Monitoring Emissions of Dioxins, Hydrogen Fluoride and Hydrogen Bromide Solid Waste Incinerator

8th October 2003

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1. INTRODUCTION

At the request of Novartis Ringaskiddy Ltd., the Environment Department of Enterprise Ireland sampled the flue gas of the company's Solid Waste Incinerator for dioxins, hydrogen fluoride and hydrogen bromide. Samples of the ash and fly-ash were also taken from the Solid Waste Incinerator and leachates prepared from each and analysed for dioxins.

The tests were carried out on the 8th October 2003.

This report contains the results obtained and compares them with the limits set in the company's Integrated Pollution Control Licence, Register No. 545.

Note: The survey work and preparation of this report were carried out in conjunction with Mr. Paddy Wright of Wright Environmental Services.

2. SUMMARY

The flue gas of the company's Solid Waste Incinerator was sampled and analysed for dioxins, hydrogen fluoride and hydrogen bromide. A sample of the ash and fly-ash were also taken from the Solid Waste Incinerator and leachates prepared from each and analysed for dioxins.

A summary of the results is presented in Table 1 along with the emission limit values specified in the company's Integrated Pollution Control Licence.

Table 1 - Summary of Results – 8th October 2003

Test	Analytical Result (TEQ)	Concentration Dioxins (TEQ)	Emission Limit Value
Equipment Blank Dioxins (TEQ)*	0.0036ng	-	-
Flue Gas Dioxins (TEQ)	0.038ng	0.0097 ng/Nm^3	0.1 ng/Nm^3
Ash Leachate Dioxins (TEQ)	-	0.00054 ng/l	-
Fly-Ash Leachate Dioxins (TEQ)	-	0.0019 ng/l	-
Hydrogen Fluoride	-	Less than 0.4 mg/Nm^3	4 mg/Nm^3
Hydrogen Bromide	-	Less than 0.5 mg/Nm^3	5 mg/Nm^3

* An explanation of TEQ is given in Appendix II.

From this it can be seen that the emissions of dioxins, hydrogen fluoride and hydrogen bromide are well below the emission limit values.

3. RESULTS

The flue gas of the company's Solid Waste Incinerator (Emission Point Reference No. 3) was sampled and analysed for dioxins, hydrogen fluoride and hydrogen bromide. A blank sample was collected from the dioxin sampling equipment in the same manner as the emission test except that no gas was drawn through the sampling train, this result is used to measure any contribution from the equipment, collecting medium or washing solvents. Samples of the ash and fly-ash were also taken from the Solid Waste Incinerator and leachates prepared from each and analysed for dioxins.

Sampling and analytical methods are described in Appendix I.

The tests were carried out on the 8th October 2003 and samples for dioxin analysis were sent to Analytical and Environmental Services in the UK for analysis. Copies of their analytical reports are supplied separately. The reports are numbered D2464 - 2466 and D2467 - 2470. The samples for hydrogen fluoride and hydrogen bromide were analysed at the Enterprise Ireland laboratories.

The results are presented in Tables 2 and 3.

These results show that the emissions of dioxins, hydrogen fluoride and hydrogen bromide are well below the emission limit values (ELV) contained in the company's Integrated Pollution Control Licence.

Table 2 - Dioxins (TEQ*) – 8.10. 2003

Sample No. **	Sample	Sampling Period	Analytical Result (TEQ)	Concentration Dioxins (TEQ)	ELV Dioxins (TEQ)
Sample 4	Equipment Blank Dioxins (TEQ)	18.00 on 7.10.2003 to 09.00 on 8.10.2003	0.0036ng	-	-
Sample 5	Flue Gas Dioxins (TEQ)	10.00 to 16.15 8.10.2003	0.038ng	0.0097 ng/Nm^3	0.1 ng/Nm^3
Sample 6	Ash Leachate Dioxins (TEQ)	8.10.2003	-	0.00054 ng/l	-
Sample 7	Fly-Ash Leachate Dioxins (TEQ)	8.10.2003	-	0.0019 ng/l	-

* An explanation of TEQ is given in Appendix II.

** These sample numbers identify the samples in the Analytical and Environmental Services reports.

Table 3

Hydrogen Fluoride and Hydrogen Bromide Emissions – 16th April 2003

Compound Measured	Sampling Period	Test Result mg/Nm^3	Emission Limit Value mg/Nm^3
Hydrogen Fluoride	10.30 - 11.10	Less than 0.4	4
Hydrogen Fluoride	11.15 - 12.25	Less than 0.4	4
Hydrogen Fluoride	12.30 - 13.14	Less than 0.4	4
Hydrogen Bromide	10.30 - 11.10	Less than 0.5	5
Hydrogen Bromide	11.15 - 12.25	Less than 0.5	5
Hydrogen Bromide	12.30 - 13.14	Less than 0.5	5

Appendix I

Sampling and Analytical Methods

Sampling and Analytical Methods

Dioxins Emissions

The term dioxins is used in this report to include the 17 congeners of dioxins and dibenzofurans specified in the company's integrated pollution control licence.
The flue gas was sampled using a Graseby Anderson Universal Stack Sampler as outlined in U.S. E.P.A. Method 23. This involves drawing a measured volume of the flue gas through a heated sampling probe and filter and then through a cooled XAD 2 resin trap over a period of at least six hours. The filter and resin trap together with washings of the sampling train are collected and preserved as the sample.
This sample was analysed by Analytical and Environmental Services, Northumberland Dock Road, Wallsend, Tyne and Wear, United Kingdom.
The blank sample was collected in the same manner except that no gas was drawn through the sampling train, this result is used to measure any contribution from the equipment, collecting medium or washing solvents.
The results are expressed as ng/Nm^3, dry gas corrected to 11% oxygen content.
A copy of the Analytical and Environmental Services report is supplied separately. The report is numbered D2467 - 2470.

Dioxins in Ash and Fly-Ash

A sample of the ash and fly-ash were collected by the company from the Solid Waste Incinerator during the emission test. These samples were sent to be analysed by Analytical and Environmental Services, Northumberland Dock Road, Wallsend, Tyne and Wear, United Kingdom. The leachates were prepared according to DIN 38414. These leachate samples were then analysed for dioxin content. The results are expressed as ng/l of leachate.
A copy of the Analytical and Environmental Services report is supplied separately. The report is numbered D2464 - 2466.

Hydrogen Fluoride and Hydrogen Bromide

A measured volume of flue gas was drawn through high purity water in plastic impingers over periods of about 30 to 60mins. After each sampling period, sample collection was completed by drawing about 25mls of high purity water through the PTFE sampling probe into the impingers. The samples were returned to the Enterprise Ireland laboratories where total fluoride and bromide were determined by ion-chromatography as per method 4110B: "Determination of Anions by Ion Chromatography - Standard Methods for Examination of Water and Wastewater - 19th edition 1995".
The result is expressed as mg/Nm^3, dry gas corrected to 11% oxygen content.

Standardisation of Flue Gas Emissions

The concentrations of flue gas emissions have been calculated to standard reference conditions as specified in the company's Integrated Pollution Control Licence Reg. No. 545.

- Temperature : 273 K.
- Pressure : 101.3 kPa.
- Oxygen : 11 %.
- Dry gas :

Appendix II

Explanation of TEQ

Toxic Equivalents

In order to assess the toxicity of complex mixtures of PCDDs (dioxins) and PCDFs (furans) the concept of toxic equivalents was devised. International Toxicity Equivalent Factors are assigned to individual dioxins and furans on the basis of how toxic they are in comparison with 2,3,7,8-TCDD, the most potent dioxin which has been assigned a value of 1.0. By comparison, animal and cell tests show that 2,3,7,8-TCDF is approximately one-tenth as toxic as 2,3,7,8-TCDD. Consequently its toxic equivalent value is 0. 1.

International Toxicity Equivalent Factors have been developed for those dioxins and furans that contribute most to the toxicity of a complex mixture which are those that have chlorine substitution in at least the 2,3,7 and 8 positions. Multiplication of the concentration of a particular PCDD or PCDF by its International Toxicity Equivalent Factor therefore gives a 2,3,7,8-TCDD Toxic Equivalent. The toxicity of any mixture, relative to 2,3,7,8-TCDD is therefore the sum of individual Toxic Equivalents.

Of the 210 dioxins and furans, 17 contribute most to the toxicity of a complex mixture and are of most concern. This does not mean that the remaining 193 dioxins and furans are not toxic but that they contribute comparatively little to the toxicity of a complex mixture.

The most widely accepted Toxic Equivalent system is the NATO/CCMS system.

When measuring the emission of dioxins and furans the Environmental Protection Agency specifies that these 17 congeners should be determined. The amount of each congener found is multiplied by its Toxic Equivalent Factor and the results added together to obtain their I-TEQ (International Toxic Equivalent) or TEQ (Toxic Equivalent). The limit set in the company's Integrated Pollution Control Licence is for these 17 congeners TEQ.

Dioxin and Furan Congeners (17) and their Toxic Equivalent Factors

Compound	I-TEF
2,3,7,8-Tetrachlorodibenzodioxin (TCDD)	1
1,2,3,7,8-Pentachlorodibenzodioxin	0.5
1,2,3,4,7,8-Hexachlorodibenzodioxin (HxCDD)	0.1
1,2,3,7,8,9-Hexachlorodibenzodioxin (HxCDD)	0.1
1,2,3,6,7,8-Hexachlorodibenzodioxin (HxCDD)	0.1
1,2,3,4,6,7,8-Heptachlorodibenzodioxin (HpCDD)	0.01
Octachlorodibenzodioxin (OCDD)	0.001
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	0.1
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	0.5
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	0.05
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzofuran (OCDF)	0.001