Final Report

AUSTRALIAN MEAT PROCESSOR CORPORATION

Biogas Quality Study Research Project

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Executive Summary

This research project study report presents the findings from sampling and testing at three Australian red meat processing plants located in regional New South Wales (NSW) and South Australia (SA). The objective of the study was to evaluate the quantity, quality and purity of biogas production from a typical Covered Anaerobic Lagoon (CAL) system used in the Australian red meat processing industry.

Biogas production and quality

The study determined biogas production and quality on the basis of organic content removed in the CAL system (i.e. m^3 biogas/kg Chemical Oxygen Demand (COD) removed). The biogas conversion rates as a function of COD removed at each abattoir, including methane composition of the biogas, is shown in **Table A.**

Table A - Biogas conversion rates as a function of COD removed

Parameter	Unit	Abattoir A	Abattoir B	Abattoir C
Methane composition in biogas	%	65.3	68.4	63.0
Biogas conversion rate	m_3/kg COD removed	0.654	0.625	0.219
Methane conversion rate	m_3 CH_4/kg COD removed	0.375	0.428	0.138

The range of biogas conversion across all the sampled abattoirs was from 0.219 to 0.654 m^3 biogas/ kg COD removed, equivalent to a methane conversion rate from 0.138 to 0.428 m^3 CH_4/ kg COD removed, based on a methane composition range from 63 to 68.4% respectively. Other gas species measured in the biogas at significant quantities are summarised in **Table B.**

Table B – Gas composition of biogas across the study

Chemical Parameter	Content
Methane (CH_4)	51-83%
Carbon dioxide (CO_2)	17-33%
Oxygen (O_2)	< 0.2 – 3.8%
Hydrogen Sulphide (H_2S)	0.074 - 0.41%^
Balance Gases (Nitrogen (N_2) and Argon (Ar))	0.8-17.5%

^ see comment in **Table 5.2**

The primary constituents in the biogas across all three abattoirs in this study were methane and carbon dioxide, with a mean values across the study of 64.4% and 25.7% respectively. Oxygen

and balance gases (nitrogen and argon) were also found to be in non-trace quantities, with a mean value across the study of 0.91% and 7.1 % respectively. Balance gases were not directly analysed in this study. It can be seen that Abattoirs A & B CAL systems produced similar results in terms of biogas production and quality, whereas the Abattoir C CAL system produced similar quality biogas at a lower conversion rate. This was possibly due to difficulties in commissioning the CAL system. Based on a limited published literature review, these results (with the exception of Abattoir C) seem to be within reasonable expectations and comparable to other industries that generate biogas from wastewater streams using anaerobic treatment.

Trace quantities of other gas species were measured in the biogas, with a majority below the detectable limit of the measurement/analysis technique used for testing. The trace gas species included ammonia, N_xO & NO_x, carbon monoxide, volatile fatty acids, sulphides (predominately hydrogen sulphide) and siloxanes. Moisture in the biogas was also present as both water vapour and water droplets, indicating that the biogas stream was saturated. Of particular interest is hydrogen sulphide and its prevalence in significant trace concentrations in the biogas ranging from 737 to 4,050 ppm across the three abattoirs. The global mean for hydrogen sulphide in this study was 1,630 ppm.

CAL Commissioning and steady state conditions

Based on advice provided to The Odour Unit from abattoir personnel, biogas generation was observed at each abattoir within three months after commissioning of the CAL system. During and after this period of time, biogas volume and quality (such as methane content) can vary. This study found that after three months from the commissioning date the CAL system at each abattoir was producing biogas that consisted of methane levels greater than 50%. Further advice from abattoir personnel after the completion of the sampling run in this study revealed that a more consistent volume and methane-rich biogas production was possible once the CAL systems achieved steady state conditions.

Biogas suitability for energy recovery

This study has found that the biogas produced from the CAL systems is suitable for energy recovery applications. However the need for the removal of hydrogen sulphide from the biogas needs to be considered and is the subject of separate MLA report (A.ENV.0098) prepared concurrently with this project.

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1 Background

Australian red meat processing plants generate significant volumes of high strength wastewater as part of their normal operation. This wastewater generally undergoes some form of treatment on-site prior to discharge. There are several conventional strategies available to manage these types of wastewater streams amongst them being anaerobic treatment, widely used as one of the first steps in wastewater treatment. One of the well-known configurations for anaerobic treatment is by the use of covered ponds (or lagoons) commonly referred to as a Covered Anaerobic Lagoon (CAL).

Anaerobic wastewater treatment in CALs involves the breakdown of organic material by acid- and methane-forming bacteria in an environment free of oxygen. An effect of this natural process is the generation of a mixture of gaseous species commonly known as biogas. Biogas is primarily composed of methane and carbon dioxide. Other trace gas compounds can include hydrogen sulphide, nitrogen-based compounds (such as ammonia, N_xO & NO_x), carbon monoxide, volatile fatty acids and siloxanes.

In general, biogas cannot be vented to atmosphere as it is highly odorous, a potent greenhouse gas, flammable and potentially toxic to air and the biological environment. As such, biogas is treated and used as a source of energy or is thermally oxidised using a purpose-built flare system.

The quantity and quality of biogas generated are dependent on a number of key factors including but not limited to:

- pH;
- Organic and inorganic content;
- Environmental conditions such as temperature; and
- Available oxygen.

A thorough understanding of biogas composition and quality is an essential element if consideration is given to recovering the biogas for use in downstream processes such as use in boilers and drier systems, cogeneration and trigeneration equipment, and in designing the emergency biogas flare. While there is ample data on biogas quantity and quality from CALs,

there is little public information on the quantity, quality, and purity of biogas liberated from a typical CAL used in the Australian red meat processing industry.

1.1 Scope of study

In order to obtain specific data on the biogas quantity and quality generated from a typical CAL in the Australian red meat processing industry, the scope of this research study involved visiting three separate red meat processing sites, two in New South Wales (NSW) and one in South Australia (SA). For the purposes of this study, the names of the participating abattoirs have been withheld and referred to as follows:

- **Abattoir A:** Abattoir located in Northern NSW
- **Abbatoir B:** Abattoir located in Southern NSW
- **Abattoir C:** Abattoir located in Southern SA

To obtain representative data for the CAL performance, each abattior site was visited on three separate occasions, spaced at least one week apart between each measurement. Each visit involved the collection of gas and wastewater samples from the CALs. These samples were subsequently tested for parameters that are known to be key indicators of biogas and wastewater quality at suitably accrediated laboratories in Sydney, NSW.

2 Project objectives

The objective of the research study was to determine the quantity and quality biogas generated from a typical CAL in red meat industry. To achieve this, the collected measurement and testing results generated in the study were used to derive the biogas production on the basis of Chemical Oxygen Demand (COD) removed in the CAL per unit of organic content removed (i.e. m^3 biogas/kg COD removed). Based on the derived result, comments were made on the quantity and quality of biogas at the different red meat processing plants, a comparison of this performance to other CALs in different industries, and its suitability for energy recovery strategies.

3 Study Methodology

The sampling and testing methods used in this study, and a brief overview of each sampled abattoir site, has been summarised in the following sections.

3.1 CAL sampling conditions

Currently at each of the participating abattoirs the biogas that is generated by the CALs is directed to a purpose-built flare system. The quantity of biogas generated is measured by an on-site flow meter, attached to the flare system. An example of the flow meter is shown in **Photo 3.1.** The flow meter was used in this study to measure volumetric flow, cumulative flow and temperature of the biogas extracted by the flare system. This was used to determine the quantity of biogas generated for at least a one-month period.

Photo 3.1 – Flow meter attached to the biogas flare system

In general, the CAL systems at each abattoir were found to be performing close to 80% COD removal, indicating that they were at or near a fully-commissioned state. Raw and treated wastewater from the CALs was collected in this study (see **Sections 3.2.1-3.2.3** for details).

3.2 Wastewater sampling

Wastewater samples were collected using suitable bottles supplied by the testing laboratory. The sampling at each site is detailed in the following sections.

3.2.1 Abattoir A

Abattoir A produces a range of meat and rendered products. Overall, this process generates approximately 7 Megalitres (ML) of wastewater per week, over a 5 day production week. The site processes cattle only.

The wastewater treatment flow process can be broken up into three sections as follows:

1 Primary treatment by Screening and a Dissolved Air Flotation (DAF) unit;
2 Secondary treatment by a single CAL system; and
3 Tertiary treatment to remove nutrients such as nitrogen and phosphorous (nitrification and denitrification, and biological phosphorus removal). Clarification is then undertaken to remove suspended solids (Mixed Liquor Suspended Solids) from the treated wastewater.

The final treated effluent is discharged to sewer, used for land application or is recycled

The wastewater received by the CAL system (see **Photo 3.2**) is generated at several upstream areas including holding yards, slaughtering floor, rendering plant, boning room and washing stations. All wastewater from these points converge into a common sump located within the CAL area (refer **Photo 3.3**). This point was considered the ‘CAL inlet’ sample location. Composite inlet wastewater samples were collected at this point spanning a period of approximately 5 production hours during a slaughtering cycle.

Effluent exiting the CAL system flows into another sump (see **Photo 3.4**) before undergoing further treatment downstream. This exit sump was considered the ‘CAL outlet’ sample location. Composite outlet wastewater samples were collected at this location spanning a period of approximately 5 production hours, and corresponded with the collection of an inlet wastewater sample.

Photo 3.2 – CAL system at Abattoir A

Photo 3.3 – Abattoir A CAL system: Inlet wastewater collection point

Photo 3.4 – Abattoir A CAL system: Outlet wastewater collection point

3.2.2 Abattoir B

All wastewater generated at Abattoir B is initially treated by a primary wastewater treatment system responsible for removing all solids, before subsequent treatment via the CAL system. This system has two CALs, each with a capacity of 28 ML (see **Photo 3.5**). The site processes cattle.

Wastewater entering the two CALs is received from several upstream areas including the holding yards, slaughtering floor, rendering plant, boning room, and washing stations. All wastewater from these points converge into a common sump located within the CAL area where it bifurcates between the CALs. (see **Photo 3.6**). The common sump is the 'CAL inlet wastewater' sample location. Composite inlet wastewater samples were collected at this point spanning a period of approximately 4 production hours during slaughtering and wash-down cycles.

Effluent exiting the CAL system flows into another sump (refer **Photo 3.7**) before undergoing further treatment in a Biological Nutrient Removal (BNR) pond system. The treated wastewater is then stored in a holding pond before subsequent discharge to sewer, land application or recycling. The sump receiving the wastewater exiting from the CAL was considered the 'CAL outlet wastewater' sample location. Composite outlet wastewater samples were collected at this

location spanning a period of approximately 4 hours during slaughtering and wash-down cycles, and corresponded with the collection of an inlet wastewater sample.

Photo 3.5 – CAL system at Abattoir B

Photo 3.6 – Abattoir B: Inlet wastewater collection point

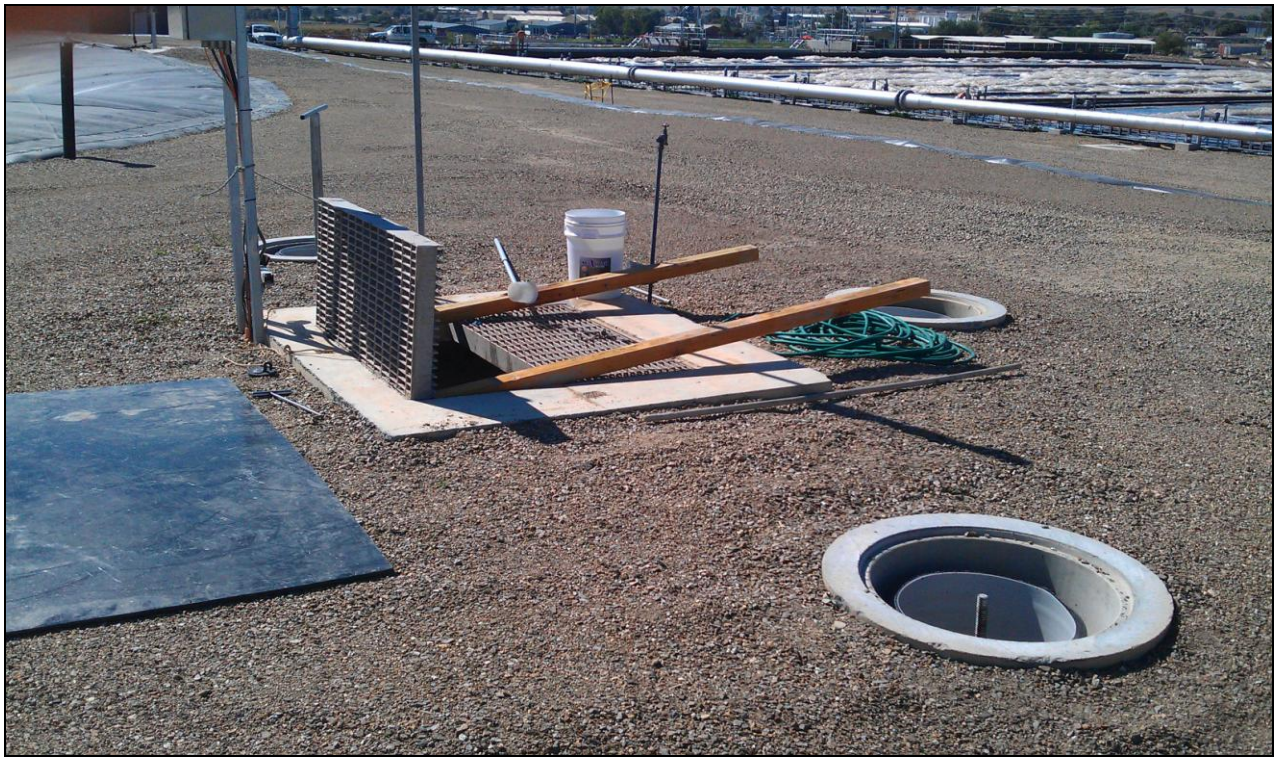


Photo 3.7 – Abattoir B: Outlet wastewater collection point

3.2.3 Abattoir C

Similar to the other sites, wastewater generated at Abattoir C is received from several upstream areas including the holding yards, slaughtering floor, rendering plant, and washing stations. A contrast however is that Abattoir C process both cattle and sheep whereas the other two abattoirs process cattle only.

All wastewater generated from the process is directed to a tallow recovery plant for removal of solids by screening and secondary tallow recovery. Following this, the effluent is passed through a Dissolved Air Flotation (DAF) unit and then bifurcates into two individual sumps each connected to a CAL with a capacity of 20 ML (see **Photo 3.8**). Both inlet sumps were sampled and this point was termed as the 'inlet wastewater' sample location (see **Photo 3.9**). Composite inlet wastewater samples were collected over a period of approximately 4-5 hours. Both cattle and sheep slaughtering and wash-down cycles for were included in the sampling regime.

The outflows from both CALs are directed to separately connected sumps that exist at the eastern (see **Photo 3.10**) and western quadrants of the CAL area. The streams from both sumps then converge and are pumped off-site for further treatment. Samples were collected at both sumps and considered the 'CAL outlet wastewater' sample location. Composite outlet

wastewater samples were collected at this location and corresponded with the collection of inlet wastewater samples.

Photo 3.8– CAL system at Abattoir C

Photo 3.9 – Abattoir C: Inlet wastewater collection point

Photo 3.10 – Abattoir C: Eastern outlet wastewater collection point indicated

3.3 Wastewater Testing

All collected samples were chilled after collection and transported to MGT Environmental Laboratories, Sydney NSW for testing. The scope for the testing is as follows:

- COD loadings and degree of removal;
- Biochemical Oxygen Demand, over 5 days (BOD_5), loadings and degree of removal;
- Suspended Solids (SS) loadings and degree of removal; and
- Volatile Suspended Solids (VSS) loadings and degree of removal.

Each wastewater testing parameter is briefly described in the following sections.

3.3.1 Chemical Oxygen Demand

The COD of wastewater is the measured amount of oxygen needed to chemically oxidise the organics present. It is considered a critical parameter in determining the performance of the CAL systems at each abattoir in this study.

3.3.2 Biochemical Oxygen Demand

The BOD is the measured amount of oxygen required by acclimated microorganisms to biologically degrade the organic matter in the wastewater.

3.3.3 Suspended Solids

SS is the measure of the quantity of small solid particles that either settle or remain in suspension in the wastewater.

3.3.4 Volatile Suspended Solids

VSS is a measure of the total solids that are oxidised upon ignition.

3.4 Biogas Sampling and Testing

Over the course of this study all biogas generated from the CAL systems at each of the abattoirs are directed to a purpose-built flare system. Where there are two CALs, the biogas is captured and directed to the flare system through a common duct. Each flare system is equipped with a knock-out vessel, designed to minimise entrainment of liquid in the biogas prior to flaring. All gas samples were collected downstream of the knockout vessel in Tedlar ® bags and subsequently transported to SGS Australia Pty Ltd Laboratory in Sydney NSW for gas speciation by Gas Chromatography (GC) analysis. In-situ testing was also carried out using GasTec ® detector tubes over the course of the sampling period. This was mostly important when measuring the hydrogen sulphide content in the biogas as the sample is collected, due to the rapid decay of this compound in storage and transport.

3.4.1 Biogas

As previously mentioned, biogas consists of a mixture of gaseous compounds in a methane and carbon dioxide matrix. Gas speciation was carried out to identify those chemicals species present in the biogas at detectable quantities. A list of the gas compounds tested is shown **Table 3.1.**

Siloxanes concentration analysis was only undertaken for the biogas samples collected at Abattoir C as it was not part of the original scope in this research study, but tested at The Odour Unit's discretion. Siloxanes are found at abattoirs that use anti-foam and other siloxanes-containing agents, but this is understood to be not a common practice. Each abattoir in this study advised that they do not use siloxanes-containing agents.

Table 3.1 – List of biogas chemical constituents

Chemical name	Chemical Nomenclature	Comment
Methane	CH_4	The fuel used to power the cogeneration equipment. It is a potent greenhouse gas.
Carbon Dioxide	CO_2	Hinders combustion. It is a greenhouse gas.
Carbon Monoxide	CO	-
Hydrogen Sulphide	H_2S	Causes corrosion of engine parts
Sulphur Dioxide	SO_2	Unlikely to be present alongside H_2S
Oxygen	O_2	-
Ammonia	NH_3	Indicates poor biogas quality
Nitric Oxide	NO	-
Nitrogen Dioxide	NO_2	-
Nitrous Oxide	N_2O	-
Volatile Petroleum Hydrocarbons (VPH)	-	C_5-C_{12} aliphatics^ and C_9-C_{10} Aromatics^^
Benzene, Toluene, Ethylbenzene & Xylene (BTEX)	-	Hinders combustion
Carbon Monoxide	CO	Assists with combustion
Volatile Fatty Acids (VFAs)		A good indicator of biogas condition
Moisture	H_2O	Hinders combustion
Siloxanes	-	Can cause significant internal damage to engines

^ Aliphatics - Petroleum hydrocarbons (PHCs) that do not contain benzene rings.
^^ Aromatics - Petroleum hydrocarbons (PHCs) that contain benzene ring

Each of the flare systems at the abattoirs were designed and constructed by Australian Burner Manufacturers (ABM). An example of a typical flare system setup at the abattoirs is shown in **Photo 3.11.**

Photo 3.11 – Typical biogas flare system

3.5 CAL system commissioning and sampling dates

The CAL system commissioning and sampling dates are summarised in **Table 3.2.**

Table 3.2 – CAL system commissioning and sampling dates

Site	Commissioning date	Sampling start date	Sampling finish date
Abattoir A	June 2011	24 October 2011	22 November 2011
Abattoir B	16 January 2012	21 March 2012	17 April 2012
Abattoir C	January 2013	20 March 2013	29 May 2013

4 Results

The following sections summarise wastewater and gas testing results across the three abattoirs sampled in this study.

The wastewater testing results are presented in the conventional testing parameters, that is, in milligrams per litre (mg/L). The biogas testing results are presented as follows:

- Part per million by volume;
- 1 % = 10,000 ppm; and
- v/v = volume per volume.

4.1 Result calculations

4.1.1 COD Removal

The COD removal efficiency was determined from the inlet and outlet COD concentrations. The mass of COD removed was derived from the wastewater testing results and the total wastewater inflow of the CAL systems over the sampling period. This was expressed as kilograms of COD removed per day by the CAL systems.

4.1.2 Biogas Quantity

The biogas quantity in this study was evaluated by assuming that the cumulative volume of biogas flared represents the biogas generated over a set period of time. This assumption was considered conservative as the flare system only activates once the pressure under the covers of the CALs reach a pressure set point (found to be around 40 Pa). This method was adopted in this study as it is difficult, in practical terms, to determine the true biogas volume generated by the CAL system.

4.1.3 Biogas Moisture

Across the entire study, the exact moisture content of the biogas was difficult to directly measure both in-situ and at the laboratory. This was due to the volatile nature of the biogas and the lack of available intrinsically safe devices to carry this task out. A change in temperature and pressure of the sample bag upon receipt by the laboratory meant the true reading could not be measured. Notwithstanding this, it is reasonable to assume that the moisture levels of the gas stream would

have been at saturation level given the prevailing warm and moist conditions inside the CAL and the extended period of gas/water contact. The saturation levels of water in a predominantly methane/carbon dioxide gas will need to be determined independently, if this information is required.

4.2 Abattoir A Results

Abattoir A was sampled between 24 October 2011 and 22 November 2011. **Table 4.1** summarises wastewater testing results, **Table 4.2** summarises biogas GC analysis testing results, **Table 4.3** summarises in-situ gas measurements collected using the on-site flare meter and Gastec ® detector tubes, and **Table 4.4** summarises the mean daily biogas flared at the site over 20 September 2011 to 22 November 2011.

Table 4.1 – Abattoir A Wastewater Testing Result: 24 October – 21 November 2011

Sampling Date		24 October 2011			8 November 2011			22 November 2011		
Parameter	**Unit**	**CAL Inlet**	**CAL Outlet**	**Removal (%)**	**CAL Inlet**	**CAL Outlet**	**Removal (%)**	**CAL Inlet**	**CAL Outlet**	**Removal (%)**
BOD_5	mg/L	2,700	980	63	750	330	56	3,200	450	86
COD	mg/L	2,200	750	66	3,200	1,300	59	3,500	1,000	71
SS	mg/L	2,000	430	79	1,800	700	61	1,900	280	85
VSS	mg/L	2,400	370	85	1,800	640	64	1,800	280	84
Mean Temperature	^{o}C	32	31	-	34	31	-	32	31	-
Wastewater Inflow	ML/day	1.4								
COD Removed	kg/day	2,030			2,660			3,500		

Table 4.2 – Abattoir A Biogas Laboratory Analysis: 24 October – 21 November 2011

Sampling Date	24 Oct 2011		8 Nov 2011		21 Nov 2011	
Parameter	**Result 1**	**Result 2 ^**	**Result 1**	**Result 2**	**Result 1 ^**	**Result 2**
Methane	63.15%	> 54%	54.02%	51.48%	59.0%	62.9%
Carbon dioxide	20.70%	> 18%	27.60%	27.90%	28.2%	32.7%
Oxygen	< 0.3%	3.8%	< 0.3%	< 0.3%	1.25%	0.80%
Ammonia	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm
Nitric Oxide & Nitrogen Dioxide	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm
Nitrous Oxide	< 5 ppm	< 5 ppm	< 5 ppm	< 5 ppm	< 5ppm	< 5ppm
Volatile Petroleum Hydrocarbons	> 15 ppm v/v	15 ppm v/v	> 15 ppm v/v	> 15 ppm v/v	> 15 ppm v/v	> 15ppm v/v
Benzene, Toluene, Ethylbenzene, and Xylene	> 10 ppm	> 10 ppm	> 10 ppm	> 10 ppm	> 10 ppm	> 10 ppm
Carbon Monoxide	20 ppm	16 ppm	3 ppm	3 ppm	4 ppm	4 ppm
Hydrogen Sulphide	> 860 ppm	> 580 ppm	1,200 ppm	1,270 ppm	1,106 ppm	1,335 ppm
Sulphur Dioxide	< 2ppm	< 1ppm	< 2 ppm	< 2ppm	< 1 ppm	< 1 ppm
Total Volatile Fatty Acids	3.81 ppm	3.24 ppm	0.48 ppm	0.53 ppm	0.09 ppm	0.13 ppm
Balance Gases (Nitrogen and Argon)	12.9%	21.4%	15.2%	17.46%	11.4%	3.45%

^ Sample bag suffered a slight leak that may have affected analyte concentration

Table 4.3 – Abattoir A In-situ Biogas Measurements: 24 October – 21 November 2011

Measurement date	**24 Oct 2011**		**8 Nov 2011**		**21 Nov 2011**	
Test Item	**Gas Meter**	**Gastec® Tube**	**Gas Meter**	**Gastec® Tube**	**Gas Meter**	**Gastec® Tube**
Methane	57.4%	-	53.8%		54.5%	-
Carbon dioxide	-	> 14,000 ppm	-	> 7,100 ppm		-
Nitrogen Compounds						
Ammonia	-	not detectable	-	not detectable	-	not detectable
Hydrogen Sulphide	-	1,150 ppm 1,050 ppm	-	920 ppm 940 ppm	-	1,200 ppm 1,300 ppm
Moisture ^	assumed saturated		assumed saturated		assumed saturated	

^ not directly measured. See comment in **Section 4.1.3**

Table 4.4 – Abattoir A Mean Monthly Biogas Flared: 20 September – 22 November 2011

Date	**Mean Biogas Flared (m^3/day)**
20 September – 30 September 2011	1,100
1 October – 31 October 2011	1,530
1 November – 22 November 2011	2,980
Global mean	**1,870**

Courtesy of Abattoir A

4.2.1 Comments on results

Overall, the general findings from wastewater and biogas testing at Abattoir A were as follows:

- The dominant biogas composition was methane, carbon dioxide and balance gases (nitrogen and argon). Methane levels were found to be greater than 60% on two out of the three visits. Of particular interest was the speed at which the methane conversion commenced inside the CAL, with methane production levels of greater than 50% being achieved in the first month (as advised by Abattoir A);
- The significant reduction in COD and BOD levels indicate that the pond was operating well during the sampling period. These levels are likely to further reduce as the pond matures. The peak recorded removal efficiencies across the three visits for COD and BOD were 76% and 81% respectively;
- Hydrogen sulphide levels existed in significant trace quantities, with a peak level measured at 1,335 ppm;
- All other compounds measured in the biogas were found in trace quantities; and
- The mean biogas conversion rate at Abattoir A across all three visits was calculated to be approximately 0.654 m^3 biogas/kg COD removed, equivalent to a methane conversion rate (based on a mean methane composition of 65.3%) of approximately 0.375 m^3 CH_4/kg COD removed .

4.3 Abattoir B Results

Abattoir B was sampled between 21 March 2012 and 17 April 2012. **Table 4.5** summarises wastewater testing results, **Table 4.6** summarises biogas GC analysis testing results, **Table 4.7** summarises in-situ gas measurements collected using the on-site flare meter and Gastec ® detector tubes, and **Table 4.8** summarises the mean daily biogas flared at the site over 16 March 2012 and 17 April 2012.

Table 4.5 – Abattoir B Wastewater Results 21 March 2012 and 17 April 2012

Sampling Date		21 March 2012			3 April 2012			17 April 2012		
Parameter	**Unit**	**Inlet**	**Outlet**	**Removal Efficiency (%)**	**Inlet**	**Outlet**	**Removal Efficiency (%)**	**Inlet**	**Outlet**	**Removal (%)**
BOD_5	mg/L	3,800	630	83	3,600	510	86	3,000	240	92
COD	mg/L	4,400	840	81	3,800	910	76	4,300	670	84
SS	mg/L	1,800	410	77	1,600	470	71	2,200	330	85
VSS	mg/L	1,800	410	77	1,500	420	72	2,100	320	85
Mean Temperature (Slaughtering cycle)	^oC	36.2	29.0	-	34.9	29.6	-	32.3	28.4	-
Mean Temperature (Wash-down cycle)	^oC	-	-	-	29.5	29.9	-	28.2	29.4	-
Wastewater Inflow	ML/day	4.5			4.6			3.8		
COD Removed	kg/day	16,000			13,250			13,730		

Table 4.6 – Abattoir B Biogas Laboratory Analysis 21 March 2012 and 17 April 2012						
Date	**21 March 2012**		**3 April 2012**		**17 April 2012**	
Test Item	**Result 1**	**Result 2**	**Result 1**	**Result 2**	**Result 1**	**Result 2**
Methane	69.22%	70.10%	68.28%	67.16%	67.3%	68.3%
Carbon dioxide	25.90%	26.50%	24.10%	24.10%	23.5%	24.2%
Oxygen	< 0.3%	< 0.3%	< 0.3%	< 0.3%	1.60%	< 0.2%
Ammonia	< 0.1 ppm	< 0.1ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm
Nitric Oxide & Nitrogen Dioxide	< 0.5ppm	< 0.5 ppm	< 0.5 ppm	< 0.5ppm	< 0.5 ppm	< 0.5 ppm
Nitrous Oxide	< 5ppm	< 5 ppm	< 5 ppm	< 5 ppm	< 5 ppm	< 5 ppm
Volatile Petroleum Hydrocarbons	<15 ppm v/v	< 15 ppm v/v	<15 ppm v/v	< 15 ppm v/v	< 15 ppm v/v	< 15 ppm v/v
Benzene, Toluene, Ethylbenzene, and Xylene	< 10 ppm	< 10 ppm	< 10 ppm	< 10 ppm	< 10 ppm	< 10 ppm
Carbon Monoxide	5 ppm	5 ppm	3 ppm	3 ppm	2 ppm	2 ppm
Hydrogen Sulphide	1,404 ppm	1,404 ppm	1,034 ppm	950 ppm	737 ppm	749 ppm
Sulphur Dioxide	< 1 ppm	< 1 ppm	< 1 ppm	< 1 ppm	< 1 ppm	< 1 ppm
Total Volatile Fatty Acids	0.88 ppm	1.12 ppm	1.14 ppm	1.23 ppm	1.33 ppm	1.43 ppm
Balance Gases (Nitrogen and Argon)	4.3%	2.9%	7.2%	8.3%	7.5%	7.2%

Table 4.7 – Abattoir B Biogas In-situ Biogas Measurements: 21 March 2012 – 17 April 2012									
Measurement Date	**21 March 2012**			**3 April 2012**			**17 April 2012**		
On-site Gas Meter	**Low Range**	**Mean**	**Upper Range**	**Low Range**	**Mean**	**Upper Range**	**Low Range**	**Mean**	**Upper Range**
Methane	n/r ^^	n/r ^^	n/r ^^	76.8%	80.1%	82.5%	82.0%	82.5%	83.1%
Oxygen	n/r ^^	n/r ^^	n/r ^^	-	-	-	0%	0%	0%
GasTec® Tubes	**Low Range**	**Mean**	**Upper Range**	**Low Range**	**Mean**	**Upper Range**	**Low Range**	**Mean**	**Upper Range**
Ammonia	not detectable								
Hydrogen Sulphide	1,300 ppm	1,390 ppm	1,600 ppm	1,220 ppm	1,270 ppm	1,300 ppm	810 ppm	895 ppm	965 ppm
Benzene in aromatics	not detectable								
Xylene	-						not detectable		
Sulphur Dioxide	< 0.2 ppm			< 0.2 ppm			< 0.2 ppm		
Toluene	not detectable								
Moisture^	assumed saturated								

^ not directly measured. See comment in **Section 4.1.3**
^^ n/r: not recorded as meters were offline

Table 4.8 – Abattoir B Mean Daily Biogas Flared: 16 March 2012 – 17 April 2012				
Source	**Sampling Date**	**Mean Biogas Flared (m^3/day)**		
The Odour Unit readings	16 March 2012 – 21 March 2012	6,430		
	22 March 2012 – 3 April 2012	5,560		
	4 April 2012 – 17 April 2012	5,950		
Abattoir B readings	30 March 2012 – 17 April 2012	**Lowest flared**	**Mean flared**	**Peak flared**
		2,570	6,310	13,830
Global mean		6,070		

4.3.1 Comments on results

Overall, the general findings from wastewater and biogas testing were as follows:

- The dominant biogas components are methane, carbon dioxide and balance gases (nitrogen and argon). Methane levels were found to be greater than 67% across all visits. Similarly to Abattoir A, of particular interest was the speed at which the methane conversion commenced inside the CAL, with significant methane production levels observed within 4-6 weeks (as advised by Abattoir B);
- The significant reduction in COD and BOD levels indicate that the pond is operating well within the sampling period, with levels likely to further reduce as the pond matures. The peak recorded removal efficiencies across the three (3) visits for COD and BOD were 84% and 92% respectively;
- Hydrogen sulphide levels exist in significant trace quantities, with a peak level measured in-situ at 1,600 ppm. Interestingly, this decreased over the three visits with the lowest recorded measurement at 737 ppm. Notwithstanding this, methane levels remained relatively consistent throughout the three visits;
- All other compounds present in the biogas were in trace quantities;
- The methane levels recorded via the gas meter on-site appears was found to be reading higher than that measured in the laboratory. The reason for was later identified to be due to a malfunction of the meter. This was rectified by Abattoir B who later had advised that measured methane levels were by then consistent with the laboratory findings; and
- The mean biogas conversion rate at Abattoir B across all three was calculated to be approximately 0.625 m^3 biogas/kg COD removed, equivalent to a methane conversion rate (based on a mean methane composition of 68.4%) of approximately 0.428 m^3 CH_4/kg COD removed.

4.4 Abattoir C Results

Abattoir C was sampled between 20 March 2013 and 29 May 2013. **Table 4.9** summarises wastewater testing results, **Table 4.10** summarises biogas GC analysis testing results, **Table 4.11** summarises in-situ gas measurements collected using the on-site flare meter and Gastec ® detector tubes, and **Table 4.12** summarises the mean daily biogas flared at the site over 9 May 2013 and 21 June 2013.

Table 4.9 – Abattoir C Wastewater Testing Results: 20 March 2013 – 29 May 2013

Parameter	Unit	20 March 2013			16 April 2013			29 May 2013		
		Inlet	Outlet	Removal Efficiency (%)	Inlet	Outlet	Removal Efficiency (%)	Inlet	Outlet	Removal Efficiency (%)
BOD_5	mg/L	6,900	1,300	81	3,800	850	78	5,500	1,200	78
COD	mg/L	20,000^	2,500	88	7,800^	1,600	80	13,000^	1,900	85
SS	mg/L	3,200	490	85	1,900	310	84	4,500	380	92
VSS	mg/L	3,100	490	84	1,800	260	86	3,300	250	92
Wastewater Inflow	ML/day	3.041			3.212			3.365		
COD removed	kg/day	53,200			19,900			37,400		

^ accumulation of sludge in CAL inlet sump pit present during sampling

Table 4.10 – Abattoir C Biogas Laboratory Analysis: 20 March 2013 – 29 May 2013

Date	20 March 2013		16 April 2013		29 May 2013
Test Item	Result 1	Result 2	Result 1	Result 2	Result 1
Methane	66%	60%	65%	60%	65%
Carbon dioxide	33%	30%	32%	30%	33%
Oxygen	0.23%	2.2%	0.66%	2.2%	0.44%
Ammonia	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm	< 0.1 ppm
Nitric Oxide & Nitrogen Dioxide	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm	< 0.5 ppm
Nitrous Oxide	< 5ppm	< 5ppm	< 5ppm	< 5ppm	< 5ppm
Volatile Petroleum Hydrocarbons	< 15 ppm v/v	< 15 ppm v/v	< 15 ppm v/v	< 15 ppm v/v	< 15 ppm v/v
Benzene, Ethylbenzene, and Xylene	< 10 ppm	< 10 ppm	< 10 ppm	< 10 ppm	< 10 ppm
Toluene	> 100 ppm	> 100 ppm	> 50 ppm	> 50 ppm	> 100 ppm
Carbon Monoxide	3 ppm	3 ppm	2 ppm	2 ppm	2 ppm
Hydrogen Sulphide	7,650 ppm	6,070 ppm	4,050 ppm	3,070 ppm	3,250 ppm
Methyl Mercaptan	24.6 ppm	19.9 ppm	3.6 ppm	3.3 ppm	3.2 ppm
Sulphur Dioxide	< 1ppm	< 1ppm	< 1 ppm	< 1 ppm	< 1 ppm
Total Volatile Fatty Acids	0.01 ppm	0.02 ppm	0.10 ppm	0.036 ppm	0.06 ppm
Total Siloxanes	< 1ppm	< 1ppm	< 1ppm	< 1ppm	< 1 ppm
Balance Gases(Nitrogen and Argon)	0.8%	7.8%	2.3%	7.8%	1.6%

Table 4.11 – Abattoir C In-situ Biogas Measurements: 20 March 2013 – 29 May 2013									
Measurement Date	**20 March 2013**			**16 April 2013**			**29 May 2013**		
Parameter	**Low Range**	**Mean**	**Upper Range**	**Low Range**	**Mean**	**Upper Range**	**Low Range**	**Mean**	**Upper Range**
On-site Gas Meter									
Methane	55%	62%	69%	51%	58%	67%	69%	70%	71%
GasTec ® Tubes									
Carbon Dioxide	17%	20%	22%	21%	22%	25%	24%	24%	25%
Sulphur Dioxide	< 0.2 ppm			< 0.2 ppm			n/d		
Ammonia	not detectable								
Hydrogen Sulphide	1,800	2,160	2,500	1,375	1,675	2,400	2,850	3,160	3,500
Benzene in aromatics	not detectable								
Xylene	n/m						not detectable		
Toluene	not detectable								
Moisture ^	assumed saturated								

^ not directly measured. See comment in **Section 4.1.3**

Table 4.12 – Abattoir C Mean Daily Biogas Flared at Abattoir C: 9 May – 21 June 2013			
Date	**Mean Biogas Flared (m^3/day)**		
9 May – 31 May 2013	3,150 ^		
1 June – 21 June 2013	3,080 ^^		
9 May – 21 June 2013	**Lowest Flared ^^^**	**Mean Flared**	**Peak Flared**
	467	3,120	5,820

^ 9 May flaring log only represents a 14 hour period
^^ 21 June flaring log only represents a 7 hour period
^^^ excludes days where no flaring occurred i.e. 0 m^3 was recorded (this occurred on 18 & 19 May 2013).

4.4.1 Comments on results

Overall, the general findings from wastewater and biogas testing were as follows:

- The dominant biogas components are methane, carbon dioxide, oxygen and balance gases (nitrogen and argon). Based on the laboratory analysis data, the mean biogas methane composition level was 63%;
- The significant reduction in COD and BOD levels indicate that the pond is operating well from a wastewater treatment viewpoint, with levels likely to further reduce as the pond matures. The peak recorded removal efficiencies across the three (3) visits for COD and BOD were 80% and 79% respectively;
- Hydrogen sulphide levels existed in significant trace quantities, with a peak level measured at 7,650 ppm. The global mean across all recorded measurements was 2,400 ppm;
- All other compounds present in the biogas were measured in trace quantities;
- Methane levels measured by the laboratory and on-site gas meter appears to be consistent;
- The mean biogas conversion rate at Abattoir C across all three visits is approximately 0.219 m^3/kg COD removed, equivalent to a methane conversion rate (based on 63.0% methane) of approximately 0.138 m^3 CH_4/kg COD removed; and
- Based on the above, and in comparison the other conversion rate results in this study, the gas conversion rate result for Abattoir C was lower than expectations. This may due to the greater difficulties experienced by Abattoir C during the commissioning of the CAL system. A follow-up test in several months' time may assist in determining if this result is atypical or representative of other CAL systems in the red meat industry.

5 Discussion

The following section summarise the biogas conversion rates, biogas quality, biogas quantity and suitability of biogas for energy recovery obtained in this research study.

5.1 Biogas conversion rate

Table 5.1 summarises the mean biogas conversion rates derived for each abattoir in this study and compares these to other reported conversion rates found in industries other than red meat processing.

Table 5.1 – Biogas conversion rates as a function of COD removed

Parameter	Abattoir A	Abattoir B	Abattoir C	Dairy (AU)	Flushed Dairy Cattle Manure (USA)	Brewery (Pilot scale)
kg of COD removed / day	2,711	12,080	20,500	-	6,710	-
Volume of biogas flared (m^3/day)	1,770	6,070	3,120	-	3,360	-
Methane composition in biogas (%)	65.3	68.4	63.0	-	70.1	67-79
Biogas conversion rate (m^3/kg COD removed)	0.654	0.625	0.219	-	0.500	0.418-0.44
Methane conversion rate (m^3 CH_4/kg COD removed)	0.375	0.428	0.138	0.35[1]	0.351[2]	0.28-0.35[3]

^ For the purpose of calculating the performance of the biogas conversion rate (m^3/kg of COD removed) of the CAL system, the mean daily logged volume of biogas flared and quantity of COD removed has been used. Complementing the results from sampling and testing in this study, weekly wastewater data supplied by Abattoir C from the period of 20 March to 5 June 2013 has been used in calculating the mean COD available and removed for the CALs. This has generated a result that is considered to be more representative of the CALs performance within the sampling period, due to the extensive nature of abattoir's testing programme.

As shown in **Table 5.1,** the range of biogas conversion across all the sampled abattoirs was from 0.219 to 0.654 m^3 biogas/ kg COD removed, equivalent to a methane conversion rate from 0.138 to 0.428 m^3 CH_4/ kg COD removed, based on a methane composition range from 63 to 68.4% respectively. Based on published values, these results seem to be within reasonable expectations and comparable to other industries that generate biogas from wastewater streams using anaerobic treatment. The exception is Abattoir C which was found to have a lower biogas conversion than the other two abattoirs. This may have been attributed to the on-going optimisation by Abattoir C of the CAL system during sampling period of this study.

5.2 Biogas quality

Table 5.2 summarises the typical biogas composition range values found in this study.

Table 5.2 – Composition of biogas across study

Chemical Parameter	Concentration range	Mean Concentration
Methane	51-83%	64.4%
Carbon dioxide	17-33%	25.7%
Oxygen	< 0.2 – 3.8%	0.91%
Ammonia	Trace	Trace
Nitric Oxide & Nitrogen Dioxide	Trace	Trace
Nitrous Oxide	Trace	Trace
Volatile Petroleum Hydrocarbons	Trace	Trace
Benzene, Ethylbenzene, and Xylene	Trace	Trace
Toluene	Trace	Trace
Carbon Monoxide	Trace	Trace
Hydrogen Sulphide	0.074 - 0.41%^	0.16%
Methyl Mercaptan	Trace	Trace
Sulphur Dioxide	Trace	Trace
Total Volatile Fatty Acids	Trace	Trace
Total Siloxanes	Trace	Trace
Balance Gases (Nitrogen and Argon)	0.8-17.5%	7.1%

^ excludes laboratory analysis measurements for biogas samples collected on 20 March 2013 at Abattoir C, which indicated hydrogen sulphide levels of 6,070 ppm and 7,650 ppm (see **Table 4.10**). These measurements appear to be atypical and localised to that particular sampling event based on the overall results in this study. The reason for the higher than expected hydrogen sulphide levels may be related to the greater difficulties experienced at Abattoir C during commissioning of the CAL system. As such, these measurements were not taken into account in the range.

The primary constituents in the biogas across all three abattoirs in this study were methane and carbon dioxide, with a mean values across the study of 64.4% and 25.7% respectively. Oxygen and balance gases (nitrogen and argon) were also found to be in non-trace quantities, with a mean value across the study of 0.91% and 7.1% respectively. Balance gases were not directly analysed in this study.

Trace quantities of other gas species were measured in the biogas, with a majority below the detectable limit of the measurement/analysis technique used for testing. The trace gas species included ammonia, N_xO & NO_x, carbon monoxide, volatile fatty acids, sulphides (predominately

hydrogen sulphide) and siloxanes. Moisture in the biogas was also present as both water vapour and water droplets, indicating that the biogas stream was saturated.

Of particular interest is the hydrogen sulphide levels and its prevalence in significant trace concentrations in the biogas ranging from 737 to 4,050 ppm across the three abattoirs, corresponding to a global mean of 1,630 ppm. On face value, and for comparison, this range appears to be analogous to biogas produced from swine and dairy manures reported to contain from 300 to 4,500 ppm of hydrogen sulphude[1]. The relevance of hydrogen sulphide in biogas and its associated issues for use in industrial units (such as cogeneration and trigeneration equipment, dryers and boilers) has been extensively reviewed in MLA project code A.ENV.0098 (June 2012), and therefore has been only briefly discussed in this study (see **Section 5.4)**.

5.3 Biogas quantity

Valuable quantities of biogas were found to be flared at the site over the sampling periods, with a mean range of 1,870 to 6,070 m^3 across the three abattoirs. The overall mean volume of biogas flared at the site was 3,690 m^3. Further research work will be required to determine if this quantity is sufficient for use in gas engine operating in an industrial environment.

5.4 CAL system commissioning and steady state conditions

Based on advice provided to The Odour Unit from abattoir personnel, biogas generation was observed at each abattoir within three months after commissioning of the CAL system. During and after this period of time, biogas volume and quality (such as methane content) can vary. This study found that after three months from the commissioning date the CAL system at each abattoir was producing biogas that consisted of methane levels greater than 50%. Further advice from abattoir personnel after the completion of the sampling run in this study revealed that a more consistent volume and methane-rich biogas production was possible once the CAL systems achieved steady state conditions.

5.5 Suitability for energy recovery

The following are preliminary comments on the biogas suitability for energy recovery based on the findings in this study:

- The biogas is rich in methane and at levels that would be considered suitable for energy generation;

- Biogas conditioning is also required to remove water vapour and carbon dioxide;
- It is generally accepted that biogas cleaning to remove hydrogen sulphide will be required if it is to be used in process equipment such as boilers, drier systems and cogeneration or trigeneration plants to prevent damage by acid wear. However The Odour Unit is aware of one large gas engine generator installation in NSW which combusts landfill gas with similarly high hydrogen sulphide levels, without the need for scrubbing to remove this compound;
- Other gas compounds found in the biogas were found trace quantities that would not be considered significant nor potentially problematically if used in a gas-fired engine systems; and
- The efficacy of beneficially using the limited volume of biogas generated will need to be determined on a case-by-case basis. At worst the biogas could be used as a supplementary fuel.

Further data would assist in determining if the results found at Abattoir C are representative of biogas conversion rates and CAL performances in the red meat industry during commissioning stages.

6 References

1 Diary Australia, *Eco-efficiency for Australian dairy processors - Fact sheet 5: Biogas,* August 2004

2 US Environmental Protection Agency, *An evaluation of a covered anaerobic lagoon for flushed dairy cattle manure stabilization and biogas production*, Final report, 17 June 2008

3 Ince, B.K., Ince, O., Anderson, G.K., and Arayici, S. (2001), *Assessment of biogas use as an energy source from anaerobic digestion of brewery wastewater*, Water, Air, and Soil Pollution, 126, 239.

4 Meat & Livestock Australia Limited, A.ENV.0098 - *Review of Biogas Cleaning,* Final report*,* June 2012

Appendices

Appendix 1 – Biogas GC Analysis Laboratory Result Sheets

- Abattoir A – Biogas Laboratory Analysis Result Sheets October 2011 – November 2011
- Abattoir B - Biogas Laboratory Analysis Result Sheets March 2012 – April 2012
- Abattoir C - Biogas Laboratory Analysis Result Sheets March 2013 – May 2013

Abattoir A

Biogas Laboratory Analysis Result Sheets October 2011 – November 2011

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 14024**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**24-October-2011**
		Date Reported:	**21-November-2011**
Type of sample:	**Off Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID **Sample 1** **Sample 2**
89911

Test Item	Method	Result	Result
Sample ID		**89911-1**	**89911-2**
Methane	SGSMC112	63.15%	>54%*
Carbondioxide	SGSMC112	20.70%	>18%*
Oxygen	SGSMC112	<0.3%	3.8%*
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	>15 ppm v/v	>15 ppm v/v
BTEX	SGSMC112	>10ppm	>10ppm
Carbon Monoxide	SGSMC112	20ppm	16ppm*
Hydrogen Sulphide	SGSMC112	>860ppm	>580ppm*
Sulphur Dioxide	SGSMC112	<2ppm	<1ppm*
acetic acid	SGSMC112	0.88ppm	0.81ppm*
propanoic acid	SGSMC112	0.40ppm	0.33ppm*
i-butanoic acid	SGSMC112	0.26ppm	0.21ppm*
butanoic acid	SGSMC112	0.43ppm	0.34ppm*
i-valeric acid	SGSMC112	0.75ppm	0.64ppm*
valeric acid	SGSMC112	0.96ppm	0.81ppm*
i-capric acid	SGSMC112	0.083ppm	0.068ppm*
capric acid	SGSMC112	0.046ppm	0.036ppm*
Total VFA	SGSMC112	3.81ppm	3.24ppm*
Balance (Nitrogen and Argon)	SGSMC112	15.8%	24.1%*

**** NOTE: sample 2 suffered a leak, possibly the result of depressurisation in transit, resulting in a significant air leak, and reduction in analyte concentration***

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 14142**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**08-November-2011**
		Date Reported:	**21-November-2011**
Type of sample:	**Off Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID **Sample 1** **Sample 2**
89980

Test Item	Method	Result	Result
Sample ID		**89980-1**	**89980-2**
Methane	SGSMC112	54.02%	51.48%
Carbondioxide	SGSMC112	27.60%	27.90%
Oxygen	SGSMC112	<0.3%	<0.3%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	>15 ppm v/v	>15 ppm v/v
BTEX	SGSMC112	>10ppm	>10ppm
Carbon Monoxide	SGSMC112	3ppm	3ppm
Hydrogen Sulphide	SGSMC112	1200ppm	1270ppm
Sulphur Dioxide	SGSMC112	<2ppm	<2ppm
acetic acid	SGSMC112	0.29ppm	0.26ppm
propanoic acid	SGSMC112	0.025ppm	0.030ppm
i-butanoic acid	SGSMC112	0.006ppm	<0.005ppm
butanoic acid	SGSMC112	0.082ppm	0.069ppm
i-valeric acid	SGSMC112	0.028ppm	0.011ppm
valeric acid	SGSMC112	0.048ppm	0.155ppm
i-capric acid	SGSMC112	<0.005ppm	<0.005ppm
capric acid	SGSMC112	<0.005ppm	<0.005ppm
Total VFA	SGSMC112	0.48ppm	0.53ppm
Balance (Nitrogen and Argon)	SGSMC112	17.96%	20.19%

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 14239**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**22-November-2011**
		Date Reported:	**28-November-2011**
Type of sample:	**Off Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID		**Sample 1**	**Sample 2**
90048			

Test Item	**Method**	**Result**	**Result**
Sample ID		**90048-1**	**90048-2**
Methane	SGSMC112	59.0%	62.9%
Carbondioxide	SGSMC112	28.2%	32.7%
Oxygen	SGSMC112	1.25%	0.80%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	>15 ppm v/v	>15 ppm v/v
BTEX	SGSMC112	>10ppm	>10ppm
Carbon Monoxide	SGSMC112	4ppm	4ppm
Hydrogen Sulphide	SGSMC112	1106ppm	1335ppm
Sulphur Dioxide	SGSMC112	<1ppm	<1ppm
acetic acid	SGSMC112	0.08ppm	0.11ppm
propanoic acid	SGSMC112	0.01ppm	0.02ppm
i-butanoic acid	SGSMC112	<0.005ppm	<0.005ppm
butanoic acid	SGSMC112	<0.005ppm	<0.005ppm
i-valeric acid	SGSMC112	<0.005ppm	<0.005ppm
valeric acid	SGSMC112	<0.005ppm	<0.005ppm
i-capric acid	SGSMC112	<0.005ppm	<0.005ppm
capric acid	SGSMC112	<0.005ppm	<0.005ppm
Total VFA	SGSMC112	0.09ppm	0.13ppm
Balance (Nitrogen and Argon)	SGSMC112	11.4%	3.45%

**** NOTE: sample 1 has suffered a minor air leak in transit, possibly the result of a small pin-hole leak in the sample bag, causing a reduction in analyte concentration***

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

Abattoir B

Biogas Laboratory Analysis Result Sheets March 2012 – April 2012

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 15141**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**22-March-2012**
		Date Reported:	**02-April-2012**
Type of sample:	**Bio-Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID
90364 **Sample 1** **Sample 2**

Test Item	Method	Result	Result
Sample ID		**90364-1**	**90364-2**
Methane	SGSMC112	69.22%	70.10%
Carbondioxide	SGSMC112	25.90%	26.50%
Oxygen	SGSMC112	<0.3%	<0.3%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	>15 ppm v/v	>15 ppm v/v
BTEX	SGSMC112	>10ppm	>10ppm
Carbon Monoxide	SGSMC112	5ppm	5ppm
Hydrogen Sulphide	SGSMC112	1404ppm	1404ppm
Sulphur Dioxide	SGSMC112	<1ppm	<1ppm
acetic acid	SGSMC112	0.38ppm	0.44ppm
propanoic acid	SGSMC112	0.20ppm	0.23ppm
i-butanoic acid	SGSMC112	0.15ppm	0.16ppm
butanoic acid	SGSMC112	0.10ppm	0.11ppm
i-valeric acid	SGSMC112	0.075ppm	0.08ppm
valeric acid	SGSMC112	0.06ppm	0.07ppm
i-capric acid	SGSMC112	0.023ppm	0.018ppm
capric acid	SGSMC112	0.016ppm	0.015ppm
Total VFA	SGSMC112	0.88ppm	1.12ppm
Balance (Nitrogen and Argon)	SGSMC112	4.3%	2.90%

NOTEs

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 15169**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**04-April-2012**
		Date Reported:	**11-April-2012**
Type of sample:	**Bio-Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID
90384 **Sample 1** **Sample 2**

Test Item	Method	Result	Result
Sample ID		**90384-1**	**90384-2**
Methane	SGSMC112	68.28%	67.16%
Carbondioxide	SGSMC112	24.10%	24.10%
Oxygen	SGSMC112	<0.3%	<0.3%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	<15 ppm v/v	<15 ppm v/v
BTEX	SGSMC112	<10ppm	<10ppm
Carbon Monoxide	SGSMC112	3ppm	3ppm
Hydrogen Sulphide	SGSMC112	1034ppm	950ppm
Sulphur Dioxide	SGSMC112	<1ppm	<1ppm
acetic acid	SGSMC112	0.48ppm	0.54ppm
propanoic acid	SGSMC112	0.23ppm	0.24ppm
i-butanoic acid	SGSMC112	0.16ppm	0.17ppm
butanoic acid	SGSMC112	0.10ppm	0.10ppm
i-valeric acid	SGSMC112	0.075ppm	0.08ppm
valeric acid	SGSMC112	0.06ppm	0.06ppm
i-capric acid	SGSMC112	0.021ppm	0.020ppm
capric acid	SGSMC112	0.016ppm	0.015ppm
Total VFA	SGSMC112	1.14ppm	1.23ppm
Balance (Nitrogen and Argon)	SGSMC112	7.2%	8.3%

NOTEs

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 15245**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**18-April-2012**
		Date Reported:	**23-April-2012**
Type of sample:	**Bio-Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID **Sample 1** **Sample 2**
107454

Test Item	Method	Result	Result
Sample ID		**107454-1**	**107454-2**
Methane	SGSMC112	67.3%	68.3%
Carbondioxide	SGSMC112	23.5%	24.2%
Oxygen	SGSMC112	1.60%	<0.2%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	<15 ppm v/v	<15 ppm v/v
BTEX	SGSMC112	<10ppm	<10ppm
Carbon Monoxide	SGSMC112	2ppm	2ppm
Hydrogen Sulphide	SGSMC112	737ppm	749ppm
Sulphur Dioxide	SGSMC112	<1ppm	<1ppm
acetic acid	SGSMC112	0.58ppm	0.64ppm
propanoic acid	SGSMC112	0.27ppm	0.29ppm
i-butanoic acid	SGSMC112	0.18ppm	0.19ppm
butanoic acid	SGSMC112	0.11ppm	0.12ppm
i-valeric acid	SGSMC112	0.08ppm	0.08ppm
valeric acid	SGSMC112	0.07ppm	0.07ppm
i-capric acid	SGSMC112	0.02ppm	0.02ppm
capric acid	SGSMC112	0.02ppm	0.022ppm
Total VFA	SGSMC112	1.33ppm	1.43ppm
Balance (Nitrogen and Argon)	SGSMC112	7.5%	7.2%

NOTEs

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

Abattoir C

Biogas Laboratory Analysis Result Sheets March 2013 – May 2013

ANALYTICAL REPORT

Customer:	The Odour Unit Pty Ltd
Attention:	Michael Assal
Your Reference:	Investigation of digester gases
SGS Report Number:	ENV 17578

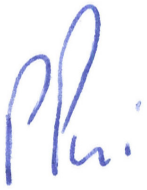
Date of Receipt of Samples: 21 March 2013

The work has been carried out in accordance with your instructions. The results and associated information are contained in the following pages of the report. Should you have any queries regarding this report please contact the undersigned.

Reported by: Dr David Stone

Date: ___4/4/2013_____

Report authorised by: Dr Paul Pui



Date: ___5/4/2013_____

1. Background

Two samples of process gas (in 10-litre Tedlar gas sample bags) were delivered to SGS by TOU. The list of samples appears below. The scope of this investigation is to determine the nature of any sulphur-containing gases, and major VOCs in the process gas .

2.1 Sample description

Sample	Description		Material Type
1	MLA Biogas #1	21 March, 2013	process gas
2	MLA Biogas #2	21 March, 2013	process gas

2.2 Sample preparation prior to analysis:

No preparation was required, the gases are sampled directly. Blank analyses were run between samples to avoid any possibility of contamination from one sample to affect the result for another.

For Sulphur gases hydrocarbons 250 or 10 microlitre of gas was directly injected onto a Gas Chromatograph with Sulphur Chemi-luminescence detector (GC-SCD) using a syringe.
For volatile organic compounds, the process gases were trapped onto a clean thermal desorbtion tube using a syringe, and thermally desorbed, using method US EPA TO-17.

Major gases were determined using 10 microlitre of gas directly injected onto a Gas Chromatograph with thermal conductivity detector (GC-TCD)

3. Preliminary laboratory examinations

Because of the reactive nature of the samples, the samples were analysed for all analytes including Volatile Organic Compounds (VOCs) within 24 hours of arrival.

4. Analytical Spectroscopic Results

4.1 Table 1. GC-TCD examination of process gases

	Sample 1	Sample 2
analyte	Concentration (%)	
methane	66%	60%
carbon dioxide	33%	30%
air	1%	10%

4.2 Table 2. GC-SCD examination of process gases

	Sample 1	Sample 2
analyte	Concentration (ppm)	
hydrogen sulphide	7,650	6,070
carbonyl sulphide	0.8	0.07
methyl mercaptan	24.6	19.9
ethyl mercaptan	0.047	0.043
i-propyl mercaptan	0.019	0.017

propyl mercaptan	0.015	0.013
dimethyl sulphide	1.43	1.29
dimethyl disulphide	0.94	0.87
ethylmethyl disulphide	<0.03	<0.03
carbon disulphide	0.22	0.19

4.3 Table 3. GC-MS examination of process gases

	Sample 1	Sample 2
analyte	Concentration (ppb)	
i-butane	<0.6	<0.6
butane	<0.6	<0.6
i-pentane	<0.6	<0.6
pentane	27.4	24.7
hexanes	23.6	17.2
heptane	29.4	25.4
octane	162	142
nonane	442	438
decane	969	988
undecane	300	326
dodecane	18.2	21.8
tridecane	10.1	11.3
tetradecane	2.5	4.0
pentadecane	<0.6	1.6
benzene	10.3	11.2
toluene	>100ppm	>100ppm
ethylbenzene	25.3	20.8
m,p-xylenes	69.8	64.8
o-xylene	66.1	58.7
C3-alkylbenzenes	1080	1050
naphthalene	19.8	19.1

4.4 Table 4. Siloxanes in process gases by TD-GC-MS

	Sample 1	Sample 2
analyte	Concentration (ppb)	
hexamethyl cyclotrisiloxane	9.4	7.5
octamethyl cyclotetrasiloxane	6.7	6.4
decamethyl cyclopentasiloxane	13.6	6.6
dodecamethyl cyclohexasiloxane	210	169
tetradecamethyl cycloheptasiloxane	121	137
hexadecamethyl cyclooctasiloxane	15.2	17.3

5. Conclusions

This is a biogas with high amounts of H2S and methyl mercaptan, but relatively low amounts of the other common VOCs and siloxanes.

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 17578**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**21-March-2013**
		Date Reported:	**04-April-2013**
Type of sample:	**Bio-Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID			
116245		**Sample 1**	**Sample 2**

Test Item	**Method**	**Result**	**Result**
Sample ID		**116245-1**	**116245-2**
Methane	SGSMC112	66.0%	60.0%
Carbondioxide	SGSMC112	33.0%	30.0%
Oxygen	SGSMC112	0.23%	2.2%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	<15 ppm v/v	<15 ppm v/v
BTEX	SGSMC112	<10ppm	<10ppm
Carbon Monoxide	SGSMC112	3ppm	3ppm
Hydrogen Sulphide	SGSMC112	7650ppm	6070ppm
Sulphur Dioxide	SGSMC112	<1ppm	<1ppm
acetic acid	SGSMC112	0.01ppm	0.02ppm
propanoic acid	SGSMC112	<0.005ppm	<0.005ppm
i-butanoic acid	SGSMC112	<0.005ppm	<0.005ppm
butanoic acid	SGSMC112	<0.005ppm	<0.005ppm
i-valeric acid	SGSMC112	<0.005ppm	<0.005ppm
valeric acid	SGSMC112	<0.005ppm	<0.005ppm
i-capric acid	SGSMC112	<0.005ppm	<0.005ppm
capric acid	SGSMC112	<0.005ppm	<0.005ppm
Total VFA	SGSMC112	0.01ppm	0.02ppm
Balance (Nitrogen and Argon)	SGSMC112	0.8%	7.8%

NOTES:

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

ANALYTICAL REPORT

Customer:	The Odour Unit Pty Ltd
Attention:	Michael Assal
Your Reference:	Investigation of digester gases
SGS Report Number:	ENV 17734

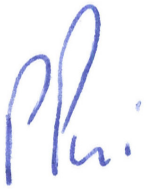
Date of Receipt of Samples: 17 April 2013

The work has been carried out in accordance with your instructions. The results and associated information are contained in the following pages of the report. Should you have any queries regarding this report please contact the undersigned.

Reported by: Dr David Stone

Date: ___24/4/2013_____

Report authorised by: Dr Paul Pui



Date: ___29/4/2013_____

1. Background

Two samples of process gas (in 10-litre Tedlar gas sample bags) were delivered to SGS by TOU. The list of samples appears below. The scope of this investigation is to determine the nature of any sulphur-containing gases, and major VOCs in the process gas .

2.1 Sample description

Sample	Description		Material Type
1	MLA Biogas #1	17 April, 2013	process gas
2	MLA Biogas #2	17 April, 2013	process gas

2.2 Sample preparation prior to analysis:

No preparation was required, the gases are sampled directly. Blank analyses were run between samples to avoid any possibility of contamination from one sample to affect the result for another.

For Sulphur gases hydrocarbons 250 or 10 microlitre of gas was directly injected onto a Gas Chromatograph with Sulphur Chemi-luminescence detector (GC-SCD) using a syringe.
For volatile organic compounds, the process gases were trapped onto a clean thermal desorbtion tube using a syringe, and thermally desorbed, using method US EPA TO-17.

Major gases were determined using 10 microlitre of gas directly injected onto a Gas Chromatograph with thermal conductivity detector (GC-TCD)

3. Preliminary laboratory examinations

Because of the reactive nature of the samples, the samples were analysed for all analytes including Volatile Organic Compounds (VOCs) within 24 hours of arrival.

4. Analytical Spectroscopic Results

4.1 Table 1. GC-TCD examination of process gases

	Sample 1	Sample 2
analyte	Concentration (%)	
methane	65%	60%
carbon dioxide	32%	30%
air	3%	10%

4.2 Table 2. GC-SCD examination of process gases

	Sample 1	Sample 2
analyte	Concentration (ppm)	
hydrogen sulphide	4,050	3,070
carbonyl sulphide	0.43	0.37
methyl mercaptan	3.6	3.3
ethyl mercaptan	0.040	0.035
i-propyl mercaptan	0.012	0.011

propyl mercaptan	0.010	0.008
dimethyl sulphide	0.43	0.29
dimethyl disulphide	0.54	0.37
ethylmethyl disulphide	<0.03	<0.03
carbon disulphide	0.077	0.254

4.3 Table 3. GC-MS examination of process gases

	Sample 1	Sample 2
analyte	Concentration (ppb)	
i-butane	1.1	0.9
butane	<0.5	<0.5
i-pentane	7.4	1.7
pentane	30.4	30.8
hexanes	44.2	39.9
heptane	81.9	50.6
octane	403	301
nonane	723	562
decane	2,563	2,074
undecane	1,216	955
dodecane	116	43.0
tridecane	21.2	8.4
tetradecane	9.6	4.3
pentadecane	11.3	6.5
benzene	30.2	14.3
toluene	>50ppm	>50ppm
ethylbenzene	44.9	22.3
m,p-xylenes	168	69.2
o-xylene	141	70.2
C3-alkylbenzenes	2,024	1,777
naphthalene	36.0	5.1

4.4 Table 4. Siloxanes in process gases by TD-GC-MS

	Sample 1	Sample 2
analyte	Concentration (ppb)	
hexamethyl cyclotrisiloxane	60.6	13.6
octamethyl cyclotetrasiloxane	20.7	10.4
decamethyl cyclopentasiloxane	57.8	7.3
dodecamethyl cyclohexasiloxane	547	35.9
tetradecamethyl cycloheptasiloxane	120	63.7
hexadecamethyl cyclooctasiloxane	12.1	11.1

5. Conclusions

This is a biogas with high amounts of H2S and methyl mercaptan, but relatively low amounts of the other common VOCs and siloxanes.

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 17734**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**17-April-2013**
		Date Reported:	**24-April-2013**
Type of sample:	**Bio-Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID			
116885		**Sample 1**	**Sample 2**

Test Item	**Method**	**Result**	**Result**
Sample ID		**116885-1**	**116885-2**
Methane	SGSMC112	65.0%	60.0%
Carbondioxide	SGSMC112	32.0%	30.0%
Oxygen	SGSMC112	0.66%	2.2%
Nitrogen Compounds			
Ammonia	SGSMC112	<0.1ppm	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	<15 ppm v/v	<15 ppm v/v
BTEX	SGSMC112	<10ppm	<10ppm
Carbon Monoxide	SGSMC112	2ppm	2ppm
Hydrogen Sulphide	SGSMC112	4050ppm	3070ppm
Sulphur Dioxide	SGSMC112	<1ppm	<1ppm
acetic acid	SGSMC112	0.10ppm	0.036ppm
propanoic acid	SGSMC112	<0.005ppm	<0.005ppm
i-butanoic acid	SGSMC112	<0.005ppm	<0.005ppm
butanoic acid	SGSMC112	<0.005ppm	<0.005ppm
i-valeric acid	SGSMC112	<0.005ppm	<0.005ppm
valeric acid	SGSMC112	<0.005ppm	<0.005ppm
i-capric acid	SGSMC112	<0.005ppm	<0.005ppm
capric acid	SGSMC112	<0.005ppm	<0.005ppm
Total VFA	SGSMC112	0.10ppm	0.036ppm
Balance (Nitrogen and Argon)	SGSMC112	2.3%	7.8%

NOTES:

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

ANALYTICAL REPORT

Customer:	The Odour Unit Pty Ltd
Attention:	Michael Assal
Your Reference:	Investigation of digester gases
SGS Report Number:	ENV 18031

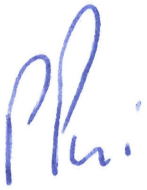
Date of Receipt of Samples: 30th May 2013

The work has been carried out in accordance with your instructions. The results and associated information are contained in the following pages of the report. Should you have any queries regarding this report please contact the undersigned.

Reported by: Dr David Stone

Date: ___4/6/2013_____

Report authorised by: Dr Paul Pui



Date: ___5/6/2013_____

1. Background

One sample of process gas (in 10-litre Tedlar gas sample bags) was delivered to SGS by TOU.
The list of samples appears below. The scope of this investigation is to determine the nature of any sulphur-containing gases, and major VOCs in the process gas .

2.1 Sample description

Sample	Description		Material Type
1	MLA Biogas #1	29 May, 2013	process gas

2.2 Sample preparation prior to analysis:

No preparation was required, the gases are sampled directly. Blank analyses were run between samples to avoid any possibility of contamination from one sample to affect the result for another.

For Sulphur gases hydrocarbons 250 or 10 microlitre of gas was directly injected onto a Gas Chromatograph with Sulphur Chemi-luminescence detector (GC-SCD) using a syringe.
For volatile organic compounds, the process gases were trapped onto a clean thermal desorbtion tube using a syringe, and thermally desorbed, using method US EPA TO-17.

Major gases were determined using 10 microlitre of gas directly injected onto a Gas Chromatograph with thermal conductivity detector (GC-TCD)

3. Preliminary laboratory examinations

Because of the reactive nature of the samples, the samples were analysed for all analytes including Volatile Organic Compounds (VOCs) within 24 hours of arrival.

4. Analytical Spectroscopic Results

4.1 Table 1. GC-TCD examination of process gases

	Sample 1
analyte	Concentration (%)
methane	65%
carbon dioxide	33%
air	2%

4.2 Table 2. GC-SCD examination of process gases

	Sample 1
analyte	Concentration (ppm)
hydrogen sulphide	3,250
carbonyl sulphide	0.33
methyl mercaptan	3.2
ethyl mercaptan	0.03
i-propyl mercaptan	0.01
propyl mercaptan	0.01

dimethyl sulphide	0.23
dimethyl disulphide	0.34
ethylmethyl disulphide	<0.03
carbon disulphide	0.061

4.3 Table 3. GC-MS examination of process gases

	Sample 1
analyte	Concentration (ppb)
i-butane	<0.5
butane	<0.5
i-pentane	1.9
pentane	14.6
hexanes	37.2
heptane	22.1
octane	97.3
nonane	617
decane	425
undecane	82.9
dodecane	4.6
tridecane	0.7
tetradecane	0.3
pentadecane	<0.3
benzene	8.6
toluene	>100ppm
ethylbenzene	12.4
m,p-xylenes	25.7
o-xylene	22.5
C3-alkylbenzenes	187
naphthalene	0.7

4.4 Table 4. Siloxanes in process gases by TD-GC-MS

	Sample 1
analyte	Concentration (ppb)
hexamethyl cyclotrisiloxane	57.0
octamethyl cyclotetrasiloxane	37.8
decamethyl cyclopentasiloxane	29.4
dodecamethyl cyclohexasiloxane	19.6
tetradecamethyl cycloheptasiloxane	37.3
hexadecamethyl cyclooctasiloxane	7.4

5. Conclusions

This is a biogas with high amounts of H2S and methyl mercaptan, but relatively low amounts of the other common VOCs and siloxanes.

CERTIFICATE OF ANALYSIS

Client's Name:	**Odour Unit**	Report No:	**ENV 18031**
Contact:	**Michael Assal**	Client Ref No:	**N/A**
Site:	**MLA, NSW**	Date Received:	**30-May-2013**
		Date Reported:	**04-June-2013**
Type of sample:	**Bio-Gas**	Sampled by:	**N/A**
Container:	**Tedlar Bag**	Page:	**1 of 1**

Item: **Analysis of Biogas**

SGS Lab ID
117977 **Sample 1**

Test Item	Method	Result
Sample ID		**117997-1**
Methane	SGSMC112	65.0%
Carbondioxide	SGSMC112	33.0%
Oxygen	SGSMC112	0.44%
Nitrogen Compounds		
Ammonia	SGSMC112	<0.1ppm
Nitric Oxide & Nitrogen dioxide	SGSMC112	<0.5ppm
Nitrous Oxide	SGSMC112	<5ppm
Volatile Petroleum Hydrocarbons	SGSMC112	<15 ppm v/v
BTEX	SGSMC112	<10ppm
Carbon Monoxide	SGSMC112	2ppm
Hydrogen Sulphide	SGSMC112	3250ppm
Sulphur Dioxide	SGSMC112	<1ppm
acetic acid	SGSMC112	0.06ppm
propanoic acid	SGSMC112	<0.005ppm
i-butanoic acid	SGSMC112	<0.005ppm
butanoic acid	SGSMC112	<0.005ppm
i-valeric acid	SGSMC112	<0.005ppm
valeric acid	SGSMC112	<0.005ppm
i-capric acid	SGSMC112	<0.005ppm
capric acid	SGSMC112	<0.005ppm
Total VFA	SGSMC112	0.06ppm
Balance (Nitrogen and Argon)	SGSMC112	1.6%

NOTES:

For: SGS Australia Pty. Ltd.

Dr David Stone PhD (cantab) MRACI CChem
Senior Chemist

Appendix 2 – Wastewater Analysis Laboratory Result Sheets

- Abattoir A – Wastewater Laboratory Result Sheets October 2011 – November 2011
- Abattoir B - Wastewater Laboratory Result Sheets March 2012 – April 2012
- Abattoir C - Wastewater Laboratory Result Sheets March 2013 – May 2013

Abattoir A

Wastewater Laboratory Result Sheets October 2011 – November 2011

mgt LabMark
ENVIRONMENTAL LABORATORIES

Certificate of Analysis

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: Michael Assal

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Report	316338-W-V1
Client Reference	WASTEWATER ANALYSIS
Received Date	Oct 24, 2011

Client Sample ID			**INLET:**	**OUTLET:**
			0820-1225	**0823-1235**
Sample Matrix			**Water**	**Water**
mgt-LabMark Sample No.			**S11-Oc12865**	**S11-Oc12866**
Date Sampled			**Oct 24, 2011**	**Oct 24, 2011**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	2700	980
Chemical Oxygen Demand (COD)	5	mg/L	2200	750
Suspended Solids	5	mg/L	2000	430
Volatile Suspended Solids	5	mg/L	2400	370

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day) - Method: 4050-4051 BOD	Sydney	Oct 25, 2011	2 Day
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Oct 31, 2011	28 Day
Suspended Solids - Method: 4100 Total Suspended Solids	Sydney	Oct 27, 2011	7 Day
Volatile Suspended Solids - Method: 4100 Total Volatile Suspended Solids	Sydney	Oct 31, 2011	7 Day

mgt LabMark
ENVIRONMENTAL LABORATORIES
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NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street EVELEIGH NSW 2015

Order No.:
Report #: 316338
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Oct 24, 2011 4:10 PM
Due: Nov 1, 2011 4:00 PM
Priority: 5 Day
Contact name: Michael Assal

Client Job No.: WASTEWATER ANALYSIS

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site #1261								
Sydney Laboratory - NATA Site #1645					X	X	X	X
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
INLET	Oct 24, 2011		Water	S11-Oc12865	X	X	X	X
OUTLET	Oct 24, 2011		Water	S11-Oc12866	X	X	X	X

mgt-LabMark Internal Quality Control Review

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis.
7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001)

For samples received on the last day of holding time, notification of testing requirements should have been received at least

6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as an RPD

UNITS

mg/kg:milligrams per Kilogram

mg/L:milligrams per litre

µg/L:micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%:Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

TERMS

Dry:	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR:	Limit Of Reporting.
SPIKE:	Addition of the analyte to the sample and reported as percentage recovery.
RPD:	Relative Percent Difference between two Duplicate pieces of analysis.
LCS:	Laboratory Control Sample - reported as percent recovery.
CRM:	Certified Reference Material - reported as percent recovery.
Method Blank:	In the case of solid samples these are performed on laboratory certified clean sands.
	In the case of water samples these are performed on de-ionised water.
Surr - Surrogate:	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate:	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate:	A second piece of analysis from a sample outside of the client's batch of samples but run within the laboratory batch of analysis.
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USEPA:	U.S Environmental Protection Agency
APHA:	American Public Health Association
ASLP:	Australian Standard Leaching Procedure (AS4439.3)
TCLP:	Toxicity Characteristic Leaching Procedure
COC:	Chain Of Custody
SRA:	Sample Receipt Advice
CP:	Client Parent - QC was performed on samples pertaining to this report
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QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

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Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample>
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data below the LOR with a positive RPD - eg: LOR 0.1, Result A = <0.1 (raw data is 0.02) & Result B = <0.1 (raw data is 0.03) resulting in a RPD of 40% calculated from the raw data.

mgt LabMark
ENVIRONMENTAL LABORATORIES

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Suspended Solids	%	99			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	N11-Oc11945	NCP	mg/L	6.4	5.9	8	30%	Pass	
Chemical Oxygen Demand (COD)	S11-Oc13522	NCP	mg/L	760	750	1	30%	Pass	
Suspended Solids	S11-Oc12865	CP	mg/L	2000	1800	7	30%	Pass	
Volatile Suspended Solids	S11-Oc12865	CP	mg/L	2400	2400	1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Onur Mehmet Client Services

NATA Signatories:

Bob Symons Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

mgt LabMark
ENVIRONMENTAL LABORATORIES

Certificate of Analysis

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: Michael Assal

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Report	317836-W
Client Reference	WASTE WATER ANALYSIS
Received Date	Nov 08, 2011

Client Sample ID			**INLET**	**OUTLET**
Sample Matrix			**Water**	**Water**
mgt-LabMark Sample No.			**S11-No04831**	**S11-No04832**
Date Sampled			**Nov 08, 2011**	**Nov 08, 2011**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	750	330
Chemical Oxygen Demand (COD)	5	mg/L	3200	1300
Suspended Solids	5	mg/L	1800	700
Volatile Suspended Solids	5	mg/L	1800	640

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day) - Method: 4050-4051 BOD	Sydney	Nov 09, 2011	2 Day
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Nov 11, 2011	28 Day
Suspended Solids - Method: 4100 Total Suspended Solids	Sydney	Nov 09, 2011	7 Day
Volatile Suspended Solids - Method: 4100 Total Volatile Suspended Solids	Sydney	Nov 10, 2011	7 Day

mgt LabMark
ENVIRONMENTAL LABORATORIES
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NATA # 1261 & 1645
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 8215 6222
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street EVELEIGH NSW 2015

Order No.:
Report #: 317836
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Nov 8, 2011 4:45 PM
Due: Nov 16, 2011 4:00 PM
Priority: 5 Day
Contact name: Michael Assal

Client Job No.: WASTE WATER ANALYSIS

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site #1261								
Sydney Laboratory - NATA Site #1645					X	X	X	X
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
INLET	Nov 08, 2011		Water	S11-No04831	X	X	X	X
OUTLET	Nov 08, 2011		Water	S11-No04832	X	X	X	X

mgt-LabMark Internal Quality Control Review

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mgt LabMark
ENVIRONMENTAL LABORATORIES

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Chemical Oxygen Demand (COD)	%	98			70-130	Pass	
Suspended Solids	%	92			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	S11-No05007	NCP	mg/L	11	12	7.0	30%	Pass	
Chemical Oxygen Demand (COD)	S11-No05396	NCP	mg/L	420	420	<1	30%	Pass	
Suspended Solids	N11-No04446	NCP	mg/L	< 5	5.5	20	30%	Pass	
Volatile Suspended Solids	S11-No04831	CP	mg/L	1800	1700	4.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Onur Mehmet Client Services

NATA Signatories:

Bob Symons Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

mgt LabMark
ENVIRONMENTAL LABORATORIES

Certificate of Analysis

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: Michael Assal

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Report	319357-W
Client Reference	WATE WATER ANALYSIS
Received Date	Nov 22, 2011

Client Sample ID			**INLET**	**OUTLET**
Sample Matrix			**Water**	**Water**
mgt-LabMark Sample No.			**S11-No13613**	**S11-No13614**
Date Sampled			**Nov 22, 2011**	**Nov 22, 2011**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	3200	450
Chemical Oxygen Demand (COD)	5	mg/L	3500	1000
Suspended Solids	5	mg/L	1900	280
Volatile Suspended Solids	5	mg/L	1800	280

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day) - Method: 4050-4051 BOD	Sydney	Nov 23, 2011	2 Day
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Nov 25, 2011	28 Day
Suspended Solids - Method: 4100 Total Suspended Solids	Sydney	Nov 23, 2011	7 Day
Volatile Suspended Solids - Method: 4100 Total Volatile Suspended Solids	Sydney	Nov 23, 2011	7 Day

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Melbourne
3-5 Kingston Town Close
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Phone : +61 3 9564 7055
NATA # 1261 & 1645
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 8215 6222
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street EVELEIGH NSW 2015

Order No.:
Report #: 319357
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Nov 22, 2011 6:00 PM
Due: Nov 30, 2011 4:00 PM
Priority: 5 Day
Contact name: Michael Assal

Client Job No.: WATE WATER ANALYSIS

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site #1261								
Sydney Laboratory - NATA Site #1645					X	X	X	X
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
INLET	Nov 22, 2011		Water	S11-No13613	X	X	X	X
OUTLET	Nov 22, 2011		Water	S11-No13614	X	X	X	X

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mgt LabMark
ENVIRONMENTAL LABORATORIES

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Chemical Oxygen Demand (COD)	%	100			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	S11-No13613	CP	mg/L	3200	3000	4	30%	Pass	
Chemical Oxygen Demand (COD)	S11-No13613	CP	mg/L	3500	3400	2	30%	Pass	

Comments

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Custody Seals Intact (if used)	N/A
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Organic samples had Teflon liners	Yes
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Abattoir B

Wastewater Laboratory Result Sheets March 2012 – April 2012

mgt LabMark
ENVIRONMENTAL LABORATORIES

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NSW 2015

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Report	331155-W
Client Reference	WASTE WATER ANALYSIS
Received Date	Mar 22, 2012

Client Sample ID			**WW OUTLET**	**WW INLET**
Sample Matrix			**Water**	**Water**
mgt-LabMark Sample No.			**S12-Ma13988**	**S12-Ma13989**
Date Sampled			**Mar 21, 2012**	**Mar 21, 2012**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	630	3800
Chemical Oxygen Demand (COD)	5	mg/L	840	2500
Suspended Solids	5	mg/L	410	1800
Volatile Suspended Solids	5	mg/L	410	1800

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Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day) - Method: 4050-4051 BOD	Sydney	Mar 22, 2012	2 Day
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Mar 22, 2012	28 Day
Suspended Solids - Method: 4100 Total Suspended Solids	Sydney	Mar 22, 2012	7 Day
Volatile Suspended Solids - Method: 4100 Total Volatile Suspended Solids	Sydney	Mar 22, 2012	7 Day

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ENVIRONMENTAL LABORATORIES
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Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 9564 7055
NATA # 1261
Site # 1254

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 8215 6222
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Order No.:
Report #: 331155
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Mar 22, 2012 10:45 AM
Due: Mar 29, 2012 4:00 PM
Priority: 5 Day
Contact name: Michael Assal

Client Job No.:
WASTE WATER ANALYSIS

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217					X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
External Laboratory								
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
WW OUTLET	Mar 21, 2012		Water	S12-Ma13988	X	X	X	X
WW INLET	Mar 21, 2012		Water	S12-Ma13989	X	X	X	X

mgt-LabMark Internal Quality Control Review

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis.
7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001)

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6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment

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Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as an RPD

UNITS

mg/kg:milligrams per Kilogram

mg/L:milligrams per litre

µg/L:micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%:Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 milliltres

TERMS

Dry:	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR:	Limit Of Reporting.
SPIKE:	Addition of the analyte to the sample and reported as percentage recovery.
RPD:	Relative Percent Difference between two Duplicate pieces of analysis.
LCS:	Laboratory Control Sample - reported as percent recovery.
CRM:	Certified Reference Material - reported as percent recovery.
Method Blank:	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate:	The addition of a like compound to the analyte target and reported as percentage recovery.
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APHA:	American Public Health Association
ASLP:	Australian Standard Leaching Procedure (AS4439.3)
TCLP:	Toxicity Characteristic Leaching Procedure
COC:	Chain Of Custody
SRA:	Sample Receipt Advice
CP:	Client Parent - QC was performed on samples pertaining to this report
NCP:	Non-Client Parent - QC was performed on samples not pertaining to this report, however QC is representative of the sequence or batch that client samples were analysed within

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

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Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample>
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data below the LOR with a positive RPD - eg: LOR 0.1, Result A = <0.1 (raw data is 0.02) & Result B = <0.1 (raw data is 0.03) resulting in a RPD of 40% calculated from the raw data.

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Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Chemical Oxygen Demand (COD)	%	96			70-130	Pass	
Suspended Solids	%	97			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	S12-Ma13988	CP	mg/L	630	630	<1	30%	Pass	
Chemical Oxygen Demand (COD)	S12-Ma12666	NCP	mg/L	160	160	2.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Suspended Solids	S12-Ma13989	CP	mg/L	1800	1800	3.0	30%	Pass	
Volatile Suspended Solids	S12-Ma13989	CP	mg/L	1800	1700	4.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Onur Mehmet	Client Services
Bob Symons	Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

mgt LabMark
ENVIRONMENTAL LABORATORIES

Certificate of Analysis

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: Michael Assal

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Report	331840-W
Client Reference	RE TEST: WASTE WATER ANALYSIS
Received Date	Mar 27, 2012

Client Sample ID			**WW INLET**
Sample Matrix			**Water**
mgt-LabMark Sample No.			**S12-Ma18800**
Date Sampled			**Mar 21, 2012**
Test/Reference	LOR	Unit	
Chemical Oxygen Demand (COD)	5	mg/L	4400

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Mar 28, 2012	28 Day

mgt LabMark
ENVIRONMENTAL LABORATORIES
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Melbourne
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NATA # 1261
Site # 1254

Sydney
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Lane Cove West NSW 2066
Phone : +61 2 8215 6222
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street EVELEIGH NSW 2015

Order No.:
Report #: 331840
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Mar 27, 2012 3:46 PM
Due: Apr 3, 2012 4:00 PM
Priority: 5 Day
Contact name: Michael Assal

Client Job No.:
RE TEST: WASTE WATER ANALYSIS

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Chemical Oxygen Demand (COD)
Laboratory where analysis is conducted					
Melbourne Laboratory - NATA Site # 1254 & 14271					
Sydney Laboratory - NATA Site # 18217					X
Brisbane Laboratory - NATA Site # 20794					
External Laboratory					
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**	
WW INLET	Mar 21, 2012		Water	S12-Ma18800	X

mgt-LabMark Internal Quality Control Review

General

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Holding Times

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UNITS

mg/kg:milligrams per Kilogram

mg/L:milligrams per litre

µg/L:micrograms per litre

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TERMS

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Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

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10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data below the LOR with a positive RPD - eg: LOR 0.1, Result A = <0.1 (raw data is 0.02) & Result B = <0.1 (raw data is 0.03) resulting in a RPD of 40% calculated from the raw data.

Quality Control Results

mgt-LabMark Unit F6, Building F, 16 Mars Road, Lane Cove West, NSW, Australia, 2066
ABN : 50 005 085 521 Telephone: +61 2 8215 6222 Facsimile: +61 2 9420 2977

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Bob Symons	Client Services
Bob Symons	Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

mgt LabMark
ENVIRONMENTAL LABORATORIES

Certificate of Analysis

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: Michael Assal

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Report	332928-W
Client Reference	WASTE WATER ANALYSIS
Received Date	Apr 04, 2012

Client Sample ID			**WASTE WATER INLET**	**WASTE WATER OUTLET**
Sample Matrix			**Water**	**Water**
mgt-LabMark Sample No.			**S12-Ap03088**	**S12-Ap03089**
Date Sampled			**Apr 03, 2012**	**Apr 03, 2012**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	3600	510
Chemical Oxygen Demand (COD)	5	mg/L	3800	910
Suspended Solids	5	mg/L	1600	470
Volatile Suspended Solids	5	mg/L	1500	420

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day) - Method: 4050-4051 BOD	Sydney	Apr 05, 2012	2 Day
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Apr 05, 2012	28 Day
Suspended Solids - Method: 4100 Total Suspended Solids	Sydney	Apr 05, 2012	7 Day
Volatile Suspended Solids - Method: 4100 Total Volatile Suspended Solids	Sydney	Apr 10, 2012	7 Day

mgt LabMark
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NATA # 1261 Site # 20794

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street EVELEIGH NSW 2015

Order No.:
Report #: 332928
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Apr 4, 2012 2:15 PM
Due: Apr 13, 2012 4:00 PM
Priority: 5 Day
Contact name: Michael Assal

Client Job No.: WASTE WATER ANALYSIS

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217					X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
External Laboratory								
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
WASTE WATER INLET	Apr 03, 2012		Water	S12-Ap03088	X	X	X	X
WASTE WATER OUTLET	Apr 03, 2012		Water	S12-Ap03089	X	X	X	X

mgt-LabMark Internal Quality Control Review

General

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3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
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mgt LabMark
ENVIRONMENTAL LABORATORIES

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Chemical Oxygen Demand (COD)	%	101			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	N12-Ap02903	NCP	mg/L	2300	2300	1.0	30%	Pass	
Chemical Oxygen Demand (COD)	S12-Ap00422	NCP	mg/L	8.0	10	24	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Suspended Solids	S12-Ap03089	CP	mg/L	470	480	1.0	30%	Pass	
Volatile Suspended Solids	S12-Ap03089	CP	mg/L	420	440	3.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Onur Mehmet	Client Services
Bob Symons	Senior Analyst-Inorganic (NSW)

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Final report - this Report replaces any previously issued Report

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mgt LabMark
ENVIRONMENTAL LABORATORIES

Certificate of Analysis

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: Michael Assal-ALL INVOICES

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Report	334088-W
Client Reference	WASTE WATER OUTLET
Received Date	Apr 17, 2012

Client Sample ID			**WWINLET**	**WWOUTLET**
Sample Matrix			**Water**	**Water**
mgt-LabMark Sample No.			**S12-Ap09838**	**S12-Ap09839**
Date Sampled			**Apr 17, 2012**	**Apr 17, 2012**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	3000	240
Chemical Oxygen Demand (COD)	5	mg/L	4300	670
Suspended Solids	5	mg/L	2200	330
Volatile Suspended Solids	5	mg/L	2100	320

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day) - Method: 4050-4051 BOD	Sydney	Apr 18, 2012	2 Day
Chemical Oxygen Demand (COD) - Method: 4520 COD	Sydney	Apr 19, 2012	28 Day
Suspended Solids - Method: 4100 Total Suspended Solids	Sydney	Apr 19, 2012	7 Day
Volatile Suspended Solids - Method: 4100 Total Volatile Suspended Solids	Sydney	Apr 19, 2012	7 Day

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ENVIRONMENTAL LABORATORIES
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Melbourne
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Oakleigh VIC 3166
Phone : +61 3 9564 7055
NATA # 1261
Site # 1254

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 8215 6222
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name: The Odour Unit Pty Ltd
Address: Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Order No.:
Report #: 334088
Phone: 02 9209 4220
Fax: 02 9209 4421

Received: Apr 17, 2012 7:50 PM
Due: Apr 26, 2012 4:00 PM
Priority: 5 Day
Contact name: Michael Assal-ALL INVOICES

Client Job No.:
WASTE WATER OUTLET

mgt-LabMark Client Manager: Onur Mehmet

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217					X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
External Laboratory								
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
WWINLET	Apr 17, 2012		Water	S12-Ap09838	X	X	X	X
WWOUTLET	Apr 17, 2012		Water	S12-Ap09839	X	X	X	X

mgt-LabMark Internal Quality Control Review

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis.
7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001)

For samples received on the last day of holding time, notification of testing requirements should have been received at least

6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as an RPD

UNITS

mg/kg:milligrams per Kilogram

mg/L:milligrams per litre

µg/L:micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%:Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 milliltres

TERMS

Dry:	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR:	Limit Of Reporting.
SPIKE:	Addition of the analyte to the sample and reported as percentage recovery.
RPD:	Relative Percent Difference between two Duplicate pieces of analysis.
LCS:	Laboratory Control Sample - reported as percent recovery.
CRM:	Certified Reference Material - reported as percent recovery.
Method Blank:	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate:	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate:	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate:	A second piece of analysis from a sample outside of the client's batch of samples but run within the laboratory batch of analysis.
Batch SPIKE:	Spike recovery reported on a sample from outside of the client's batch of samples but run within the laboratory batch of analysis.
USEPA:	U.S Environmental Protection Agency
APHA:	American Public Health Association
ASLP:	Australian Standard Leaching Procedure (AS4439.3)
TCLP:	Toxicity Characteristic Leaching Procedure
COC:	Chain Of Custody
SRA:	Sample Receipt Advice
CP:	Client Parent - QC was performed on samples pertaining to this report
NCP:	Non-Client Parent - QC was performed on samples not pertaining to this report, however QC is representative of the sequence or batch that client samples were analysed within

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample>
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data below the LOR with a positive RPD - eg: LOR 0.1, Result A = <0.1 (raw data is 0.02) & Result B = <0.1 (raw data is 0.03) resulting in a RPD of 40% calculated from the raw data.

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Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Chemical Oxygen Demand (COD)	%	98			70-130	Pass	
Suspended Solids	%	94			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	S12-Ap09096	NCP	mg/L	510	510	1.0	30%	Pass	
Chemical Oxygen Demand (COD)	S12-Ap09838	CP	mg/L	4300	3900	8.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	N/A
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Onur Mehmet	Client Services
Bob Symons	Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

Abattoir C

Wastewater Laboratory Result Sheets March 2013 – May 2013

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Certificate of Analysis

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Accreditation Number 1261
Site Number 18217

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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: **Michael Assal-ALL INVOICES**

Report **373180-W**
Client Reference N1700L
Received Date Mar 22, 2013

Client Sample ID			**CAL INLET**	**CAL OUTLET**
Sample Matrix			**Water**	**Water**
Eurofins | mgt Sample No.			**S13-Ma18621**	**S13-Ma18622**
Date Sampled			**Mar 20, 2013**	**Mar 20, 2013**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	6900	1300
Chemical Oxygen Demand (COD)	5	mg/L	20000	2500
Suspended Solids	5	mg/L	3200	490
Volatile Suspended Solids	5	mg/L	3100	490

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day)	Sydney	Mar 22, 2013	2 Day
- Method: 4050-4051 BOD			
Chemical Oxygen Demand (COD)	Sydney	Mar 22, 2013	28 Day
- Method: 4520 COD			
Suspended Solids	Sydney	Mar 26, 2013	7 Day
- Method: 4100 Total Suspended Solids dried at 103-105°C			
Volatile Suspended Solids	Sydney	Mar 26, 2013	7 Day
- Method: 4100 Total Volatile Suspended Solids			

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NATA # 1261
Site # 1254 & 14271

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mgt LabMark ENVIRONMENTAL LABORATORIES

Company Name:	The Odour Unit Pty Ltd	**Order No.:**		**Received:**	Mar 22, 2013 11:26 AM
Address:	Suite 16012, Australian Technology Park, 2 Locomotive	**Report #:**	373180	**Due:**	Apr 2, 2013
	EVELEIGH	**Phone:**	02 9209 4220	**Priority:**	5 Day
	NSW 2015	**Fax:**	02 9209 4421	**Contact Name:**	Michael Assal-ALL INVOICES
Client Job No.:	N1700L				

mgt-LabMark Client Manager: Jean Heng

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217					X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
External Laboratory								
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
AL INLET	Mar 20, 2013		Water	S13-Ma18621	X	X	X	X
AL OUTLET	Mar 20, 2013		Water	S13-Ma18622	X	X	X	X

Date Reported:Apr 02, 2013

Date Reported:Apr 02, 2013

Eurofins | mgt Internal Quality Control Review and Glossary

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5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

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****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

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ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
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TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

QC - ACCEPTANCE CRITERIA

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QC DATA GENERAL COMMENTS

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4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Chemical Oxygen Demand (COD)	%	94			70-130	Pass	
Suspended Solids	%	101			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	S13-Ma17906	NCP	mg/L	3.3	3.4	2.0	30%	Pass	
Chemical Oxygen Demand (COD)	S13-Ma18621	CP	mg/L	20000	20000	2.0	30%	Pass	
Suspended Solids	S13-Ma18621	CP	mg/L	3200	3600	13	30%	Pass	
Volatile Suspended Solids	S13-Ma18621	CP	mg/L	3100	3600	13	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Jean Heng	Client Services
Bob Symons	Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

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Certificate of Analysis

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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: **Michael Assal-ALL INVOICES**

Report **376074-W**
Client Reference N1700L
Received Date Apr 18, 2013

Client Sample ID			**CAL INLET**	**CAL OUTLET**
Sample Matrix			**Water**	**Water**
Eurofins | mgt Sample No.			**S13-Ap13670**	**S13-Ap13671**
Date Sampled			**Apr 18, 2013**	**Apr 18, 2013**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	3800	850
Chemical Oxygen Demand (COD)	5	mg/L	7800	1600
Suspended Solids	5	mg/L	1900	310
Volatile Suspended Solids	5	mg/L	1800	260

Sample History

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A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day)	Sydney	Apr 18, 2013	2 Day
- Method: 4050-4051 BOD			
Chemical Oxygen Demand (COD)	Sydney	Apr 18, 2013	28 Day
- Method: 4520 COD			
Suspended Solids	Sydney	Apr 22, 2013	7 Day
- Method: 4100 Total Suspended Solids dried at 103-105°C			
Volatile Suspended Solids	Sydney	Apr 22, 2013	7 Day
- Method: 4100 Total Volatile Suspended Solids			

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Company Name:	The Odour Unit Pty Ltd	**Order No.:**	N1700-3 MA2	**Received:** Apr 18, 2013 12:00 AM
Address:	Suite 16012, Australian Technology Park, 2 Locomotive	**Report #:**	376074	**Due:** Apr 26, 2013
	EVELEIGH	**Phone:**	02 9209 4220	**Priority:** 5 Day
	NSW 2015	**Fax:**	02 9209 4421	**Contact Name:** Michael Assal-ALL INVOICES
Client Job No.:	N1700L			

Eurofins | mgt Client Manager: Jean Heng

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217					X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
External Laboratory								
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
AL INLET	Apr 18, 2013		Water	S13-Ap13670	X	X	X	X
AL OUTLET	Apr 18, 2013		Water	S13-Ap13671	X	X	X	X

Date Reported:Apr 24, 2013

Date Reported:Apr 24, 2013

Eurofins | mgt Internal Quality Control Review and Glossary

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5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
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9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Biochemical Oxygen Demand (BOD-5 Day)	mg/L	< 2			2	Pass	
Chemical Oxygen Demand (COD)	mg/L	< 5			5	Pass	
Suspended Solids	mg/L	< 5			5	Pass	
Volatile Suspended Solids	mg/L	< 5			5	Pass	
LCS - % Recovery							
Suspended Solids	%	101			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
				Result 1	Result 2	RPD			
Biochemical Oxygen Demand (BOD-5 Day)	S13-Ap13670	CP	mg/L	3800	3400	9.0	30%	Pass	
Chemical Oxygen Demand (COD)	S13-Ap13540	NCP	mg/L	130	120	2.0	30%	Pass	
Suspended Solids	S13-Ap13670	CP	mg/L	1900	1800	4.0	30%	Pass	
Volatile Suspended Solids	S13-Ap13670	CP	mg/L	1800	1700	5.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Organic samples had Teflon liners	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Jean Heng	Client Services
Bob Symons	Senior Analyst-Inorganic (NSW)

Dr. Bob Symons
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

eurofins | mgt

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 18217

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

The Odour Unit Pty Ltd
Suite 16012, Australian Technology Park, 2 Locomotive Street
EVELEIGH
NSW 2015

Attention: **Michael Assal-ALL INVOICES**

Report **380886-W**
Client Reference N1700L
Received Date May 30, 2013

Client Sample ID			**CAL INLET**	**CAL OUTLET**
Sample Matrix			**Water**	**Water**
Eurofins | mgt Sample No.			**S13-My25036**	**S13-My25037**
Date Sampled			**May 29, 2013**	**May 29, 2013**
Test/Reference	LOR	Unit		
Biochemical Oxygen Demand (BOD-5 Day)	2	mg/L	5500	1200
Chemical Oxygen Demand (COD)	5	mg/L	13000	1900
Suspended Solids	5	mg/L	4500	380
Volatile Suspended Solids	5	mg/L	3300	250

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

Description	Testing Site	Extracted	Holding Time
Biochemical Oxygen Demand (BOD-5 Day)	Sydney	May 30, 2013	2 Day
- Method: 4050-4051 BOD			
Chemical Oxygen Demand (COD)	Sydney	Jun 03, 2013	28 Day
- Method: 4520 COD			
Suspended Solids	Sydney	May 30, 2013	7 Day
- Method: 4100 Total Suspended Solids dried at 103-105°C			
Volatile Suspended Solids	Sydney	May 31, 2013	7 Day
- Method: 4100 Total Volatile Suspended Solids			

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

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ABN – 50 005 085 521 e.mail : enviro@mgtlabmark.com.au web : www.mgtlabmark.com.au

Company Name:	The Odour Unit Pty Ltd	**Order No.:**	N1700-3 MA3
Address:	Suite 16012, Australian Technology Park, 2 Locomotive EVELEIGH NSW 2015	**Report #:**	380886
		Phone:	02 9209 4220
		Fax:	02 9209 4421
Client Job No.:	N1700L		

Received:	May 30, 2013 1:00 PM
Due:	Jun 6, 2013
Priority:	5 Day
Contact Name:	Michael Assal-ALL INVOICES

Eurofins | mgt Client Manager: Jean Heng

Sample Detail					Biochemical Oxygen Demand (BOD-5 Day)	Chemical Oxygen Demand (COD)	Suspended Solids	Volatile Suspended Solids
Laboratory where analysis is conducted								
Melbourne Laboratory - NATA Site # 1254 & 14271								
Sydney Laboratory - NATA Site # 18217					X	X	X	X
Brisbane Laboratory - NATA Site # 20794								
External Laboratory								
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**				
AL INLET	May 29, 2013		Water	S13-My25036	X	X	X	X
AL OUTLET	May 29, 2013		Water	S13-My25037	X	X	X	X

Date Reported:Jun 06, 2013

Date Reported:Jun 06, 2013

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual PQLs are matrix dependant. Quoted PQLs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Acknowledgment.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environment Protection Authority
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
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