



**GAS ANALYSIS ADDITIONAL REPORT
GLYDE 1 AND KILGOUR NORTH 1
for
ARMOUR ENERGY
by
WEATHERFORD LABORATORIES (AUSTRALIA) PTY LTD**



**Higher
Standards**





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LABORATORIES

15th March, 2013

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Attention: Josh Bluett

GAS ANALYSIS - ADDITIONAL REPORT – AB-58233
GLYDE 1 AND KILGOUR NORTH 1 APRIL 2013

Please find enclosed final results of the storage canisters gas study for the samples taken from the storage.

If Weatherford can assist you in any way, or if you require any further information, please do not hesitate to contact the undersigned.

Yours Sincerely

ALON MEIZLER
Senior Reservoir Fluid Chemist

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CHAPTER 1

OVERVIEW OF OPERATIONS

1. OVERVIEW OF OPERATIONS

As part of an ongoing program for Armour Energy Pty Ltd, Weatherford Laboratories (Australia) Pty Ltd analysed storage canisters from the following sites Glyde 1 and Kilgour North 1.

The analyses performed in the Weatherford Reservoir Fluids Laboratory included:

- Composition by gas chromatograph by ASTM D1945-03 (2010) methodology.

The analyses show a range in the composition of the products.

CHAPTER 2

VALIDATION CHECK – GLYDE 1 AND KILGOUR NORTH 1

SAMPLE VALIDATION CHECK

Client: Armour Energy
Well: Glyde 1
Date Sampled: 10/4/2013

Canister ID	Sample Details	Sampling Conditions		Opening Conditions		Sample Volume	
		Pressure, psi	Temperature, °C	Pressure, psi	Temperature, °C	Mud	Condensate
#20	Storage Canister	Unknown	Unknown	287.0	21	0	0

SAMPLE VALIDATION CHECK

Client: Armour Energy
Well: Glyde 1
Date Sampled: 11/4/2013

Canister ID	Sample Details	Sampling Conditions		Opening Conditions		Sample Volume	
		Pressure, psi	Temperature, °C	Pressure, psi	Temperature, °C	Mud	Condensate
#21	Storage Canister	Unknown	Unknown	287.0	21	0	0

SAMPLE VALIDATION CHECK

Client: Armour Energy
Well: Glyde 1
Date Sampled: 11/4/2013

Canister ID	Sample Details	Sampling Conditions		Opening Conditions		Sample Volume	
		Pressure, psi	Temperature, °C	Pressure, psi	Temperature, °C	Mud	Condensate
#22	Storage Canister	Unknown	Unknown	287.0	21	0	0

SAMPLE VALIDATION CHECK

Client: Armour Energy
Well: Glyde 1
Date Sampled: 11/4/2013

Canister ID	Sample Details	Sampling Conditions		Opening Conditions		Sample Volume	
		Pressure, psi	Temperature, °C	Pressure, psi	Temperature, °C	Mud	Condensate
#23	Storage Canister	Unknown	Unknown	287.0	21	0	0

SAMPLE VALIDATION CHECK

Client: Armour Energy
Well: Kilgour North 1
Date Sampled: 11/4/2013

Canister ID	Sample Details	Sampling Conditions		Opening Conditions		Sample Volume	
		Pressure, psi	Temperature, °C	Pressure, psi	Temperature, °C	Mud	Condensate
#18	Storage Canister	Unknown	Unknown	287.0	21	0	0

CHAPTER 3

GAS ANALYSIS – GLYDE 1 AND KILGOUR NORTH 1

COMPOSITION OF CANISTER GAS
(by Chromatographic Techniques)

Client: Armour Energy
Well: Glyde-1
Cylinder No: Canister #20
Sample Type: Unknown
Sampling Date: 10 April 2013
Sampling Conditions: Unknown psia at Unknown °C
Laboratory Opening Pressure: 51.95 psia at 21 °C

Component	Surface Gas (Mole %)	Surface Gas (Weight %)	Liquid Recovery (GPM)	Molecular Weight	Liquid Density (g/cm ³)
CO ₂ Carbon Dioxide	0.08	0.13		44.01	0.817
N ₂ Nitrogen	81.25	79.80		28.01	0.809
C ₁ Methane	7.86	4.42		16.04	0.300
C ₂ Ethane	4.14	4.36	1.103	30.07	0.356
C ₃ Propane	5.01	7.74	1.375	44.10	0.507
iC ₄ iso-Butane	0.35	0.71	0.113	58.12	0.563
nC ₄ n-Butane	1.00	2.05	0.316	58.12	0.584
iC ₅ iso-Pentane	0.14	0.36	0.051	72.15	0.624
nC ₅ n-Pentane	0.16	0.41	0.059	72.15	0.631
C ₆ Hexanes	0.01	0.02	0.003	84.00	0.685
C ₇ Heptanes	0.00	0.00	0.000	96.00	0.722
C ₈₊ Octanes plus	0.00	0.00	0.000	114.00	0.755
TOTALS:	100.00	100.00	3.020		

Sample Properties

Critical Pressure, psia:	522.86	Gas Gravity Factor, Fg:	1.0078
Critical Temperature, °R:	281.23	Super Compressibility Factor, Fpv	
Molecular Weight, g/mol:	28.5	at sampling conditions:	1.0023
Calculated Gas Gravity, Air = 1.000:	0.9846	Gas Z-Factor	
Calculated Gas Density, g/L:	1.2032	at sampling conditions*:	0.995

Gross Heating Value, Btu/scf dry gas 335 at 14.7 psia and 15.6°C
Wobbe Number: 338 at 14.7 psia and 15.6°C

Additional Analysis

Helium (mole %) <0.001

NB: Supercompressibility and Gas Z-Factor are not applicable due to unknown sampling conditions.

* From Standing, M.B., "Volumetric and Phase Behaviour of Oil Field Hydrocarbon Systems", SPE (Dallas), 1997, 8th Edition, Appendix II

COMPOSITION OF CANISTER GAS
(by Chromatographic Techniques)

Client: Armour Energy
Well: Glyde-1
Cylinder No: Canister #21
Sample Type: Unknown
Sampling Date: 11 April 2013
Sampling Conditions: Unknown psia at Unknown °C
Laboratory Opening Pressure: 21.01 psia at 21 °C

Component	Surface Gas (Mole %)	Surface Gas (Weight %)	Liquid Recovery (GPM)	Molecular Weight	Liquid Density (g/cm ³)
CO ₂ Carbon Dioxide	0.02	0.03		44.01	0.817
N ₂ Nitrogen	74.89	73.19		28.01	0.809
C ₁ Methane	8.62	4.82		16.04	0.300
C ₂ Ethane	8.50	8.92	2.266	30.07	0.356
C ₃ Propane	6.54	10.06	1.795	44.10	0.507
iC ₄ iso-Butane	0.32	0.66	0.106	58.12	0.563
nC ₄ n-Butane	0.92	1.87	0.290	58.12	0.584
iC ₅ iso-Pentane	0.08	0.19	0.028	72.15	0.624
nC ₅ n-Pentane	0.10	0.25	0.036	72.15	0.631
C ₆ Hexanes	0.01	0.02	0.002	84.00	0.685
C ₇ Heptanes	0.00	0.00	0.000	96.00	0.722
C ₈ + Octanes plus	0.00	0.00	0.000	114.00	0.755
TOTALS:	100.00	100.00	4.523		

Sample Properties

Critical Pressure, psia:	534.96	Gas Gravity Factor, F _g :	1.0052
Critical Temperature, °R:	301.33	Super Compressibility Factor, F _{pv}	
Molecular Weight, g/mol:	28.7	at sampling conditions:	1.0012
Calculated Gas Gravity, Air = 1.000:	0.9896	Gas Z-Factor	
Calculated Gas Density, g/L:	1.2093	at sampling conditions*:	0.998

Gross Heating Value, Btu/scf dry gas: 450 at 14.7 psia and 15.6°C
Wobbe Number: 452 at 14.7 psia and 15.6°C

Additional Analysis

Helium (mole %) <0.001

NB: Supercompressibility and Gas Z-Factor are not applicable due to unknown sampling conditions.

* From Standing, M.B., "Volumetric and Phase Behaviour of Oil Field Hydrocarbon Systems", SPE (Dallas), 1997, 8th Edition, Appendix II

COMPOSITION OF CANISTER GAS
(by Chromatographic Techniques)

Client: Armour Energy
Well: Glyde-1
Cylinder No: Canister #22
Sample Type: Unknown
Sampling Date: 11 April 2013
Sampling Conditions: Unknown psia at Unknown °C
Laboratory Opening Pressure: 26.55 psia at 21 °C

Component	Surface Gas (Mole %)	Surface Gas (Weight %)	Liquid Recovery (GPM)	Molecular Weight	Liquid Density (g/cm ³)
CO ₂ Carbon Dioxide	0.02	0.02		44.01	0.817
N ₂ Nitrogen	58.13	55.69		28.01	0.809
C ₁ Methane	13.80	7.57		16.04	0.300
C ₂ Ethane	15.23	15.66	4.059	30.07	0.356
C ₃ Propane	9.85	14.86	2.705	44.10	0.507
iC ₄ iso-Butane	0.56	1.11	0.182	58.12	0.563
nC ₄ n-Butane	1.84	3.66	0.578	58.12	0.584
iC ₅ iso-Pentane	0.21	0.52	0.076	72.15	0.624
nC ₅ n-Pentane	0.33	0.81	0.120	72.15	0.631
C ₆ Hexanes	0.03	0.10	0.013	84.00	0.685
C ₇ Heptanes	0.00	0.00	0.000	96.00	0.722
C ₈₊ Octanes plus	0.00	0.00	0.000	114.00	0.755
TOTALS:	100.00	100.00	7.734		

Sample Properties

Critical Pressure, psia:	562.93	Gas Gravity Factor, Fg:	0.9953
Critical Temperature, °R:	352.09	Super Compressibility Factor, Fpv	
Molecular Weight, g/mol:	29.2	at sampling conditions:	1.0023
Calculated Gas Gravity, Air = 1.000:	1.0095	Gas Z-Factor	
Calculated Gas Density, g/L:	1.2336	at sampling conditions*:	0.995

Gross Heating Value, Btu/scf dry gas 758 at 14.7 psia and 15.6°C
Wobbe Number: 755 at 14.7 psia and 15.6°C

Additional Analysis

Helium (mole %) <0.001

NB: Supercompressibility and Gas Z-Factor are not applicable due to unknown sampling conditions.

* From Standing, M.B., "Volumetric and Phase Behaviour of Oil Field Hydrocarbon Systems", SPE (Dallas), 1997, 8th Edition, Appendix II

COMPOSITION OF CANISTER GAS
(by Chromatographic Techniques)

Client: Armour Energy
Well: Glyde-1
Cylinder No: Canister #23
Sample Type: Unknown
Sampling Date: 11 April 2013
Sampling Conditions: Unknown psia at Unknown °C
Laboratory Opening Pressure: 38.64 psia at 21 °C

Component	Surface Gas (Mole %)	Surface Gas (Weight %)	Liquid Recovery (GPM)	Molecular Weight	Liquid Density (g/cm ³)
CO ₂ Carbon Dioxide	0.01	0.01		44.01	0.817
N ₂ Nitrogen	99.95	99.94		28.01	0.809
C ₁ Methane	0.02	0.01		16.04	0.300
C ₂ Ethane	0.01	0.01	0.003	30.07	0.356
C ₃ Propane	0.02	0.03	0.005	44.10	0.507
iC ₄ iso-Butane	0.00	0.00	0.000	58.12	0.563
nC ₄ n-Butane	0.00	0.00	0.000	58.12	0.584
iC ₅ iso-Pentane	0.00	0.00	0.000	72.15	0.624
nC ₅ n-Pentane	0.00	0.00	0.000	72.15	0.631
C ₆ Hexanes	0.00	0.00	0.000	84.00	0.685
C ₇ Heptanes	0.00	0.00	0.000	96.00	0.722
C ₈ + Octanes plus	0.00	0.00	0.000	114.00	0.755
TOTALS:	100.00	100.00	0.007		

Sample Properties

Critical Pressure, psia:	493.21	Gas Gravity Factor, F _g :	1.0169
Critical Temperature, °R:	227.64	Super Compressibility Factor, F _{pv}	
Molecular Weight, g/mol:	28.0	at sampling conditions:	1.0008
Calculated Gas Gravity, Air = 1.000:	0.9671	Gas Z-Factor	
Calculated Gas Density, g/L:	1.1818	at sampling conditions*:	0.998

Gross Heating Value, Btu/scf dry gas: 1 at 14.7 psia and 15.6°C
Wobbe Number: 0.85 at 14.7 psia and 15.6°C

Additional Analysis

Helium (mole %) <0.001

NB: Supercompressibility and Gas Z-Factor are not applicable due to unknown sampling conditions.

* From Standing, M.B., "Volumetric and Phase Behaviour of Oil Field Hydrocarbon Systems", SPE (Dallas), 1997, 8th Edition, Appendix II

COMPOSITION OF CANISTER GAS
(by Chromatographic Techniques)

Client: Armour Energy
Well: Kilgour North 1
Cylinder No: Canister #18
Sample Type: Unknown
Sampling Date: 11 April 2013
Sampling Conditions: Unknown psia at Unknown °C
Laboratory Opening Pressure: 26.55 psia at 21 °C

Component	Surface Gas (Mole %)	Surface Gas (Weight %)	Liquid Recovery (GPM)	Molecular Weight	Liquid Density (g/cm ³)
CO ₂ Carbon Dioxide	0.01	0.02		44.01	0.817
N ₂ Nitrogen	98.17	98.13		28.01	0.809
C ₁ Methane	1.01	0.58		16.04	0.300
C ₂ Ethane	0.22	0.23	0.058	30.07	0.356
C ₃ Propane	0.41	0.64	0.112	44.10	0.507
iC ₄ iso-Butane	0.07	0.14	0.023	58.12	0.563
nC ₄ n-Butane	0.08	0.17	0.026	58.12	0.584
iC ₅ iso-Pentane	0.02	0.05	0.008	72.15	0.624
nC ₅ n-Pentane	0.01	0.03	0.004	72.15	0.631
C ₆ Hexanes	0.00	0.00	0.000	84.00	0.685
C ₇ Heptanes	0.00	0.00	0.000	96.00	0.722
C ₈ + Octanes plus	0.00	0.00	0.000	114.00	0.755
TOTALS:	100.00	100.00	0.230		

Sample Properties

Critical Pressure, psia:	495.97	Gas Gravity Factor, F _g :	1.0167
Critical Temperature, °R:	232.18	Super Compressibility Factor, F _{pv}	
Molecular Weight, g/mol:	28.0	at sampling conditions:	1.0006
Calculated Gas Gravity, Air = 1.000:	0.9675	Gas Z-Factor	
Calculated Gas Density, g/L:	1.1822	at sampling conditions*:	0.999

Gross Heating Value, Btu/scf dry gas: 30 at 14.7 psia and 15.6°C
Wobbe Number: 31 at 14.7 psia and 15.6°C

Additional Analysis

Helium (mole %) <0.001

NB: Supercompressibility and Gas Z-Factor are not applicable due to unknown sampling conditions.

* From Standing, M.B., "Volumetric and Phase Behaviour of Oil Field Hydrocarbon Systems", SPE (Dallas), 1997, 8th Edition, Appendix II