Infinis Energy Services Limited

Periodic monitoring of raw landfill gas

Silent Valley Landfill Site

Report	LSO170404-TG
Date	26 April 2017
Version	1

1015

PERIODIC MONITORING OF RAW LANDFILL GAS

SILENT VALLEY LANDFILL SITE

Report prepared for

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Issue history

Version	Date	Approved	
LSO170404-TG, 1	26 April 2017	N Ford	N Ford
First issue			

1 Introduction

Infinis Energy Services Limited (Infinis) contracted Environmental Scientifics Group (ESG) to undertake monitoring of the landfill gas supply to its combustion operations at the Silent Valley Landfill site.

2 Test methodology

Infinis requested that duplicate samples of landfill gas be collected and analysed for the priority trace components (LFGTGN04, Table 1.1) specified in Environment Agency guidance (Guidance for monitoring trace components in landfill gas – LFGTGN04 v3.0, 2010). The test methodology should be in accordance with that specified within LFGTGN04.

Based on LFGTGN04 the priority trace gas components are sampled using a combination of four sampling media as shown in Table 1.

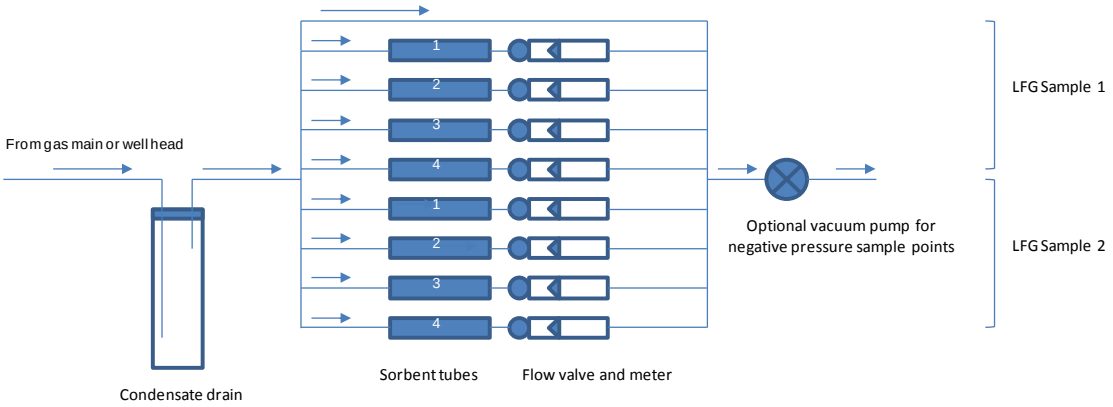
Table 1 Sampling media and analytical methods

Trace component	CAS number	Sampling method	Analytical method
1,1-dichloroethane	75-34-3	Dual solid sorbent	ATD-GC-MS
1,2-dichloroethane	107-06-2	Dual solid sorbent	ATD-GC-MS
1,1-dichloroethene	75-35-4	Dual solid sorbent	ATD-GC-MS
1,2-dichloroethene	540-59-0	Dual solid sorbent	ATD-GC-MS
1,3-butadiene	106-99-0	Dual solid sorbent	ATD-GC-MS
1-butanethiol	109-79-5	Dual solid sorbent	ATD-GC-MS
1-pentene	109-67-1	Dual solid sorbent	ATD-GC-MS
1-propanethiol	107-03-9	Dual solid sorbent	ATD-GC-MS
2-butoxyethanol	111-76-2	Dual solid sorbent	ATD-GC-MS
Arsenic (as As)	7440-38-2	Charcoal	ICP-MS
Benzene	71-43-2	Dual solid sorbent	ATD-GC-MS
Butyric acid	107-92-6	Dual solid sorbent	ATD-GC-MS
Carbon disulphide	75-15-0	Dual solid sorbent	ATD-GC-MS
Chloroethane	75-00-3	Dual solid sorbent	ATD-GC-MS
Chloroethene (vinyl chloride)	75-01-4	Dual solid sorbent	ATD-GC-MS
Dichloromethane	75-09-2	Dual solid sorbent	ATD-GC-MS
Dimethyl disulphide	624-92-0	Dual solid sorbent	ATD-GC-MS
Dimethyl sulphide	75-18-3	Dual solid sorbent	ATD-GC-MS
Ethanal (acetaldehyde)	75-07-0	Silica gel/2,4 DNPH	HPLC-DAD
Ethanethiol	75-08-1	Dual solid sorbent	ATD-GC-MS
Ethyl butyrate	105-54-4	Dual solid sorbent	ATD-GC-MS
Furan (1,4-epoxy-1,3-butadiene)	110-00-9	Dual solid sorbent	ATD-GC-MS
Hydrogen sulphide	7783-06-4	Charcoal	IC
Methanal (formaldehyde)	50-00-0	Silica gel/2,4 DNPH	HPLC-DAD
Methanethiol	74-93-1	Dual solid sorbent	ATD-GC-MS
Styrene	100-42-5	Dual solid sorbent	ATD-GC-MS
Tetrachloromethane	56-23-5	Dual solid sorbent	ATD-GC-MS
Toluene	108-88-3	Dual solid sorbent	ATD-GC-MS
Trichloroethene	79-01-6	Dual solid sorbent	ATD-GC-MS

ATD – automated thermal desorption
GC-MS – gas chromatography and mass spectrometry
ICP-MS – inductively couple plasma/mass spectrometry
HPLC-DAD – high performance liquid chromatography and diode array detection
IC – ion chromatography

Sampling for all components is undertaken simultaneously using a multiple stream sampler as shown in Figure 1.

Figure 1 Landfill gas sampling arrangement



A sample is taken from either the gas main or well head and passed through a condensate drain to remove excess moisture. The sample gas is then split to pass through a series of eight regulated rotameters arranged in two banks of four. There is also a bypass stream for excess sample. This allows the duplicate simultaneous sampling at regulated flow rates onto four sampling media. The flow rates and sampling duration are set in accordance with LFGTGN04 requirements as summarised in Table 2.

Table 2 Sampling media and analytical methods

Media	Target species	Sampling rate (ml/min)	Sampling duration (min)	Sample volume (l)
Dual solid sorbent (Tenax/Sulficarb)	VOCs	20	10	0.2
Silica gel and 2,4 DNPH (SKC 226-119)	Aldehydes	20	50	1.0
Activated carbon 1 (SKC 226-09)	Arsenic	100	50	5.0
Activated carbon 2 (SKC 226-09)	Hydrogen sulphide	100	50	5.0

In the case of negative pressure sources it is necessary to employ a vacuum pump at the sampler's common outlet. This is not normally required with positive pressure systems

This results in two duplicate samples of landfill gas with each sample comprising the four sub-samples above covering all of the priority trace components within Table 1.

The samples are subject to the analytical procedures described in Table 1 to provide a mass on the collected sample which can then be related to the volume of gas sampled to provide a component concentration in the sampled landfill gas.

The sampling followed internal procedure GAS15 and is accredited under test certificate 1015.

3 Site information

Sample point details			
Date	4 April 2017	Site	Silent Valley landfill site
Ambient temperature	14 °C	Atmospheric pressure	100.1 kPa
Monitoring organisation	ESG UKAS 1015	Analytical laboratory	ESG UKAS 1015
Location of sampling point	Gas main to compound After blower	Area of influence of collection system sampled	All
Type of sample point	¼" Tefen	Temperature of gas	14°C
Pressure at sample point	100 mb	Type of waste	Not recorded
Status of gas system	Active	Age of waste	Not recorded

4 Preliminary checks and field measurements

Parameter		Concentration
Methane	%	44.0
Carbon dioxide	%	26.0
Oxygen	%	0.2
Nitrogen (by difference)	%	29.8
Hydrogen sulphide	ppmv	90
Carbon monoxide	ppmv	1

*carbon monoxide is measured with a hydrogen sulphide filter in the sampling line.

Preliminary bulk gas measurements were undertaken using a Gasdata LMSxi electrochemical cell analyser (no 1227). Reported measurements are spot readings following gas sampling for a period of 5 minutes.

5 Results of landfill gas analysis

The results of the sampling and analysis are summarised in Table 3 below.

Table 3 Priority trace component measurement results

Parameter		Concentration ($\mu g/m^3$,STP)
1 Pentene		<106
1,1-Dichloroethane		372
1,1-Dichloroethylene		957
1,2-Dichloroethane		<53
1,2-Dichloroethylene		957
1,3-Butadiene		<37
1,4 epoxy 1,3 butadiene		<37
1-Propanethiol		<106
2-butoxyethanol		<106
Benzene		4894
Butyric acid		<213
Carbon disulphide		29789
Carbon tetrachloride		<53
Chloroethane		<53
Dichloromethane		<53
Dimethyl disulphide		904
Dimethyl sulphide		11703
Ethyl butyrate		106
Ethyl mercaptan		<160
Methyl mercaptan		<532
N-Butyl mercaptan		<160
Styrene		53
Toluene		8511
Trichloroethylene		<53
Vinyl chloride monomer		<160
Arsenic		140
Hydrogen sulphide		106388
Acetaldehyde	*	106
Formaldehyde	*	213

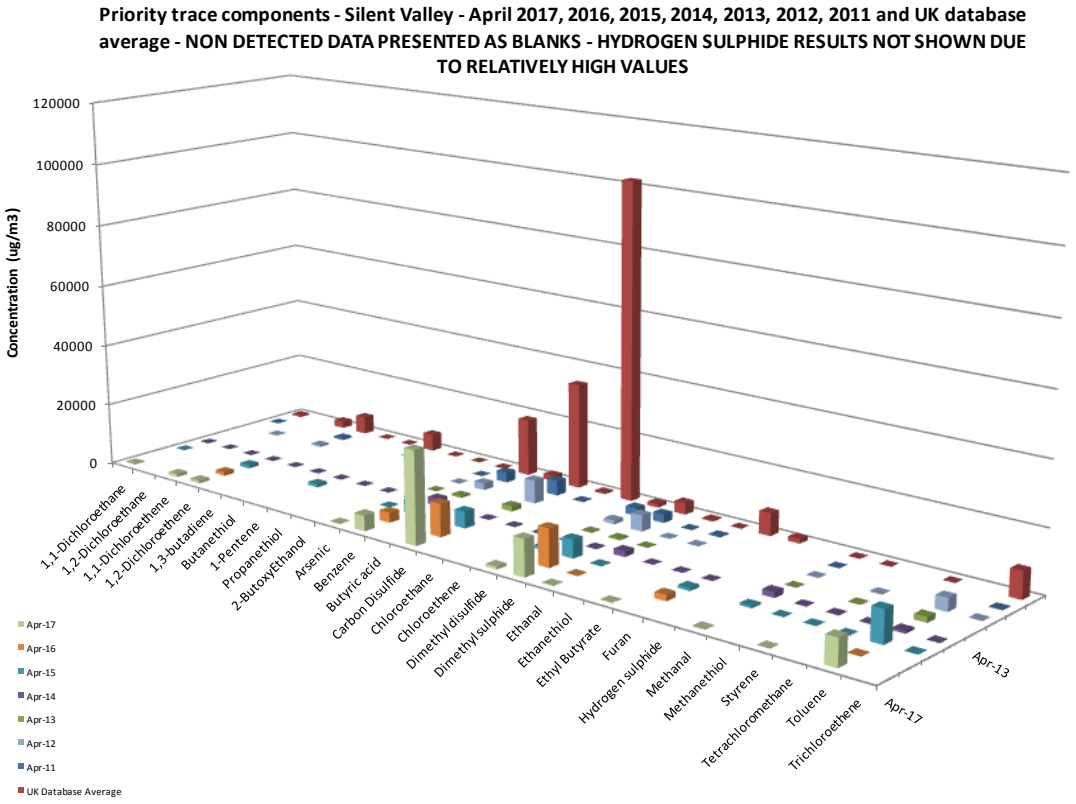
* indicates result is UKAS accredited

< indicates result is below the method limit of detection

The above reported results are the maximum concentrations measured for each parameter in two samples.

The maximum results of the current analyses are compared with historical data and the UK database average in Figure 2.

Figure 2 Historical priority trace component analysis results at Silent Valley



6 Notes

Sampling of landfill gas was undertaken in accordance with ESG procedure GAS15 and is UKAS accredited under certificate 1015.

Analysis of collected samples was undertaken by ESG's Bretby laboratory. The analytical results which fall within ESG's scope of accreditation under certificate 1015 are identified in Table 3.

The priority component measurements which can be considered to be within the scope of UKAS accreditation are identified in Table 3.

Any interpretations and opinions expressed are outside of the scope of UKAS accreditation.

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