 5 days to homogenize the reservoir fluid.

Live reservoir fluid analysis is necessary in the sample validation process as well as during the completion of various fluid studies. A description of the experimental equipment used for these analysis follows.

All live fluid analyses are completed with a JEFRI Gasometer. This unit in conjunction with GC analysis (see below) provides the full fluid compositional analysis, GOR, density at sampling P&T corrected to standard conditions. The JEFRI gasometer consists of a motor-driven piston in a stationary cylinder. The piston displacement is monitored to determine the swept volume of the cylinder. The cylinder pressure is automatically held at ambient pressure. Piston motion is tracked by a linear encoder, which is subsequently, converted to measure the gas volume in the cylinder. The total Gasometer volume is 10 L. The evolved gas can be re-circulated through the system to facilitate equilibrium at a maximum flow rate of 40 L/hr. The operating pressure of the Gasometer is ambient pressure (up to a maximum of 40 psia) and the operating temperature ranging from room temperature to 40°C.

Following the flash of the live fluid sample to ambient conditions in the gasometer, compositional analysis of residual hydrocarbon liquid and evolved gas phase is conducted using gas chromatography (GC).

Analysis of hydrocarbon liquids is conducted using an HP6890 liquid injection gas chromatograph equipped with flame ionization detector (FID). In this system, separation of individual components is carried out in a 30m long, 530mm diameter "Megabore" capillary column made of fused silica with 2.6-micrometer thick methyl silicone as the stationary phase. The operating temperature range of the stationary phase is 60 to 400°C. Over this temperature range, the components eluted are from C_1 to C_{36} along with naphthenes and aromatics components. Based on the physical properties, these components are retarded in a segregated fashion by the stationary phase during the flow of carrier gas (helium) through the column. With prior knowledge of the amount of "retention" for known compounds contained in calibration standards, the same compounds can be identified in the unknown hydrocarbon sample by matching "retention" times. The relative concentration of each component is determined by the concentration of ions hitting the FID upon the elution of each component.

The analysis of hydrocarbon gases is carried out using an HP6890 gas injection GC equipped with two separation columns. The first column is a combination of a 100 mesh packed column and 100 mesh molecular sieve using high purity helium as a carrier gas. The molecular sieve is used to achieve separation of the light gaseous components (nitrogen, oxygen, and methane) while the packed column serves to separate ethane, propane, butanes, pentanes, and hexanes along with carbon dioxide and hydrogen sulfides. The second column is a packed column as described previously in liquid analysis. This column is capable of achieving separation of components up to C_{12-}, along with the associated naphthenes and aromatics that are lumped into the C_{6+} fraction during analysis and reporting. Components up to C_4 are analyzed using a thermal conductivity detector (TCD) while the C_{5+} components are analyzed for using a FID detector. The instrument has programmable air actuated multiport valves that allow the flow of the sample mixture to be varied between the two columns, and hence, allowing for the correct separation and analysis of the injected gas.

Fluid Volumetric (PVT) and Viscosity Equipment

The preliminary saturation pressure, constant composition expansion (CCE), differential vaporization (DV), multi-stage separation tests (MSST) are measured using a pressure-volume-temperature (PVT) apparatus. The PVT apparatus consists of a variable volume, visual JEFRI PVT cell. The main component of the cell consists of a Pyrex glass cylinder 15.2-cm long with an internal diameter of 3.2 cm. An especially designed floating piston and a magnetically coupled impeller mixer are mounted inside the Pyrex cylinder to allow for mercury-free operation. The bottom section of the piston is furnished with o-rings to isolate the hydraulic fluid from the cell content. The piston allows liquid level measurements as small as 0.005 cc. The magnetically coupled impeller mixer, mounted on the bottom end cap of the PVT cell, allow quick equilibration of the hydrocarbon fluid. The effective volume of the cell is approximately 120 cc. The Pyrex cylinder is housed inside a steel shell with vertical tempered glass plates to allow visual observation of the internal tube contents.

A variable volume JEFRI displacement pump controls the volume, and hence, the pressure of the fluids under investigation by means of injection or withdrawal of transparent hydraulic fluid connected to the floating piston from the top of the JEFRI PVT cell. The same hydraulic fluid is also connected to the outer steel shell to maintain a balanced differential pressure on the Pyrex cylinder. The PVT cell is mounted on a special bracket, which can be rotated 360°. The bracket along with the PVT cell is housed inside a temperature controlled, forced air circulation oven. The cell temperature is measured with a platinum resistance thermal detector (RTD) and displayed on a digital indicator with an accuracy of 0.2°F. The cell pressure is monitored with a calibrated digital Heise pressure gauge precise to ± 0.1% of full scale. The temperature and pressure ratings of this PVT system are 15,000 psi (103 MPa) and 360°F (182°C).

The fluid volume in the PVT cell is determined using a cathetometer readable to the nearest 0.01 mm. The cathetometer is equipped with a high-resolution video camera that minimizes parallax in readings and uses a high-resolution encoder producing both linear and volumetric readings. The height measurements by the cathetometer have been precisely calibrated with the total cell volume prior to the start of the test. The floating piston is designed in the shape of a truncated cone with gradually tapered sides, which allows measurement of extremely small volumes of liquid (0.005 cc) corresponding to roughly 0.01% of the cell volume.

The viscosity of the live reservoir fluid is measured at the reservoir temperature and pressure conditions using Cambridge SPL440 electromagnetic viscometer, which consists of one cylindrical cell containing the fluid sample and a piston located inside the cylinder. The piston is moved back and forth through the fluid by imparting an electromagnetic force on the piston. Viscosity is measured by the motion of the piston, which is impeded by viscous flow around the annulus between the piston and the sample cylinder wall. Various sizes of pistons are used to measure the viscosity of various fluids having different levels of viscosity. The temperature is maintained at the experimental condition using a re-circulating fluid heating system. The internal temperature is monitored using an internal temperature probe. The temperature rating of the viscometer is 190°C and pressure rating is 15,000 psig. The accuracy is ±1.5% of full scale for each individual piston range. The total volume of fluid sample required for viscosity measurement is 5 cc.

A cylindrical piston cell (carrier chamber) with a maximum internal volume of 25 mL is attached at the top of the viscometer. The purpose of this cell is to allow the operator to conduct the differential vaporization pressure steps within the viscometer. The back and forth motion of the piston within a narrow clearance provides sufficient agitation to achieve phase equilibration and allow gases to escape and accumulate at the top of the carrier chamber. The heating jacket is wrapped around the viscometer and the carrier chamber and maintains experimental temperature uniformly throughout the system.

The JEFRI PVT cell is also equipped with fiber optic light transmittance probes to measure the onsets of hydrocarbon solids nucleation (OHSP) due to changes in the temperature, pressure and/or composition. These fiber optic probes are mounted across the windows of the visual cell. The principle behind the measurement is based on the transmittance of a laser light in the near infra red (NIR) wavelength through the test fluid undergoing temperature, pressure or the fluid composition changes. In this system, a computerized pump is controlled to maintain the system pressure during isobaric temperature sweeps for wax nucleation, isothermal pressure drop and/or isobaric injections of precipitating solvents for asphaltene nucleation studies. The process variables (i.e., temperature, pressure, solvent volume, time and transmitted light power level) are recorded and displayed from the detector. The fiber optic light transmittance system referred to here that detects the conditions of OHSP is termed as the light scattering system (LSS).

High pressure filters are also used during the asphaltene nucleation study to quantify the amount of asphaltene in the fluid at the specified conditions. The filter manifold used is rated for 10,000 psia. The filter assembly consists of two plates screwed together with the hydrophobic filter sandwiched between them.

Appendix D: PROCEDURE

Fluids Preparation and Validation

After homogenizing, a small portion of the single-phase reservoir fluid is first subjected to a single stage flash experiment to determine flash Gas-Oil-ratio (GOR). The flashing is conducted from some pressure above the bubble point pressure at reservoir temperature into an atmospheric Gasometer and measuring the corresponding volumes of gas and liquid. The atmospheric flash also provides parameters such as GOR and stock tank oil density. The flashed fluids (gas and liquid) are then subjected to compositional analysis using gas chromatographic technique. Subsequently, live oil composition is calculated based on the measured gas and liquid compositions and GOR values. In addition, a sub-sample taken from each cylinder is isobarically transferred into the PVT cell at the reservoir temperature. Subsequently, a quick P-V relationship is established to determine the saturation pressure.

Constant Composition Expansion Procedure

A sub-sample of the test fluid is initially charged to the PVT apparatus and the system temperature stabilized at the reservoir temperature. The CCE experiment is then conducted by incrementally reducing the pressure from some pressure above the bubble point pressure to a pressure well below the bubble point pressure in a number of discrete steps. At each pressure step, the magnetic stirrer is used to make sure that the subject fluid achieved equilibrium. Total fluid volume (with visual observation of a single or two phase condition in the cell) is measured at each pressure stage, and subsequently, a pressure-volume (P-V) plot is created identifying the phase state at each P-V condition. The intersection of the two lines plotted using the pressure and volume data above and slightly below the observed phase change corresponded to the measured saturation pressure of the fluid. In this manner, the P-V plot confirms the saturation pressure observed visually in the PVT cell. The measured pressure and volume data are then used to compute live oil compressibility above the bubble point pressure and relative oil volumes over the entire pressure range.

Differential Vaporization Procedure

Subsequent to the completion of the CCE experiment, another sub-sample of the test fluid is charged to the PVT apparatus and the cell contents are then mixed with the magnetic mixer to allow for phase equilibration at the reservoir temperature and pressure conditions. A differential vaporization (DV) experiment is then conducted by incrementally reducing the pressure in the PVT cell in discrete steps. In these steps, the pressure is reduced below the saturation pressure, and hence, allowing the gas phase to evolve. A typical pressure stage in a DV test is described below:

- The pressure in the PVT cell is reduced to a pressure just above the bubble point pressure of the oil. This is the starting point of the DV test.
- The pressure of the fluid is then reduced to the first pressure stage (below the bubble point pressure) of the DV test allowing free gas to evolve. The magnetic mixer is then used to achieve equilibration between the free gas and the pressurized liquid.
- The evolved gas phase is then isobarically removed from the PVT cell into an evacuated pycnometer for gravimetric density and compositional analysis by the flash procedure (see Fluid Analysis Equipment Section)
- The previous two steps are repeated until either an atmospheric pressure or a predetermined abandonment pressure is reached.

Multi-Stage Separation Test

Subsequent to the completion of the DV experiment, another sub-sample of the test fluid is charged to the PVT apparatus and the cell contents are then mixed with the magnetic mixer to allow for phase equilibration at the reservoir temperature and pressure conditions. A multi-stage separation experiment is then conducted by incrementally reducing the pressure and temperature conditions in the PVT cell in discrete steps. In these steps, the pressure is reduced below the saturation pressure, and hence, allowing the gas phase to evolve. A typical pressure stage in a separation test is described below:

- The pressure in the PVT cell is reduced to a pressure just above the bubble point pressure of the oil. This is the starting point of the separation test.
- The temperature of the PVT cell are then reduced to the first-stage separation test temperature and allowed the cell content to equilibrate. The pressure of the fluid is then reduced to the first pressure stage (below the bubble point pressure) of the separation test allowing free gas to evolve. The magnetic mixer is then used to achieve equilibration between the free gas and the pressurized liquid.
- The evolved gas phase is then isobarically removed from the PVT cell into an evacuated pycnometer for gravimetric density and compositional analysis by the flash procedure (see Fluid Analysis Equipment Section)

The previous two steps are repeated in five stages to stock tank conditions.

Liquid Phase Viscosity and Density Measurements During DV Step

Prior to measuring the viscosity, a suitable size piston is selected with the proper viscosity range and the electromagnetic viscometer is calibrated using a fluid with known viscosity.

A portion of the live reservoir fluid used in the DV test is then transferred into a high-pressure high-temperature electromagnetic viscometer. The viscometer is initially evacuated and kept at the same temperature as that of the PVT cell. During the transfer of approximately 15 cc of live hydrocarbon liquid to the evacuated viscometer, flashing of oil takes place, and hence, the viscometer system is flushed with live oil twice to make sure a representative live oil sample is taken. Subsequent to transfer of live reservoir fluid into the viscometer, the fluid system is allowed to achieve thermal and pressure equilibration. Then, the viscosity reading is taken. Following the viscosity reading, incremental pressure reduction steps are repeated as those used in DV steps. At each pressure point, the piston was allowed to run back and forth for sufficient time to achieve pressure equilibration and allow the liberated gas to migrate vertically upwards and accumulate at the top of the carrier chamber.

Experiments are also conducted independently using a PVT cell for phase equilibration. The viscosity measurements done on liquid sample transferred from the PVT cell after equilibration compares very well with the measurements done on liquid sample subjected to pressure steps within the viscometer.

Stock-Tank Oil (STO) Viscosity and Density Measurements

A sample of STO is taken in a known capillary tube to measure the STO viscosity at a preset temperature. The temperature bath is maintained at the preset temperature.

A small sample of the liquid is also transferred into the Anton Paar DMA45 densitometer to measure the density of the liquid phase. The viscosity and density measurements are repeated for data consistency check.

Asphaltene, Wax and Sulfur Content Measurements

Asphaltene content of stock-tank oil samples is conducted using the IP-143 (French Institute of Petroleum) procedure. In this procedure, the asphaltenes are characterized as the n-heptane insoluble fractions of the crude oil. Wax content of the STO is measured using UOP (Universal Oil Product) 46-64 procedure. The sulfur content of the STO is measured using ASTM D 2494 procedure. All other STO analysis were measured according to industrial standards.

SAR(P)A Analysis

A spinning band distillation was carried out on the original sample to establish two fractions. The initial boiling point to 300°C fraction was then analyzed using a supercritical fluid chromatographic (ASTM 5186-91) method to determine the saturates and aromatics content. The greater than 300°C fraction first subjected to a gravimetric analysis to determine the pentane insoluble content (asphaltenes). This method dissolves the fraction in an equal weight of toluene, then 40 volumes of pentane were added to precipitate the insoluble portion of the sample. The precipitate was filtered, dried and weighed. The solvent was removed from the soluble portion of the sample, which was referred to as the maltenes. The maltenes were then redissolved in pentane and were chromatographically separated into saturates, aromatics and resins (polars) fraction by elution from a column filled with activated alumina, using various solvents and solvent mixtures. The solvents were then removed from each fraction and the amount of material weighed.

The data from the three methods were combined to determine the amount of each component type in the original sample. Mass balances were calculated throughout the procedure to assure accurate data.

High-Temperature High Pressure Filtration Test

During the filtration process, it is important that the monophasic fluid remains monophasic as it passes through the filter manifold. Hence, high pressure nitrogen is used on the back side of the filter so that the equal pressure is maintained on both sides of the filter. This procedure prevents any flashing of the fluid in the filter manifold and assures filtration of a representative fluid.