81-3
office

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Mr. Kieran O'Brien
Senior Inspector
EPA Regional Inspectorate
Inniscarra
Co. Cork

13 April 2005

Project No. 04.148B

Re: KTK Landfill / Waste Licence Review / Register No 81-3

Dear Kieran,

Further to your meeting with Mr. Michael Bergin (KTK Landfill) and Mr. Geoff Parker (ERML) on the 15th February 2005 at the KTK Landfill, Brownstown, Kilcullen, Co Kildare please find following our responses to your enquiries in relation to:

- The most recent landfill gas monitoring results at the site,
- An overview of the current and proposed gas management plan for the site;
- Emission data from the combustion engines and flares;
- Disposal of leachate.

Furthermore copies of the following reports have been attached to this report:

- Report on Air emission testing and Dispersion modelling of three Landfill flares located in KTK Landfill, Kilcullen, Co. Kildare. (Odour Ireland, April 2005);
- Specified Engineering Works Report in relation to the Gas Utilisation Plant (April 2004), and;
- Supplementary Report on Proposed Gas Utilisation Plant (October 2004).

1.0 PROPOSED EMISSION LIMIT VALUES FOR WL 81-3

1.1 Emissions from Gas Utilisation Plant

Emission values (for parameters as per Schedule C.5 of Waste Licence Register No 81-2) for the gas utilisation engines are depicted in the following Table 1. These emission values are compared against emission limit values specified in TA Luft (2002), Waste Licence Register No 81-2 and two recently issued EPA Waste Licence ELV's for Gas Utilisation Plant (WL 4-2 and WL 26-2).

The proposed ELV's are as per WL 26-2. Table 1 indicates that the ELV's for Carbon Monoxide, TA Luft Class 1-3 parameters and Hydrocarbons in Waste Licence 81-2 would require alteration as per more recently issued Waste Licence Register No 4-2 and 26-2.

Table 1: Emissions and ELV's from the Gas Utilisation Plant in mg/m^3.

Parameter	Deutz 620 [4]	Emission Limit Values (ELV)			
		TA Luft 2002	WL 81-2	WL 4-2	WL 26-2 proposed KTK ELV's
NO_2	162	1,000	*500*	500	500
CO	855	1,000	*650*	1,400	1,400
PM_{10}	n/d		*130*	130	130
TA Luft Class 1	n/d	n/a [1]	*20*	1,000 [2] 75 [3]	1,000 [2] 75 [3]
TA Luft Class 2			*100*		
TA Luft Class 3			*150*		
Hydrogen Chloride	n/d	-	*50*	50	50
Hydrogen Fluoride	n/d	-	*5*	5	*5*
Hydrocarbons	n/d	-	*10*	n/a	n/a

n/d = No data available / n/a = Not Applicable

1) *TA Luft (2002) does not specify ELV's for Class 1-3 Organic compounds for combustion plants.*
2) *ELV for Total Volatile Organic Compounds (VOC).*
3) *ELV for non-Methane VOC's.*
4) *Emissions from Deutz 620 engine located at Kinsale Rd Landfill, Cork. Emissions from 12th July 2002, reported by EURO Environmental Services..*

1.2 Emissions from Gas Flare

The manufacturer (HAASE) has indicated that the 1,500m^3/hr enclosed high temperature flare at the KTK Landfill facility meets all existing emission requirements set by the Irish EPA: CO<50mg/m^3, NO_x<150mg/m^3, 0.3 sec. retention time and a burning temperature of 1,000 – 1,200 °C.

The following Table 2 indicates the emission values for the 1,500m^3 enclosed high temperature HAASE flare. These emission values are compared against TA Luft (2002), Waste Licence Register No 81-2 and some recently issued EPA Waste Licence ELV's for flares (WL 4-2 and WL 26-2).

Table 2: Emissions from the flare in mg/m^3.

Parameter	HAASE Flare	Emission Limit Values (ELV)			
		TA Luft 2002	WL 81-2	WL 4-2	WL 26-2 Proposed KTK ELV's
NO_2	< 150 [3]	150	*250*	150	150
CO	< 50 [3]	50	*50*	50	50
PM_{10}	n/a	-	*130*	n/a	n/a
TA Luft Class 1	n/a	n/a	*20*	n/a	n/a
TA Luft Class 2			*100*		
TA Luft Class 3			*150*		
Hydrogen Chloride	20.4 [1]	-	*50*	50	50
Hydrogen Fluoride	8.1 [2]	-	*5*	5	5
Hydrocarbons	n/d	-	*10*	n/a	n/a
Total Organic Carbon	n/d	-	*n/a*	10	10

n/d = No data available / n/a = Not Applicable

1) Represents analytical data for total Chloride. Data obtained by GAS Energy Ltd in March 2004.

2) Represents analytical data for total Fluoride. Data obtained by GAS Energy Ltd in March 2004.

3) Information supplied by the Manufacturer (HAASE).

2.0 ANALYSIS OF LANDFILL GAS AT KTK LANDFILL

To date four (4 No) landfill gas samples have been analysed from the source, i.e. from the generated landfill gas at the KTK Landfill site by *G.A.S. Energietechnologie GmbH.* The following Table 3 indicates a summary of the main parameters analysed. The complete results have been attached at the end of this report. Please refer to attached *Drawing KTK/655 Rev. C* for sample collection locations and details of the current gas collection fields at the site.

Table 31: Analytical Results of the LFG Samples taken at KTK Landfill by G.A.S. Energietechnologie GmbH during 2004.

Location		Phase 1-2 [1]	Phase 1-2 [2]	Phase 4-5 [3]	Phase 1-2 [4]
Parameter		16/01/04	4/03/04	4/03/04	16/12/04
Methane – CH_4	Vol.-%	42.7	39.3	36.0	33.7
Carbon dioxide – CO_2	Vol.-%	38.1	33.9	27.5	26.4
Oxygen – O_2	Vol.-%	1.1	1.6	6.2	6.6
Nitrogen - N	mg/m^3	17.9	24.8	29.9	32.9
Total Chloride	mg/m^3	272.0	20.4	130.0	-
Total Fluoride	mg/m^3	97.2	8.1	59.5	-

1) Sampling point at the HAASE 1,500m^3 flare.
2) Sampling point at Phase 1 and 2 LFG ring main.
3) Sampling point at Phase 4 and 5 LFG ring main.
4) Sampling point at the HAASE 1,500m^3 flare.

It is noted that all samples were taken from the source gas, i.e. before flare or engine locations to ensure an accurate 'fingerprint' of the generated gas at the site.

3.0 GAS MANAGEMENT PLAN

3.1 Current Situation

The current Landfill Gas Management System comprises 23 No landfill gas collection boreholes and 21 No side slope risers. These are connected to the gas ring main, which is installed around the perimeter of the site at the northern, eastern and southern part of the site. The ring main competition works were carried out in April 2005. Refer to Drawing *KTK/655 Rev. C* for details of the gas extraction system.

Furthermore two enclosed 1500m^3 flares (one permanent the other hired since January 2005), one enclosed 500m^3 flare and two open 500m^3 flares are situated at the site in order to collect and flare the landfill gas produced at the site.

It is noted that a gas collection pipe connection has been installed to the neighbouring Kildare County Council landfill Silliot Hill for flaring and utilisation purposes. Current export rate is at approximately 1,000m^3/hr (February/March 2005). The connection to Silliot Hill landfill acts as a short term backup capacity for KTK gas collection system.

Refer to the following Table 4 for details of the flaring rates. In summary the current gas collection and flaring rate at the KTK Landfill site is approximately 3,184 m^3/hr.

Table 4: Details of the KTK Landfill collection and flaring capacity in February and March 2005.

Description of Flare	Design Capacity (m^3/hr)	Flow 21/02/05 (m^3/hr)	Flow 23/02/05 (m^3/hr)	Flow 25/02/05 (m^3/hr)	Flow 4/03/05 (m^3/hr)	Flow 9/03/05 (m^3/hr)	Flow 16/03/05 (m^3/hr)	Flow 25/03/05 (m^3/hr)	Average Flow (m^3/hr)
HAASE enclosed (p)	1,500	750	685	632	834	934	867	1055	**820**
HAASE enclosed (t)	500	439	438	422	435	405	406	425	**420**
Leased Phase 4 (t)	1,500	483	480	484	394	778	604	607	**675**
Open near W/B (t)	500	120	126	120	138	138	121	91	**119**
Open Phase 2 (t)	500	330	410	320	0	0	0	0	**151**
Export to Silliot Hill LF (t)	1,000	1003	965	1035	1099	931	1169	931	**1,000**
TOTAL FLOW (m^3/hr)	5,500	3,125	3,104	3,013	2,900	3,186	3,167	3,109	**3,184**

(p) = Permanent Arrangement
(t) = Temporary Arrangement

3.2 Proposed / Future Situation

The KTK Landfill is currently evaluating proposals to purchase two new landfill gas flaring systems to the KTK Landfill site: one 2,500 m^3/hr and one 1,500 m^3/hr flaring system. These new flaring systems would replace the temporary three 500 m^3 flares (two open and one enclosed) and one 1,500 m^3/hr hired ground flare. With the proposed system in place the future flaring capacity at the site will be 5,500 m^3/hr.

Furthermore currently two landfill gas combustion engines have been installed at the site (*Type - TBG 620 V16 K - manufactured by Deutz Energy GmbH in Mannheim, Germany*) each capable of generating 1MW of power. A third engine has been planned for the later part of 2005.

According to the manufacturer each engine will utilise, at a 50% Methane (CH_4) concentration, 650 m^3/hr of landfill gas. In the future the total utilisation capacity at the site will be 1,950 m^3/hr.

The future combined flaring and utilisation capacity at the site will be at the end of 2005 7,500 m^3/hr.

4.0 EMISSION DATA FOR THE DEUTZ ENGINES

Three separate, purpose built and environmentally controlled containers enclosing a landfill gas engine, each capable of generating 1MW of power, are planned for the KTK Landfill site. The engines (Type - *TBG 620 V16 K*) are manufactured by Deutz Energy GmbH in Mannheim, Germany. It is noted that currently two engines are installed at the site (commencement of utilisation estimated at May/June 2005), third engine being due for installation before end of 2005.

According to the manufacturer each engine will utilise, at a 50% Methane (CH_4) concentration, 650 m^3/hr of landfill gas. The stack (diameter 0.5 metres) height of each container is approximately 5 metres from ground level.
The emission values from the engines were discussed in our "*Supplementary Report on Proposed Gas Utilisation Plant*" submitted to the Agency's for its agreement in October 2004, which is attached at the end of this report. The Agency acknowledged this report and gave it's agreement to the SEW proposals by email dated 12th November 2004.

It should be noted that the engine emissions depend of the source gas – for this reason no emission data exist at this point in time for the gas utilisation engines at KTK Landfill. Furthermore discussions were carried out with the engine manufacturer Deutz, who have confirmed that the engines will meet the current emission guidelines (Waste Licence 81-2 and TA Luft 2002) – see attached data sheet in Appendix 2.

The following Table 5 indicates emission concentrations for CO and NOx from similar Deutz engines located at Kinsale Road Landfill in Cork. The analysis was prepared for Irish Power Systems in July 2002.

Table 5: CO and NOx concentrations at Deutz engines located at Kinsale Road Landfill in Cork.

	CO (at 5% Oxygen) in mg/m^3	NOx (at 5% Oxygen) in mg/m^3
Engine TV1	688	162
Engine TV2	855	119

The results in Table 5 indicate that the Deutz engines are able to comply with the emission limit values stipulated in more recently issued waste licences for CO (1,400 mg/m^3) and NOx (500 mg/mg^3). It is noted that source gas analysis was not available for this report, i.e. an evaluation of the effectiveness of the engine emission destruction removal efficiency (*DRE*) could not be carried out.

5.0 EMISSIONS FROM THE ON-SITE FLARES

An efficiency test was carried out at following on-site flares on the 22nd February 2005:

- HAASE 1,500 m^3 groundflare (permanent)
- HAASE 500 m^3 groundflare (temporary - leased)
- ORGANICS 1,500 m^3 groundflare (temporary – leased)

The following Table 6 indicates the results of main parameters – the complete report of results is enclosed.

Table 6: Emission data from on-site flares (22 February 2005).

Location / Parameter	Unit	WL 81-2 ELV	HAASE 1500 (permanent)	HAASE 500 (leased)	ORGANICS 1500 (leased)
CO	mg/m^3	50	6.25	3,822.50	126.63
Total NO_x	mg/m^3	250	23.18	7.21	6.58
Total TOC	mg/m^3	n/a	233.12	934.07	129.45
Hydrogen Chloride	mg/m^3	50	12.43	15.84	21.18
Hydrogen Fluoride	mg/m^3	5	6.22	12.45	5.09

The report prepared by Odour Ireland indicates following conclusions:

- Airflow rate measurement was not carried out in accordance with the required standards due to sample port restrictions and airflow rate measurement location. A theoretically exhaust flue gas volume was calculated.
- NO_x, SO_2, CO, O_2, HCl, HF and TOC monitoring and analysis was carried out in accordance with specified requirements;
- All data is presented as Oxygen corrected to 5% (v/v);
- A worst case dispersion modelling assessment was carried out using the recommended US EPA Screen 3 dispersion model. Those monitored parameters that have established maximum GLC limits are within these values;
- Carbon monoxide (CO) emission rates are higher in the HAASE 500 and ORGANICS 1500 flare burner exhaust, it is suggested that the destruction removal efficiency (*DRE*) for methane is reduced. Servicing of the flare burners and supplying a greater gas supply to the ORGANICS 1500 flare should eliminate this problem and maintain higher operating temperatures within the flare burner;
- As carbon monoxide (CO) concentrations are low in the exhaust flue gas of the HAASE 1500 (i.e. in the order of 6.75 mg m^{-3}), it is suggested that this landfill flare is attaining a high *DRE* for methane destruction.

It is noted that since the Odour Ireland visit and sample collection at KTK Landfill site the ORGANICS 1500 flare has been overhauled and the HAASE 500 overhaul is scheduled. It is believed that these flares will then comply with the given ELV's. Furthermore it is noted that these flares are only temporary and that the licensee is planning to replace these flares with a larger capacity flaring system in the near future (see section 3.2).

6.0 DISPOSAL OF LEACHATE

Further to the discussions at the on-site meeting (on the 15 February 2005) in relation to leachate disposal, it is still the intention of KTK Landfill to discharge into the Kilcullen foul drainage system. Hence, KTK Landfill wishes to have Condition 6.6 of Waste Licence Register No 81-2 retained in the revised licence.

If you have any queries please do not hesitate to contact Mr. Geoff Parker or the undersigned.

Yours sincerely,

Thomas Vainio-Mattila, M.Sc.

Cc: Mr. Michael Bergin (KTL Landfill)

APPENDICES:

Appendix 1 *Landfill Gas Analysis – KTK Landfill*

Appendix 2 *Deutz Engine Emissions - Manufacturers details*

Appendix 3 *Drawing KTK/655 Rev. C*

Following reports are attached:

KTK Landfill flares - Efficiency test results

SEW – April 2004

SEW – October 2004

APPENDIX 1

Landfill Gas Analysis – KTK Landfill

Report No. B0401114

KTK Landfill
Sample description

Landfill gas
Gas type

Sample at 1.500 flare, high press. side
Further information

Umweltanalytik RUK GmbH
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D-47809 Krefeld

Wickbold analysis shows significantly higher values of total Chlorine and Fluorine contents in comparison to separate trace elements. The reason for this is just one trace element 1,1 Dchloro-1-fluoroethane with a significantly high concentration with in landfill gas.

Results actual sample

Results former samples

RUK Sample-No.		0401114				
Sampling date		16.01.2004				
Comission-No.		-				
Main components			100 % CH_4			
Methane	Vol.- %	42,7	-			
Carbon dioxide	Vol.- %	38,1	-			
Oxygen	Vol.- %	1,1	-			
Nitrogen	Vol.- %	17,9				
Inorganic trace gases						
Ammonia	mg/m³n	< 0,2	< 0,5			
Hydrogen sulphide	mg/m³n	807	1.890			
Halogenated Hydrocarbons						
Dichlorodifluoromethane (F12)	mg/m³n	8,1	19,0			
Vinylchlorid	mg/m³n	3,4	8,0			
Trichloroflouromethane (F11)	mg/m³n	4,3	10,1			
1,1-Dichloroethene	mg/m³n	< 0,1	< 0,2			
Dichloromethane	mg/m³n	1,3	3,0			
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/m³n	< 0,1	< 0,2			
trans-1,2-Dichloroethene	mg/m³n	< 0,1	< 0,2			
1,1-Dichloroethane	mg/m³n	0,2	0,5			
cis-1,2-Dichloroethene	mg/m³n	1,8	4,2			
Trichloromethane	mg/m³n	< 0,1	< 0,2			
1,2-Dichloroethane	mg/m³n	< 0,1	< 0,2			
1,1,1-Trichloroethane	mg/m³n	0,1	0,2			
Tetrachloromethane	mg/m³n	< 0,1	< 0,2			
Trichloroethene	mg/m³n	0,7	1,6			
1,1,2-Trichloroethane	mg/m³n	< 0,1	< 0,2			
Tetrachloroethene	mg/m³n	0,7	1,6			
1,1,1,2-Tetrachloroethane	mg/m³n	< 0,1	< 0,2			
BTEX						
Benzene	mg/m³n	0,6	1,4			
Toluene	mg/m³n	15,1	35,3			
Ethylbenzol	mg/m³n	7,4	17,3			
m-/p-Xylene	mg/m³n	17,5	41,0			
o-Xylene	mg/m³n	4,2	9,8			
Silicon compounds						
Tetramethylsilane	mg/m³n	< 0,1	< 0,2			
Trimethylsilanol	mg/m³n	1,3	3,0			
Hexamethyldisiloxane (L2)	mg/m³n	< 0,1	< 0,2			
Hexamethylcyclotrisiloxane (D3)	mg/m³n	0,1	0,2			
Octamethyltrisiloxane (L3)	mg/m³n	< 0,1	< 0,2			
Octamethylcyclotetrasiloxane (D4)	mg/m³n	1,4	3,3			
Decamethyltetrasiloxane (L4)	mg/m³n	< 0,1	< 0,2			
Decamethylcyclopentasiloxane (D5)	mg/m³n	0,7	1,6			
Sum silicon compounds (calc.)	mg/m³n	3,5	8,2			
Sum silicon (calc.)	mg/m³n	1,2	2,8			
Hydrocarbons						
> n-Pentane, <= n-Decane	mg/m³n	n. b.	n. b.			
> n-Decane	mg/m³n	n. b.	n. b.			
Total Cl, F, S content (Wickbold)						
Total Chlorine	mg/m³n	272,0	637,0			
Total Fluorine	mg/m³n	97,2	228,0			
Total Sulphur	mg/m³n	804	1.880			

n. d. = not determined, n. a. = not applicable

Gasbag 2,5 l Linde Gasbeutel

Analysenmethoden

Hauptkomponenten	DIN 51872-04 A (GC-WLD)
Gesamt Chlor, Fluor, Schwefel	DIN EN 38409 H8 (Wickboldverbrennung), DIN EN 10304 (IC)
Schwefelorganische Verbindungen	i. A. VDI 3865 Bl. 4 (GC-MS)
Ammoniak	VDI 2461 Bl. 2 / colorimetrisch
Schwefelwasserstoff	DIN 51855-4 / Kolorimetrisch
Kohlenwasserstoffe	i. A. VDI 3865 Bl. 4 (GC-FID)
BTEX, LCKW, ECKW	i. A. VDI 3865 Bl. 4 (GC-MS)

Longuich, 22.12.2004

Dipl.-Ing. W. Schreier
(Geschäftsführer)

Dr. T. Häusler
(Laborleiter)

Report No. B0403002

KTK Landfill
Sample description

Landfill gas
Gas type

Gas sample Cell 4 + 5 at ring main pipe
Further information

Umweltanalytik RUK GmbH · Im Paesch · 54340 Longuich

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Internet: www.umweltueberwachung.de
www.deponiegas.com

Wickbold analysis shows significantly higher values of total Chlorine and Fluorine contents in comparison to separate trace elements. The reason for this is just one trace element 1,1 Dichloro-1-fluoroethane with a significantly high concentration with in landfill gas. Oxygen percentage is quite high with 6,2 %.

Results actual sample

				Results former samples		
RUK Sample-No.			**0403002**			
Sampling date			**04.03.2004**			
Comission-No.			-			
Main components			**100 % CH_4**			
Methane	Vol.- %	36,0	-			
Carbon dioxide	Vol.- %	27,5	-			
Oxygen	Vol.- %	6,2	-			
Nitrogen	Vol.- %	29,9	-			
Inorganic trace gases						
Ammonia	mg/m³n	< 0,2	< 0,5			
Hydrogen sulphide	mg/m³n	1.530	4.250			
Halogenated Hydrocarbons						
Dichlorodifluoromethane (F12)	mg/m³n	4,2	11,7			
Vinylchlorid	mg/m³n	8,3	23,1			
Trichlorofluoromethane (F11)	mg/m³n	7,5	20,8			
1,1-Dichloroethene	mg/m³n	0,1	0,3			
Dichloromethane	mg/m³n	3,3	9,2			
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/m³n	< 0,1	< 0,3			
trans-1,2-Dichloroethene	mg/m³n	0,1	0,3			
1,1-Dichloroethane	mg/m³n	0,3	0,8			
cis-1,2-Dichloroethene	mg/m³n	3,8	10,6			
Trichloromethane	mg/m³n	< 0,1	< 0,3			
1,2-Dichloroethane	mg/m³n	0,1	0,3			
1,1,1-Trichloroethane	mg/m³n	< 0,1	< 0,3			
Tetrachloromethane	mg/m³n	< 0,1	< 0,3			
Trichloroethene	mg/m³n	2,2	6,1			
1,1,2-Trichloroethane	mg/m³n	< 0,1	< 0,3			
Tetrachloroethene	mg/m³n	1,0	2,8			
1,1,1,2-Tetrachloroethane	mg/m³n	< 0,1	< 0,3			
BTEX						
Benzene	mg/m³n	1,8	5,0			
Toluene	mg/m³n	53,0	147,2			
Ethylbenzol	mg/m³n	11,7	32,5			
m-/p-Xylene	mg/m³n	31,3	86,9			
o-Xylene	mg/m³n	6,1	16,9			
Silicon compounds						
Tetramethylsilane	mg/m³n	< 0,1	< 0,3			
Trimethylsilanol	mg/m³n	2,5	6,9			
Hexamethyldisiloxane (L2)	mg/m³n	0,2	0,6			
Hexamethylcyclotrisiloxane (D3)	mg/m³n	0,1	0,3			
Octamethyltrisiloxane (L3)	mg/m³n	0,1	0,3			
Octamethylcyclotetrasiloxane (D4)	mg/m³n	2,0	5,6			
Decamethyltetrasiloxane (L4)	mg/m³n	< 0,1	< 0,3			
Decamethylcyclopentasiloxane (D5)	mg/m³n	0,7	1,9			
Sum silicon compounds (calc.)	mg/m³n	5,6	15,6			
Sum silicon (calc.)	mg/m³n	1,9	5,3			
Hydrocarbons						
> n-Pentane, <= n-Decane	mg/m³n	n. b.	n. b.			
> n-Decane	mg/m³n	n. b.	n. b.			
Total Cl, F, S content (Wickbold)						
Total Chlorine	mg/m³n	130,0	361,1			
Total Fluorine	mg/m³n	59,5	165,3			
Total Sulphur	mg/m³n	1.530	4.250			

n. d. = not determined, n. a. = not applicable

Gasbag 2,5 l Linde Gasbeutel

Analysenmethoden

Hauptkomponenten	DIN 51872-04 A (GC-WLD)
Gesamt Chlor, Fluor, Schwefel	DIN EN 38409 H8 (Wickboldverbrennung), DIN EN 10304 (IC)
Schwefelorganische Verbindungen	i. A. VDI 3868 Bl. 4 (GC-MS)
Ammoniak	VDI 2461 Bl. 2 / colorimetrisch
Schwefelwasserstoff	DIN 51855-4 / Kolorimetrisch
Kohlenwasserstoffe	i. A. VDI 3865 Bl. 4 (GC-FID)
BTEX, LCKW, ECKW	i. A. VDI 3865 Bl. 4 (GC-MS)

Longuich, 22.12.2004

Dipl.-Ing. W. Schreier
(Geschäftsführer)

Dr. T. Häusler
(Laborleiter)

Report No. B0403001

KTK Landfill
Sample description

Landfill gas
Gas type

Gas sample Cell 1 + 2 at ring main pipe
Further information

Umweltanalytik RUK GmbH · Im Paesch · 54340 Longuich

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www.deponiegas.com

This sample also shows the same trace element 1,1 Dchloro-1-fluoroethane like the sample take at Cell 4 +5 but with lower concentration. For this reason values of total Chlorine and Fluorine contents are significantly lower.

Results actual sample

				Results former samples		
RUK Sample-No.		**0403001**				
Sampling date		**04.03.2004**				
Comission-No.		-				
Main components			**100 % CH_4**			
Methane	Vol.- %	39,3	-			
Carbon dioxide	Vol.- %	33,9	-			
Oxygen	Vol.- %	1,6	-			
Nitrogen	Vol.- %	24,8	-			
Inorganic trace gases						
Ammonia	mg/m³n	< 0,2	< 0,5			
Hydrogen sulphide	mg/m³n	418	1.064			
Halogenated Hydrocarbons						
Dichlorodifluoromethane (F12)	mg/m³n	3,2	8,1			
Vinylchlorid	mg/m³n	6,5	16,5			
Trichloroflouromethane (F11)	mg/m³n	1	2,8			
1,1-Dichloroethene	mg/m³n	< 0,1	< 0,3			
Dichloromethane	mg/m³n	0,2	0,5			
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/m³n	< 0,1	< 0,3			
trans-1,2-Dichloroethene	mg/m³n	0,1	0,3			
1,1-Dichloroethane	mg/m³n	< 0,1	< 0,3			
cis-1,2-Dichloroethene	mg/m³n	4,0	10,2			
Trichloromethane	mg/m³n	< 0,1	< 0,3			
1,2-Dichloroethane	mg/m³n	< 0,1	< 0,3			
1,1,1-Trichloroethane	mg/m³n	< 0,1	< 0,3			
Tetrachloromethane	mg/m³n	< 0,1	< 0,3			
Trichloroethene	mg/m³n	0,5	1,3			
1,1,2-Trichloroethane	mg/m³n	< 0,1	< 0,3			
Tetrachloroethene	mg/m³n	0,5	1,3			
1,1,1,2-Tetrachloroethane	mg/m³n	< 0,1	< 0,3			
BTEX						
Benzene	mg/m³n	1,2	3,1			
Toluene	mg/m³n	24,4	62,1			
Ethylbenzol	mg/m³n	11,9	30,3			
m-/p-Xylene	mg/m³n	25,8	65,7			
o-Xylene	mg/m³n	5,7	14,5			
Silicon compounds						
Tetramethylsilane	mg/m³n	< 0,1	< 0,3			
Trimethylsilanol	mg/m³n	5,5	14,0			
Hexamethyldisiloxane (L2)	mg/m³n	0,1	0,3			
Hexamethylcyclotrisiloxane (D3)	mg/m³n	0,2	0,5			
Octamethyltrisiloxane (L3)	mg/m³n	< 0,1	< 0,3			
Octamethylcyclotetrasiloxane (D4)	mg/m³n	1,8	4,6			
Decamethyltetrasiloxane (L4)	mg/m³n	< 0,1	< 0,3			
Decamethylcyclopentasiloxane (D5)	mg/m³n	0,6	1,5			
Sum silicon compounds (calc.)	mg/m³n	8,2	20,9			
Sum silicon (calc.)	mg/m³n	2,7	6,9			
Hydrocarbons						
≥ n-Pentane, <= n-Decane	mg/m³n	n. b.	n. b.			
> n-Decane	mg/m³n	n. b.	n. b.			
Total Cl, F, S content (Wickbold)						
Total Chlorine	mg/m³n	20,4	51,9			
Total Fluorine	mg/m³n	8,1	20,6			
Total Sulphur	mg/m³n	408	1.040			

n. d. = not determined, n. a. = not applicable

Gasbag 2,5 l Linde Gasbeutel

Analysenmethoden

Hauptkomponenten	DIN 51872-04 A (GC-WLD)
Gesamt Chlor, Fluor, Schwefel	DIN EN 38409 H8 (Wickboldverbrennung), DIN EN 10304 (IC)
Schwefelorganische Verbindungen	i. A. VDI 3868 Bl. 4 (GC-MS)
Ammoniak	VDI 2461 Bl. 2 / colorimetrisch
Schwefelwasserstoff	DIN 51855-4 / Kolorimetrisch
Kohlenwasserstoffe	i. A. VDI 3865 Bl. 4 (GC-FID)
BTEX, LCKW, ECKW	i. A. VDI 3865 Bl. 4 (GC-MS)

Longuich, 22.12.2004

Dipl.-Ing. W. Schreier
(Geschäftsführer)

Dr. T. Häusler
(Laborleiter)

Report No. B0412141

KTK Landfill
Sample description

Landfill gas
Gas type

Sample point at 1.500 Flare
Further information

Umweltanalytik RUK GmbH · Im Paesch · 54340 Longuich

G.A.S. Energietechnologie GmbH
Herr Simon
Hessenstr. 57

D-47809 Krefeld

Umweltanalytik
Umweltanalytik RUK GmbH
Im Paesch · D-54340 Longuich
Tel. 06502-9339-0 (Fax -29)
E-Mail: ruk@umweltueberwachung.de
Internet: www.umweltueberwachung.de
www.deponiegas.com

The sample is strongly diluted by air. The values of hydrogen sulphide, chlorine and fluorine is significantly lower than the results from January 2004

Results actual sample

Results former samples

RUK Sample-No.		0412141		0401114			
Sampling date		16.12.2004		Jan. 04			
Comission-No.		-		-			
Main components			100 % CH_4				
Methane	Vol.- %	33,7	-	42,7			
Carbon dioxide	Vol.- %	26,4		38,1			
Oxygen	Vol.- %	6,6	-	1,1			
Nitrogen	Vol.- %	32,9		17,9			
Inorganic trace gases							
Ammonia	mg/m³n	n. b.	n. b.	< 0,2			
Hydrogen sulphide	mg/m³n	125	371	807			
Halogenated Hydrocarbons							
Dichlorodifluoromethane (F12)	mg/m³n	0,7	2,1	8,1			
Vinylchlorid	mg/m³n	2,6	7,7	3,4			
Trichlorofluoromethane (F11)	mg/m³n	0,2	0,6	4,3			
1,1-Dichloroethene	mg/m³n	< 0,1	< 0,3	< 0,1			
Dichloromethane	mg/m³n	< 0,1	< 0,3	1,3			
1,1,2-Trichloro-1,2,2-trifluoroethane	mg/m³n	< 0,1	< 0,3	< 0,1			
trans-1,2-Dichloroethene	mg/m³n	< 0,1	< 0,3	< 0,1			
1,1-Dichloroethane	mg/m³n	0,1	0,3	0,2			
cis-1,2-Dichloroethene	mg/m³n	0,8	2,4	1,8			
Trichloromethane	mg/m³n	< 0,1	< 0,3	< 0,1			
1,2-Dichloroethane	mg/m³n	< 0,1	< 0,3	< 0,1			
1,1,1-Trichlorodethane	mg/m³n	< 0,1	< 0,3	0,1			
Tetrachloromethane	mg/m³n	< 0,1	< 0,3	< 0,1			
Trichloroethene	mg/m³n	0,2	0,6	0,7			
1,1,2-Trichloroethane	mg/m³n	< 0,1	< 0,3	< 0,1			
Tetrachloroethene	mg/m³n	0,2	0,6	0,7			
1,1,1,2-Tetrachloroethane	mg/m³n	< 0,1	< 0,3	< 0,1			
BTEX							
Benzene	mg/m³n	0,5	1,5	0,6			
Toluene	mg/m³n	7,0	20,8	15,1			
Ethylbenzol	mg/m³n	6,2	18,4	7,4			
m-/p-Xylene	mg/m³n	12,7	37,7	17,5			
o-Xylene	mg/m³n	3,2	9,5	4,2			
Silicon compounds							
Tetramethylsilane	mg/m³n	< 0,1	< 0,3	< 0,1			
Trimethylsilanol	mg/m³n	1,5	4,5	1,3			
Hexamethyldisiloxane (L2)	mg/m³n	0,3	0,9	< 0,1			
Hexamethylcyclotrisiloxane (D3)	mg/m³n	0,1	0,3	0,1			
Octamethyltrisiloxane (L3)	mg/m³n	< 0,1	< 0,3	< 0,1			
Octamethylcyclotetrasiloxane (D4)	mg/m³n	1,2	3,6	1,4			
Decamethyltetrasiloxane (L4)	mg/m³n	< 0,1	< 0,3	< 0,1			
Decamethylcyclopentasiloxane (D5)	mg/m³n	0,3	0,9	0,7			
Sum silicon compounds (calc.)	mg/m³n	3,4	10,1	3,5			
Sum silicon (calc.)	mg/m³n	1,2	3,6	1,2			
Hydrocarbons							
> n-Pentane, <= n-Decane	mg/m³n	n. b.	n. b.	n. b.			
> n-Decane	mg/m³n	n. b.	n. b.	n. b.			
Total Cl, F, S content (Wickbold)							
Total Chlorine	mg/m³n	n. b.	n. b.	272,0			
Total Fluorine	mg/m³n	n. b.	n. b.	97,2			
Total Sulphur	mg/m³n	n. b.	n. b.	804			

n. d. = not determined, n. a. = not applicable

Gasbag 2,5 l Linde Gasbeutel

Analysenmethoden

Hauptkomponenten	DIN 51872-04 A (GC-WLD)
Gesamt Chlor, Fluor, Schwefel	DIN EN 38409 H8 (Wickboldverbrennung), DIN EN 10304 (IC)
Schwefelorganische Verbindungen	i. A. VDI 3868 Bl. 4 (GC-MS)
Ammoniak	VDI 2461 Bl. 2 / colorimetrisch
Schwefelwasserstoff	DIN 51855-4 / Kolorimetrisch
Kohlenwasserstoffe	i. A. VDI 3865 Bl. 4 (GC-FID)
BTEX, LCKW, ECKW	i. A. VDI 3865 Bl. 4 (GC-MS)

Longuich, 22.12.2004

Dipl.-Ing. W. Schreier
(Geschäftsführer)

Dr. T. Häusler
(Laborleiter)

APPENDIX 2

Deutz Engine Emissions – Manufacturers Details

Inquiry G.A.S.

Calculation of heat ballance without guaranteel

Gas analysis does not meet TR 0199-99-3017 requirements

	21/03/2005	Dimensions			
	Engine-Type	"-"	TBG620WV16K K.	TBG620WV16K K.	TBG620WV16K K.
	Speed	1/min	1500	1500	1500
	Wanted power	kW	1140	855	570
	Conditions				
	Altitude	m	100	100	100
	Intake air temperature	° C	25	25	25
	Relative air humitity	%	60	60	60
	Intercooler water temp.	° C	50	50	50
	Glycol concentration (LLK)	%	33	33	33
	Cooling water inlet temp.	° C	80	80	80
	Cooling water outlet temp.	° C	90	90	90
	Exhaust gas outlet temp.	° C	150	150	150
	Exhaust gas back pressure	mbar	50	40	25
	NOX-limit	mg/m3N 5% O2	500	500	500
	Type of gas	"-"	acc. to gas analysis	acc. to gas analysis	acc. to gas analysis
	Methane number MZ	"-"	162.6	162.6	162.6
	Lower heating value Hu	kWh/m³	4.2860	4.2860	4.2860
	Min. air demand	m³/m³	4.0655	4.0655	4.0655
	Spec. exhaust volume	m³/m³	5.0138	5.0138	5.0138
	CO2/Hu	%/(kWh/m³)	8.8711	8.8711	8.8711
	Gas density	kg/m³	1.2991	1.2991	1.2991
	Results of simulation				
	Power	kW	1140	855	570
	Speed	1/min	1500	1500	1500
	Consumption	kW ± 5%	2962	2314	1670
	Cyl. cooling water heat	kW ± 8%	797	647	501
	Oil cooling heat	kW ± 8%			
	Exh. gas pipe cool. water heat	kW ± 8%			
	Intercooler high temp. heat	kW ± 8%			
	Intercooler low temp. heat	kW ± 8%	89	60	34
	Exhaust heat total	kW ± 8%	854	678	496
	Sum of useable exhaust heat	kW ± 8%	663	530	389
	Radiation heat	kW ± 8%	56	56	56
	Unburned	kW ± 8%	25	20	14
	Combustion air mass flow	kg/h ± 8%	4553	3533	2543
	Exhaust mass flow	kg/h ± 8%	5451	4234	3050
	Exhaust temperature	°C ± 8%	532	542	549
	Lambda factor	"-" ± 8%	*1.2533*	*1.2447*	*1.2418*
	Sum of useful heat	kW ± 8%	1460	1176	890
	Utility rate	"-"	*0.8779*	*0.8777*	*0.8741*
	Efficiency	"-"	*0.3849*	*0.3695*	*0.3413*
	CO Emissions **	mg/m³ (5% O2)	< 1000	< 1000	< 1000
	HC Emissions **	mg/m³	< 1000	< 1000	< 1000
	NMHC Emissions **	mg/m³	< 150	<150	<150

**** Exhaust emission results depend on landfill gas, actual engine valve condition and engine adjustments (ignition, receiver temperature, Lambda factor)**

APPENDIX 3

Drawing KTK/655 Rev. C

KTK LANDFILL LTD. OFFICE

1500m³ HAASE ENCLOSED FLARE

PUMPED KNOCKOUT POT

COMPOSTING FACILITY

GAS UTILISATION ENGINE (TYPICAL)

LFG EXPORT CONNECTION TO SILLIOT HILL LANDFILL

PI 138

PI 138

JEEP TRACK

SAMPLING POINT 1

SAMPLING POINT 2

SAMPLING POINT 3

W21

W10

W1

W22

W11

GV1

W2A

W3A

W12

GV2A

W5

W13

W16

W4

W6

ASBESTOS BAY

W14

GYPSUM BAY

GV3

W20

GV4A

W9

W15

W7

W8

W17

W18

W19

1500m³ ORGANICS FLARE

USR1

USR2

USR3

USR4

USR5

USR6

USR7

USR8

USR9

USR10

USR11

JEEP TRACK

ACCESS ROAD

500m³ OPEN FLARE

ESB

SERVICE PLATFORM

EXISTING WEIGH BRIDGES AND OFFICE

EXISTING WHEEL WASH AND PLANT

PUMPED KNOCKOUT POT

LEACHATE SHAFT

500m³ HAASE ENCLOSED FLARE

500m³ OPEN FLARE

PUMPED KNOCKOUT POT

MUD BLASTER WHEEL WASH AND PLANT

WEIGH BRIDGES AND OFFICE

LEGEND

- GAS RING MAIN 250mm SDR 17.5
- GAS FIELD 1
- GAS FIELD 1 SIDE SLOPE RISER
- GAS FIELD 2
- GAS FIELD 2 SIDE SLOPE RISER
- GAS FIELD 3
- GAS FIELD 3 SIDE SLOPE RISER
- EXISTING GAS EXTRACTION WELL (GAS W1, W2A, W3A, W4 - W20)
- EXISTING GAS VENT (GV1, GV2A, GV3, GV4A)
- EXISTING FLARE
- PHASE 1 UPSLOPE RISER HEADWORKS
- DRIPLEG

Issue Date:		
No.	Date	Description
C	12/04/05	ISSUE TO EPA
B	30/03/05	ISSUE TO CLIENT
A	27/10/04	ISSUE TO CLIENT

Surveyed by: Environment & Resource Management Ltd.

Client: **KTK Landfill Ltd.**
Brownstown, Kilcullen
Co. Kildare

Project: FACILITY MASTER PLAN

Title of Dwg.: TOTAL REFUSE SURVEY CURRENT TO 20th AUGUST 2004 AND GAS EXTRACTION SYSTEM

Scale:	1:1000A1 1:2000A3	Dwg. No.	Rev.
		KTK/655	C
Drawn:	CC	Job No.	
Approved:	GP	03.118	

Prepared by:
Environment & Resource Management Ltd.
NO. 3 TARA COURT, DUBLIN RD., NAAS, CO. KILDARE TELEPHONE 045 874411 FAX 045 874549

C\CAD\ERM PROJECTS\KTK LANDFILL\REFUSE\655