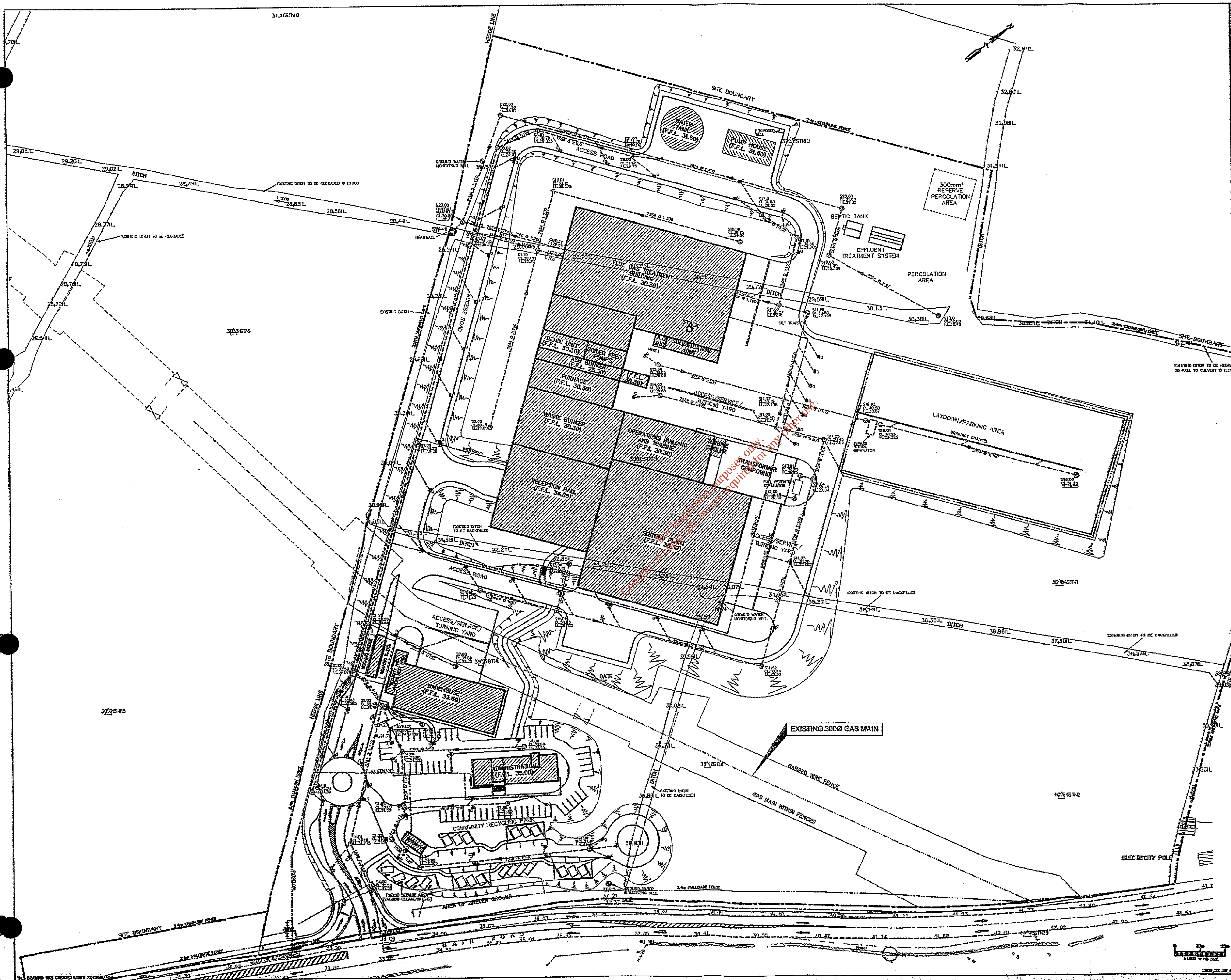
Attachment H9.4 **Drawing No. 2666-22-DR-011: Location of Surface Water Discharge Point**



NOTES

1. AC UNIT REFERS TO ACTIVATED CARBON / LIME MIXTURE UNIT

LEGEND

Symbol	Description
S1.0	SURFACE WATER SEWER/MANHOLE
SW-1	SURFACE WATER OUTFALL

ISSUE	DESCRIPTION	DRN	CHKD	AUTH CHK	APP	DATE
C	RE-ISSUE FOR INFORMATION					
B	RE-ISSUE FOR INFORMATION	KMcK	GC		SJC	10/08/03
A	FOR INFORMATION	EMT				13/02/03

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Project Management Group
Cork - Dublin

PROJECT: WASTE MGMT FACILITY - CARRANSTOWN

TITLE: LOCATION OF SURFACE WATER DISCHARGE POINT

CLIENT REF.	CLIENT DRG No.
PROJECT No. 2866	
A0 SCALE NONE	CONT'R DRG No. 2866-22-DR-011

Attachment H9.5 **Completed Waste Licence Application Table 1.14 (Surface Water Emissions)**

Table 1.14 SURFACE WATER EMISSIONS

(ONE TABLE PER EMISSION POINT)

Emission Point Ref. Nº:	SW1	
Source of Emission:	Surface run-off	
Location of emission point:	Wet drain to west of site	
Grid Ref. (12 digit, 6E, 6N):	306128 E, 270865 N	
Date of commencement:	2004	
Periods of emission (avg.):	The period or periods during which excess surface water is discharged will be dependent on rainfall patterns and cannot be defined exactly.	
Volume to be emitted:	Average/day:	0 m^3/d
	Maximum rate/hour:	48 m^3/h
	Maximum rate/day:	1150 m^3/d
Name of receiving water:	River Nanny	
Flow rate in receiving water:	.....0.04 m^3 sec^{-1} Dry Weather Flow .....0.25 m^3 sec^{-1} 95%ile flow	
Available waste assimilative capacity: kg/day	**Not available**	

ATTACHMENT NUMBER H10

Discharge to Sewer

Contents

H10.1 DISCHARGE TO SEWER

1. CONSTRUCTION IMPACTS

There will be no discharge to sewer during the construction phase of the development.

Temporary toilets and washing facilities will be provided on site for the duration of the construction period. Sanitary waste from toilets and washing facilities will be discharged to a temporary sewerage storage facility. Sanitary waste will be held on-site prior to removal and disposal off-site by a licensed waste contractor to an approved waste disposal facility. On completion of the construction period, the sanitary facilities will be removed off site, whereby the area will be fully sterilised and restored.

2. OPERATION IMPACTS

There will be no discharge to sewer during the operational phase of the development.

All domestic sewage generated on site will be treated before being discharged to a percolation area. The details of the treatment system and percolation area are provided in Attachment H6.

There will be no trade effluent generated at the site.

ATTACHMENT NUMBER H11

Wastes Arising

Contents

Attachment H11.1 Wastes Arising

H11.1 WASTES ARISING

1. SOLID RESIDUES

While the type and quantity of ash produced from any solid waste incineration process is dependent on the nature of the waste feed, experience has shown that with a typical mix of industrial, commercial and municipal waste, approximately 250 kg of solid waste residue is produced per tonne of waste. There will be four solid waste residues collected from the proposed waste to energy plant:

- Bottom ash
- Boiler ash
- Flue gas cleaning residues
- Gypsum

These will be generated continuously at a relatively constant rate throughout the year. All ashes will be stored within the process building.

The bulk at about 20% of waste input (by weight) or 30,000 tonnes (as dry material) per annum is bottom ash, mainly consisting of inert material such as sand, glass, scrap and stones. The bottom ash coming from the furnace will discharge into a water bath called a "wet bath" to cool the ashes to ambient temperature. The ash will be transported via conveyor to the ash bunker. Metal (approximately 2,100 tonnes/annum) will be recovered from the bottom ash using either a sieve or magnetic system prior to the ash bunker. The bottom ash in the ash bunker will be loaded by grab crane into trucks within the waste to energy plant building, eliminating the potential for windblown ash. These trucks will be covered and transported off site to a licensed landfill. The metal will be sent off-site to an appropriate recycling facility

About 1-2% or 1,500 to 3,000 tonnes per annum will be collected as boiler ash. The boiler ash in the hoppers beneath the boiler will be brought by conveyor to the boiler ash silos. The boiler ash may require solidification prior to landfill. This will be dependent on the composition of the ash. If solidification is required, a solidification plant may be installed within the facility, where the boiler ash would be mixed with cement/iron silicate and water, and placed into large bags. The solidification process will chemically bind the ash to the cement/iron silicate producing a solid, inert material, also eliminating any dust generation. These bags would then be transported from the plant via covered trucks to a non-hazardous or hazardous landfill, depending on analysis. For further details on cement or iron silicate, see Table 1.10 in Attachment E5.2. If a solidification plant is not installed at the facility, the ash will be solidified off site, if required, prior to landfill.

Some 2-3% or 3,500 to 5,000 tonnes per annum of the waste input will be collected as flue gas cleaning residues. The flue gas cleaning residues will be conveyed to the flue gas cleaning residue silos, which will be located within the waste to energy plant building. The flue gas cleaning residues will require solidification prior to disposal at a hazardous/non-hazardous waste landfill. If the solidification plant is installed at the

facility, these residues will be solidified with cement/iron silicate and water and transported in large bags on covered trucks. If a solidification plant is not installed at the facility, the flue gas cleaning residues will be solidified off site prior to landfill.

If installed, there will be one solidification plant which will be used for both boiler ash and flue gas cleaning residues but at different times for different batches of material. In the solidification process, cement/iron silicate, at 20% of the ash input, and water, at 50% of the ash input, will be mixed with the ash in an agitated tank. This mixture will then be discharged into $1m^3$ flexible intermediate bulk containers (FIBCs). The FIBCs will be loaded into covered trucks and sent to an appropriate licensed landfill.

Approximately 1,000 tonnes of gypsum will be collected from the wet flue gas cleaning plant. Gypsum from the vacuum belt filter in the wet flue gas cleaning system will be collected in a bunker. It will be loaded into covered trucks and transported off site for recovery or disposal to a licensed landfill

The quantities and descriptions of solid wastes that will be produced are summarised below.

The classification and descriptions of the wastes as described below are obtained from the European Waste Catalogue,

Section 19 refers to "Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use"

Section 19 01 refers to "Wastes from incineration or pyrolysis of waste"

Table 1.1 Solid Wastes produced in Waste to Energy Plant

Waste Stream	European Waste Code[1]	European Waste Code Description	% of Waste Input	Approximate Production (based on waste throughput of 150,000 tonnes/annum)
Bottom Ash	19 01 12	Bottom ash and slag other than those mentioned in 19 01 11[2]	20	30,000
Boiler Ash	19 01 15	Boiler dust containing dangerous substances	1 – 2	1,500 – 3,000
	19 01 16	Boiler dust other than those mentioned in 19 01 15		
Flue Gas Cleaning Residues	19 01 13	Fly ash containing dangerous substances	2 – 3	3,500 – 5,000
	19 01 10	Spent activated carbon from flue gas treatment		
Gypsum	19 01 99	Wastes not otherwise specified	0.67	1,000
Metals	19 01 02	Ferrous materials removed from bottom ash	1.4	2,100

Notes:

1. These European Waste Codes are as detailed in the EU Directive, 2001/118/EC, List of Wastes, effective from 1/1/02
2. 19 01 11 refers to bottom ash and slag containing dangerous substances

2. COMPOSITION, ANALYSIS AND CLASSIFICATION

Other than classification as hazardous, inert or otherwise, there is no Irish or EU standard for the quality of ash disposed of to landfill. The decision on whether or not the ash is hazardous will be made by referring to the classification set out in the European Waste Catalogue (EWC). If the ash does not contain the properties listed in H1 - H14 of the "Waste Catalogue and Hazardous Waste List" and Annex III of Directive 91/689/EEC, it is non-hazardous and is suitable for disposal in a non hazardous waste landfill.

In Germany, the quality of ash for use in road construction is defined by the Regional Work Group on Waste (LAGA) based on leachate tests. Figure 2.1 below indicates the German standards for the quality of leachate required of ash for use in construction and for ash to be disposed of in landfill for inert waste. A copy of the relevant LAGA standard is contained in Attachment H11.2.

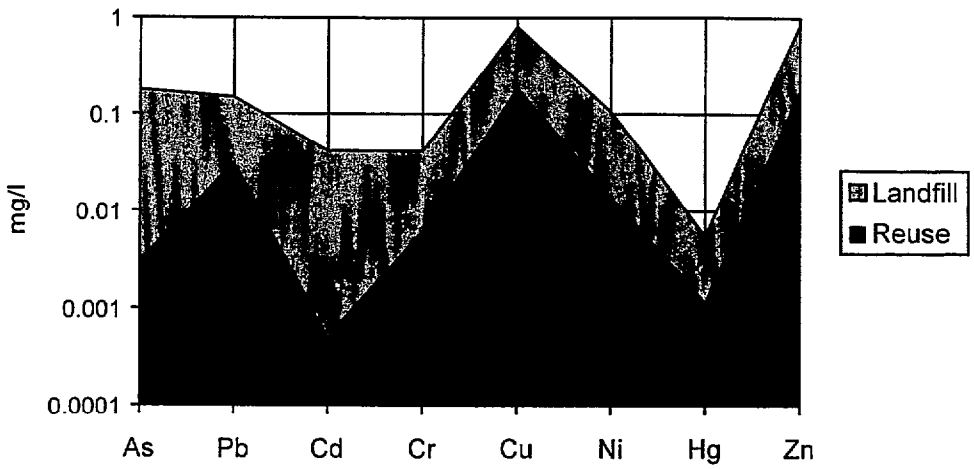


Figure 2.1 Ash Quality for Reuse and Landfill

A composite sample of each ash (Bottom ash, flue gas cleaning residues, boiler ash and gypsum) will be collected into a sampling container over a period of a week. These samples shall be sent to external consultants for compaction and drying. The samples shall then undergo the following tests at an accredited laboratory:

Table 2.1 Analysis of Ashes

Parameter	Frequency
Leachability and leachate (total soluble fraction, heavy metals soluble fraction and salts soluble fraction)[1]	Weekly
Composition	Weekly initially, then less often if composition remains standard
Total Organic Carbon[2]	Weekly

Notes:

1. Leachability and leachate testing will be carried out in accordance with the German DIN S4 standard.
2. A TOC analysis will be carried out on bottom ash to ensure compliance with the EU requirement of less than 5% unburnt material.

For flue gas cleaning residues, sampling and analysis will take place both before and after solidification.

A leachate test on the samples will be carried out so that the results can be compared with the requirements of the EU Directive and the German LAGA standard. This will ultimately determine if the ash is suitable or unsuitable for non-hazardous landfill disposal in accordance with the Landfill Directive (99/31/EC) and Directive 91/689/EEC.

This leachate testing will be carried out in accordance with the German DIN S4 Standard on ash analysis. A copy of this standard is contained in Attachment H11.3.

Typical analyses of boiler ash and flue gas cleaning residues from a similar Indaver facility in Belgium are included in Attachment H11.4.

3. RESIDUE STORAGE

3.1 BOTTOM ASH

Bottom ash will be stored in a 1,200m^3 ash bunker, which is located within the process building as shown on Drawing No. 2666-22-DR-021 in Attachment H11.5. The maximum amount of bottom ash that can be stored on site will be 1,500 tonnes. However, the average amount stored at any time will be less than half of this.

3.2 BOILER ASH

There will be two boiler ash silos, each with a capacity of 50m^3, located within the waste to energy plant building as shown on Drawing No. 2666-22-DR-021. The maximum storage on site will be 100 tonnes. However, the average amount stored on site will be less than half of this.

3.3 FLUE GAS CLEANING RESIDUES

There will be two 100 m^3 flue gas cleaning residue ash silos located within the waste to energy plant building as shown on Drawing No. 2666-22-DR-021. The maximum storage on site will be 200 tonnes. However, the average amount stored on site will be less than half of this.

3.4 GYPSUM

There will be two 20 m^3 gypsum storage units located within the waste to energy plant building as shown on Drawing No. 2666-22-DR-021. The maximum storage on site will be 40 tonnes.

4. OTHER WASTES

4.1 WASTE OILS

Hydraulic oil will be used for lubrication and cooling of moving parts through the waste to energy plant and materials recycling facility. The petrol interceptors will be inspected regularly and any material such as grit, stones or oily water will be removed. As a result, small amounts of waste oil may be generated, the details of which are summarised in Table 4.1 below.

4.2 KITCHEN WASTE

As there will be approximately 50 staff on site, residual food waste, glass, aluminium cans and plastics will be generated in the canteen and kitchen.

4.3 Office Waste

As there will be approximately 50 staff on site, office waste such as paper, cardboard, fluorescent tubes, batteries, detergents, plastics and redundant electrical equipment such as computers will occur.

4.4 Waste from Landscaping

Garden and green waste from landscaping on site will be generated.

4.5 Residual Waste from Materials Recycling Facility

The residual waste from the materials recycling facility will include any materials not suitable for recycling.

4.6 General Waste

This will include items such as pallets from delivery of equipment. Other wastes arising will include redundant items of process equipment such as pumps, motors, etc and refractory lining from the furnaces.

Table 4.1 Other Wastes produced at the Waste Management Facility

Waste Stream	European Waste Code	European Waste Code Description	Annual Production
Waste Hydraulic Oil	13 01 09	Mineral-based non-chlorinated hydraulic oils	It is extremely difficult to predict the quantities that will be produced. However, it is expected that only small quantities will arise.
	13 01 11	Synthetic hydraulic oils	
	13 01 12	Readily biodegradable hydraulic oils	
Petrol Interceptor Residues	13 05 06	Oil from oil/water separators	It is extremely difficult to predict the quantities that will be produced. However, it is expected that only small quantities will arise.
	13 05 07	Oily water from oil/water separators	
	13 05 02	Sludges from oil/water separators	
Kitchen Waste	20 01 08	Biodegradable kitchen and canteen waste	It is extremely difficult to predict the quantities that will be produced. However, it is expected that only small quantities will arise.
	20 01 25	Edible oil and fat	
	20 01 02	Glass	
	20 01 39	Plastics	
	20 01 40	Metals	
Office Waste	20 01 01	Paper and Cardboard	It is extremely difficult to predict the quantities that will be produced. However, it is expected that only small quantities will arise.
	20 01 21	Fluorescent tubes and other mecruy-containing waste	
	20 01 29	Detergents containing dangerous substances	
	20 01 30	Detergents other than those mentioned in 20 01 29	
	20 01 33	Batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries	
	20 01 35	Discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components	
	20 01 39	Plastics	
	20 01 40	Metals	
Waste from landscaping	20 02 01	Biodegradable waste	It is extremely difficult to predict the quantities that will be produced. However, it is expected that only small quantities will arise.
	20 02 02	Soil and stones	
Residual Waste from Materials Recycling Facility	19 12 12	Other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11	Approximately 20% of input to Materials Recycling Facility, i.e. 4,000 tonnes per annum
General Waste	20 01 38	Wood other than that mentioned in 20 01 37	It is extremely difficult to predict the quantities that will be produced. However, it is expected that only small quantities will arise.

5. WASTE DISPOSAL ARRANGEMENTS

The solid wastes will be removed by appropriately permitted waste management contractors and disposed of to suitably licensed facilities. Prior to operation of the facility full details of the contrsactors and facilities will be submitted to the EPA.

There may be recovery options for the bottom ash and gypsum, which are discussed in the sections below.

5.1 BOTTOM ASH

It is the intention of Indaver Ireland to proactively identify potential uses for the bottom ash. This material is suitable for use in road construction and such a use would be in accordance with government policy on re use of waste. Although there is no Irish or European legislation or standard governing the quality of ash for use in roads, if the ash is to be used for road construction it must generally be of better quality than if it were to be disposed of in landfill. For example, in Germany the quality of ash for use in road construction is defined by the Federal Work Group on Waste (LAGA) based on leachate tests.

This improvement in quality can be achieved by treating the ash in an ash recovery plant and if a suitable use for the ash can be identified it may be treated to the necessary standard.

Legislation will be required if the re-use of bottom ash is to be developed, as has happened in other European countries. If no such legislation is enacted or no market can be found for the bottom ash, it will be disposed of to a suitably licensed non-hazardous landfill site.

5.2 BOILER ASH

The boiler ash will consist of compounds that will be carried over in vapour or particulate form from the combustion chamber. It will contain a higher concentration of heavy metals than the bottom ash and will therefore be solidified with cement/iron silicate, either on or off site, prior to disposal to landfill. Depending on analysis, this ash may be classified as hazardous or non-hazardous waste and will be disposed of in a hazardous or non-hazardous waste landfill. However, from Indaver's experience of operating a similar facility, it is expected that this ash will be classified as non-hazardous.

5.3 FLUE GAS CLEANING RESIDUES

The material collected in the baghouse filter will contain particulates not collected as boiler ash. It will also contain salts from the evaporating spray towers (essentially solid residues from the flue gas cleaning process) and activated carbon. These residues will be classified as hazardous waste and as such must be disposed of in a hazardous waste landfill. Prior to disposal these residues will be solidified with cement/iron silicate, either on or off-site.

Although it is an objective of the EPA National Hazardous Waste Management Plan to develop hazardous waste landfill capacity in Ireland there is currently no such capacity. If, at the time of commissioning of the waste to energy plant there is no

landfill capacity, the flue gas cleaning residues and boiler ash will be exported for final disposal pending the establishment of a hazardous waste landfill in Ireland.

5.4 GYPSUM

Gypsum will be removed from the purge from the wet flue gas cleaning system prior to its injection into the evaporating spray towers. It can be used in the construction industry, and the gypsum recovery facility will be improved to comply with the standards required if a market exists, depending on the sulphur content of the waste. If no market is found it will be suitable for disposal to non-hazardous landfill.

5.5 METAL

The metal recovered from the bottom ash will be sent off-site to an appropriate recycling facility.

5.6 OTHER WASTES

5.6.1 Waste Oils

Waste oils will be stored in a properly bunded area and will be sent for recycling off site.

5.6.2 Kitchen Waste

If possible, biodegradable kitchen waste will be composted on site or sent off site for composting. Otherwise this material will be sent to the Waste to Energy Plant for incineration. Recyclable kitchen waste such as glass, plastics, where possible, and cans will be stored separately and sent off site for recycling.

5.6.3 Office Waste

Office waste such as paper, cardboard, fluorescent tubes, batteries and plastics, where possible, will be sent off site for recycling. Detergents and redundant electrical equipment will be sent off site for disposal at appropriately licensed facilities.

5.6.4 Waste from Landscaping

If possible, garden and green waste will be composted on site or sent off site for composting.

5.6.5 Residual Waste from Materials Recycling Facility

The residual waste from the materials recycling facility will be sent to the waste to energy plant for incineration.

5.6.6 General Waste

General waste may be removed from site by appropriately permitted waste contractors and disposed to suitably licensed facilities or sent to the waste to energy plant. Items such as wood waste will be sent for recycling.

Attachment H11.2 **Federal Work Group on Waste (LAGA) Standard**

Translation of Laga Standard
(German Regional Working Group on Waste)

UNOFFICIAL TRANSLATION

LAGA
(German Regional Working Group on Waste)

Incorporation Category	Reference Value[1] (as upper limit of Incorporation Category)
Unrestricted incorporation Restricted open incorporation Restricted incorporation subject to defined technical precautionary measures	Reference Value 0 (Z 0) Reference Value 1 (Z 1) Reference Value 2 (Z 2)
Incorporation / storage in landfills TA Technical Directive on Domestic Waste - Landfill Class I TA Technical Directive on Domestic Waste - Landfill Class II TA Technical Directive on Waste, Hazardous Wastes Landfill	Reference Value 3 (Z 3) Reference Value 4 (Z 4) Reference Value 5 (Z 5)

[1] allocation/assignment value; [classification]

Parameters		Reference Value Z 2
Appearance Colour Odour		to be specified to be specified to be specified
Dry residue Incandescent heat loss	% by weight % by weight	to be specified to be specified
Total organically fixed carbon (TOC) Extracted organic halogens (EOX)	% by weight mg/kg	1 3

Parameters		Reference Value Z 2
Coloration Turbidity Odour		to be specified to be specified to be specified
pH Electrical conductivity	µS/cm	7-13 6000
Dissolved organically fixed carbon (DOC)	mg/l	to be determined for empirical purposes
Arsenic Lead Cadmium Chromium, total Copper Nickel Mercury Zinc	mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l	to be determined for empirical purposes 0.05 0.005 0.2 0.3 0.04 0.001 0.3
Chloride Sulphate Cyanide (easily liberatable)	mg/l mg/l mg/l	250 600 0.02

2. Slag and Ash from Thermal Waste Treatment Plant

2.1 Introduction

Reprocessing measures are generally called for in regard to the recycling of slag and ash from thermal waste treatment plant. These measures are discussed in detail in an LAI (*German Regional Pollution Control Committee*) Standard Administrative Regulation governing the avoidance and recycling of residual materials in accordance with Article 5, Par. 1(3), BImSchG (*German Federal Ambient Pollution Control Act*), published in an LAGA Code of Practice on "Disposal of Residual Matter from Incineration Plant for Domestic Refuse". The Code of Practice also contains stipulations on solid contents.

2.1.1 Applicability

The present Technical Regulations apply to the use and recycling of the following kinds of waste and residual matter.

Waste Code	Designation
313 08	Slag and ash from waste incineration plant

2.1.2 Origin

The above-mentioned kinds of waste are produced in connection with the thermal treatment of waste.

2.1.3 Investigation Concept and Requirements

Before the above-mentioned materials are recycled, their endangering potential must be determined with reference to property meriting protection, as itemised in Article 2, Par. 1, AbfG (*German Waste Avoidance and Management Act*) - in particular, human health, water, soil, and air. In order to provide uniformity in the context of enforcement, Reference Values have been established to ensure environmentally compatible recycling of the materials itemised in Section 2.1.1, with due allowance for their endangering potential. In this connection, distinction is made between a number of Incorporation Categories, which are classified on the basis of origin, nature, and use according to locational prerequisites.

The definition of these Reference Values is identical to that provided in the Technical Regulations for the Recycling of Mineral Wastes and Residual Matter from the Construction Industry, Contaminated Sites and Occurrences of Damage.

Various different recycling options are indicated for the individual Incorporation Categories. The categories may be further differentiated in accordance with site hydrogeological conditions, specific conditions of incorporation, and use at the site of incorporation.

These Reference Values are provided by way of guideline values. Departures from the present Technical Regulations may be allowed where, in the individual situation, proof is duly furnished that the public good will not be impaired as a result.

2.2 Slag and Ash from Incineration Plant for Domestic Refuse (HMV - *domestic waste incineration*)

2.2.1 Definition

The incineration of domestic refuse produces solid residual matter which, at the end of the incinerator grating, is dropped into the wet slag remover or into some other discharge system (grating discharge), or which falls through the gaps of the incinerator grating into the air receiver located underneath (grating riddlings).

(continued on page 35)

HMV (*domestic waste incineration*) raw slags, comprising grating discharge and grating riddlings, are conglomerates of sintered combustion products (slags), scrap iron and other metals, glass and ceramic particles, other mineral constituents, and nonburned residues.

These slags do not include boiler dust, filter dust and other residual matter from exhaust gas purification (inter alia, see 17th BimSchV - *German Federal Ambient Pollution Control Ordinance*), which are to be collected separately from other solid residual matter.

With a view to coming closer to the goal of obtaining slags for recycling purposes that are as low as possible in heavy metal content, it is advantageous to withdraw the grating riddlings separately, and to return them to the incineration process where necessary on account of their high organic content.

HMV (*domestic waste incineration*) raw slags must be reprocessed and stored before they are recycled. These prepared and stored raw slags are referred to as HMV-slags in the following.

Chemical composition and elution properties may vary a great deal as a function of the composition of the incinerated waste, the conditions of incineration, and the required reprocessing of the residual matter. The quality of conventional HMV-slags may be enhanced by waste management measures, by selective removal of pollutants, and by further treatment.

2.2.2 Investigation Concept

Comprehensive figures are available on the composition and the elution properties of conventional HMV-slags. Because of their origin, these slags may contain, in particular, high contents of heavy metal and easily soluble salts. Accordingly, proof of a HMV-slag's suitability for recycling must be furnished prior to its use for the first time. Analytical examinations as described in Tables II. 2.2-1 and II. 2.2-2 should be conducted for this purpose. Sampling methods are stipulated in Part III.

Table II. 2.2-1: Reference Values and Solids Examination for HMV-Slags

Parameter	Dimension	Reference Value	Findings in regard to Suitability	External Monitoring Surveillance	In-Plant Inspection
Appearance	-	- [1]	+	+	+
Colour	-	- [1]	+	+	+
Odour	-	- [1]	+	+	+
Dry residue	% by weight	- [1]	+	+	+
Incandescent heat loss	% by weight	- [1]	+	+	+
Total organically fixed carbon (TOC)	% by weight				
Extracted organic halogens (EOX)	mg/kg				

missing from faxed end of page [34?] and top of page 35 - assumed to be same as table on page 2 of this file! - assignment of following 'footnote 2)' not known!

[1] to be specified
[2] 3 % by weight for contaminated sites

Table II. 2.2-2: Reference Values and Eluate Examination for HMV-Slags

Parameter	Dimension	Reference Value	Findings in regard to Suitability	External Monitoring Surveillance	In-Plant Inspection
Coloration		- [1]	+	+	+
Turbidity		- [1]	+	+	+
Odour		- [1]	+	+	+
pH		7 - 13	+	+	+
Electrical. conductivity	µS/cm	6000	+	+	+
DOC	µg/l	- [2]	+		
Arsenic	µg/l	- [2]	+		
Lead	µg/l	50	+	+	
Cadmium	µg/l	5	+	+	
Chromium, total	µg/l	200	+	+	
Copper	µg/l	300	+	+	
Nickel	µg/l	40	+	+	
Mercury	µg/l	1	+	+	
Zinc	µg/l	300	+	+	
Chloride	mg/l	250	+	+	
Sulphate	mg/l	600	+	+	
Cyanide (easily liberatable)	mg/l	0.02	+		

[1] to be specified
[2] to be determined for empirical purposes[2]

HMV-slags intended for recycling are additionally subject to quality control for the purpose of assuring their product characteristics. This quality control comprises an in-plant inspection conducted by the reprocesser, and further examinations as described in Tables II. 2.2-1 and II. 2.2-2, carried out within the scope of quarterly or half-yearly external monitoring surveillance - provided, where possible, by a testing laboratory recognised under German Federal Land legislation.

2.2.3 Evaluation and Consequences in regard to Recycling

The HMV-slag to be recycled is classified under Incorporation Categories as a function of the level of pollution found in same. Incorporation Category 2 is the only such category considered for reprocessed HMV-slags at the present time.

[2] for the purpose of gathering experience

The scope of recycling may be broadened by comparison with conventional HMV-slags in cases in which the proportion of easily-soluble constituents has been reduced.

2.2.3.1 Z 2 - Restricted Incorporation subject to Defined Technical Precautionary Measures

The values indicated in Tables II. 2.2-2 and II. 2.2-3 (Z 2 Reference Values) represent the upper limit for the incorporation of HMV-slags subject to defined technical precautionary measures. The intention is to prevent the transporting of constituents into the ground and into the groundwater. The groundwater as 'property meriting protection' is the critical aspect taken into consideration in determining these values.

Consequences in regard to recycling:

At levels below the Z 2 Reference Values, the HMV-slags indicated in Section 2.2.1 may be incorporated in certain construction projects on provision of the technical precautionary measures defined below:

a) in road and path construction, for the installation of paved surfaces in industrial and commercial areas (parking places, storage areas), and other traffic areas (for example, airports, port regions, goods transport centres), as
   - base course below water-impermeable surfacing (concrete, asphalt, paving setts) and
   - fixed base course below slightly permeable surfacing (paving setts, slabs);

b) for earthworks (controlled large-scale construction projects) in hydrogeologically favourable regions, as
   - noise-abatement earth wall with mineral surface seal ($d > 0.5$ m and $k_f < 10^{-8}$ m/s) and overlying re-cultivation layer, and

Table II. 2.2-3: Stipulations on Scope of Documentation

Supplier / Reprocesser	**Carrier / Incorpor-ater**	**Construction project sponsor**	
x	x	x	Site of incorporation (location, coordinates, land registry reference)
x	x	x	Nature of project
x	x	x	Nature and origin of HMV-slag
x		x	Certificate of quality, analysis results
x		x	Incorporation Category
x	x	x	Quantity (shipped, transported, incorporated)
		x	Hydrogeological conditions (e.g. distance from highest groundwater level, formation of surfacing)
		x	For Incorporation Category 2, nature of technical precautionary measures
x	x		Sponsor of construction project
x		x	Carrier
x	x	x	Incorporating company

- road embankment (sub-base) with water-impermeable carriageway surface and mineral surface seal ($d > 0.5$ m and $k_f < 10^{-8}$ m/s) in slope region, with overlying re-cultivation layer.

A site is deemed hydrogeologically favourable where, for example, the water-bearing stratum is covered on the upper side by plane-distributed, sufficiently thick covering layers having a high retention capacity in respect of pollutants. A retention capacity of this kind is generally provided by covering layers of clay, silt or loam in a thickness of at least 2 metres.

A distance of at least 1 metre should be maintained between the base of the fill and the highest anticipated groundwater level.

Incorporation is preferred in connection with large-scale construction projects.

The construction engineering requirements of road building (standard construction methods) must be observed in connection with the measures referred to under a) above. Moreover, it is appropriate to choose areas in which frequent tearing up or breaking up of the roadway is not anticipated (for the purpose of repairing supply and disposal pipes or cables, for example).

The equivalence of any construction methods other than those indicated under a) and b) above must be certified in consultation with the competent authority.

It is also possible to use the present Incorporation Category of HMV-slag for construction engineering purposes in the landfill site body, for example as levelling course between the body of waste and the surface-sealing system.

Construction projects are not allowed

- in established, provisionally secured, or officially planned drinking-water protection areas (I-III B),
- in established, provisionally secured, or officially planned healing-spring conservation areas (I-IV),
- in water priority areas which are listed under regional planning in the interest of securing future water supplies,
- in areas subject to frequent inundation (for example, flood control basins, areas enclosed by dykes),
- in karstic areas without adequate covering layers, in marginal areas which drain in karst, and in regions having a severely fissured, particularly water-conductive subsoil, and
- for precautionary reasons, also on surfaces whose use is of a sensitive nature, for example children's playgrounds, sports grounds, shooting grounds[3], and school yards.

It is not allowed to use the present Incorporation Category of HMV-slag in drain layers.

Where incorporating HMV-slags, due note should be taken of the fact that supply and disposal pipes and cables may be exposed to the risk of sulphate corrosion.

Unless otherwise stipulated in specific, standard interregional regulations, recycling within important areas with regard to water management, and in vulnerable or hydrogeologically sensitive areas, is subject to case-by-case examination by the competent authorities.

[3] 'Bolzplätze': could not find exact translation!

2.2.4 Quality Control

Quality control comprises a combination of in-plant inspection by the reprocesser and external monitoring surveillance.

Within the scope of his in-plant inspection, the reprocessor duly undertakes to subject the fractionated, classified and stored slag to weekly examination in regard to the parameters itemised in Tables II. 2.2-1 and II. 2.2-2.

In order to simplify the three-month period of storage prior to recycling, the HMV-slag should not be stockpiled continuously, but should be stored in clamp form. Other forms of storage or suitable measures appropriate to the available space and operational practice are also permitted, provided that they will allow unambiguous identification and allocation.

HMV-slag pending recycling is to be subjected to quality-control examination every six months in regard to the parameters itemised in Table II. 2.2-1, and the eluate is to be examined every quarter in regard to the parameters itemised in Table II. 2.2-2.

2.2.5 In-Plant Inspection, Quality Assurance and Record Keeping

The stipulations governing examination, evaluation, incorporation, and other recycling of HMV-slags call for a quality assurance and control system. The procedures in question and the competent agencies are to be established on an interregionally standard basis.

Irrespective of any such system, any exceeding of Reference Values can be tolerated only within the confines of measuring inaccuracies, and cannot be allowed to become systematic.

Any exceeding of Reference Values is deemed systematic where the admissible value of a parameter is exceeded by more than the relevant measuring inaccuracy on two successive monitoring occasions.

Systematic exceeding of the values itemised in the tables must be notified to the competent authority, who will then decide on the admissibility of further recycling.

The incorporation of HMV-slags must be recorded. Such records should be kept in conformity with Table II. 2.2-3. Details with regard to procedure are to be determined by the competent authority.

3. Mineral Residual Matter / Foundry Waste

3.1 Introduction

In-plant measures for the avoidance and recycling of residual matter and waste, and the external re-generation of sand, are of major importance in regard to the reduction of residual matter and/or waste from foundries, given that they possess considerable potential for the avoidance of residual matter and/or waste - preference is to be duly accorded to such measures. These measures are discussed in detail in the appropriate LAI (*German Regional Pollution Control Committee*) Standard Administrative Regulation governing the avoidance and recycling of residual materials in accordance with Article 5, Par. 1(3), BImSchG (*German Federal Ambient Pollution Control Act*), and are not therefore included as subject-matter of the present Technical Regulations.

Attachment H11.3 German DIN S4 Standard, DIN 38 414

Translation of DIN 38 414
(German standard methods for the examination of water, wastewater and sludge)

UNOFFICIAL TRANSLATION

German Standards October 1984

	German Standard methods for the examination of water, waste water and sludge Sludge and Sediments (Group S) Determination of the leachability by water (S 4)	DIN 38 414

This standard was set up jointly with the expert group 'Water Chemistry' in the German Chemical Engineering Society (Gesellschaft Deutscher Chemiker) (see explanatory comments).

It is required to seek the advice of experts or of relevant institutions during examinations carried out according to this Standard.

1 Area of Application

The procedure is applicable to solid, pasty and muddy materials. In the event that sludges release water during periods of settlement, i.e. that they form a sludge/water layer (thin/watery sludges), it is practical to pre-treat these samples according to section 6.4.

2 Purpose

This procedure shall establish the substances that are contained in the materials to be examined and which are dissolved in water according to the conditions of this procedure. The findings regarding nature and mass shall indicate in which way waters may be affected or endangered when the materials are stored or deposited in such a way that they come into contact with water. The procedure, however, may yield values which under waste disposal site conditions are obtained during long periods of time only or not at all. The harmfulness of the deposited or to be deposited material cannot be established solely from the analysed values of the leachate.

In order to assess the probable reaction of the waste disposal site and of the required depositing conditions required for the protection of ground and surface water, other criteria must be taken into account, such as e.g. the ratio of the leachable/eluable share to the total content of a substance in the dried residue of the sludge.
Furthermore, the water permeability of the deposited material and of the disposal site underground are of importance likewise the assumed annual quantity of the water leaking through the disposal site, the nature of the groundwater going through the soil, its level, mass and direction of flow, possibly also the speed with which the water flows. There may be also some reciprocal action with other waste material on the site or with seepage waters in the existing soil. Only an expert can assess the very complex actions taking place in the waste disposal site in each case.

This translation was commissioned by Indaver Ireland

3 Fundamentals

The sample material is elutriated with water under certain defined conditions, and subsequently the undissolved components are separated therefrom by filtration. The filtrate is then analysed to establish the concentrations of the components which need to be defined according to the water analytical methods.

As the substances may repeatedly come into contact with fresh rain or ground water during the settlement period, it is sometimes useful to carry out several courses of elutriation. There are three distinctive cases:

The sample materials may contain

a) Substances, which are easily soluble or in such a small mass that they are largely elutriated already during the first elutriation course. In such an instance, a single elutriation course is sufficient.
b) Substances that are soluble less easily or are contained in such a considerable mass that they dissolve only partially during a further elutriation course.
c) Substances whose dissolution behaviour alters during the examination process. In cases b) and c) several courses of elutriation may become necessary. (1)

Note: In order to answer specific question, it may be necessary to use other elutriation liquids instead of water. Examples to this effect are the examinations of the reciprocal action between sediment and surface water and the clarification of possible reciprocal actions within the waste disposal site body.

4 Definition

Definition of the method for determination of the leachability by water (S 4):

Method DIN (German Industrial Standards) 38 414 – S 4

5 Appliances and Chemicals

- Wide neck bottles made from glass or plastic material, as a rule with a nominal volume of 2000 ml
- Shaking and turning around devices
- Filtration device, if possible pressure filtration device with mixing appliance (see drawing)
- Hydroextractor (centrifuge)
- Device for measuring the electric conductivity,
- see method DIN 38 404-C8
- pH-meter e.g. according to DIN 19 261
- Distilled water or water of the same purity

6 Preparation of Samples

6.1 Taking samples

It must be ensured that a representative sub sample is taken from the material to be examined. In this connection, the statements as described in the Deutsche Einheitsverfahren (2) / German Standard Methods (2), sheet S 1, must be taken into account.
Further instructions regarding the use of materials or substances are contained in (3) and (4).

6.2 Size Reduction

The material, as a rule, is to be examined in the condition as found on the waste disposal site. A size reduction process must be carried out only in so far as it is necessary in order to take the sample and to carry out the examination, in general, material will be reduced in size only if the size of its grain is greater than 10 mm. Under no circumstances should it be ground. The fine grain that is obtained during the crushing process must be added again to the sample.

6.3 The formula for solid or pasty samples

The weighing-in of the original sample for elutriation must be measured in such a way that it contains approximately 100g dry matter. This means that a separate determination of the dry matter residue is required according to Method DIN 38 414 – S 2.
If non-homogenous or lumpy materials require substantially greater sample quantities, they must be mixed with a correspondingly greater volume of water (see section 7).

6.4 The formula for highly fluid sludges

Highly fluid sludges which in general contain less than 5% dry residue release water constantly during stagnation. The taking of partial quantities requires homogenous samples. If this requirement cannot be fulfilled, the entire sample must be examined. Highly fluid sludges must be filtrated or centrifuged before elutriation. The filtration residue is elutriated, and the dry residue should amount to about 100g. The mass of the sludge to be examined thus depends on the dry residue of the filtration residue (see method DIN 38 4144 – S 2). The filtrate or residual water obtained during filtration or centrifugation of the highly fluid sludge should be clear. The total volume of the filtrate or of the residual water in the centrifugal tube (sludge water) is measured, and possibly also its density. The mass of the dried filter residue/sediment in the centrifugal tube is determined.

7 Examination process

The elutriation is carried out at room temperature in a wide neck bottle with a nominal volume of 2000ml. The choice of bottle material depends on the substances to be determined. The elutriation period takes 24 hours.

Depending on the situation, the elutriation process will be carried out once or several times.

Note: Reactions taking place during that period are not determined individually. Measuring the electric conductivity, which is carried out from time to time, reveals whether further ionic substances were dissolved.

7.1 Single elution

The original sample or the sample pre-treated according to Section 6.2 to Section 6.4 which contains approximately 100g dry matter is weighed into a wide neck bottle of corresponding volume to 1g and subsequently filled with 1l water (according to Section 5). The bottle is slowly turned over or is shaken so that the sample will remain in constant movement, further size reduction, however, for example as a result of friction, if possible, should be avoided. Following the elutriation process the undissolved residue is separated by filtration or centrifuguation. Further washing or mixing with other liquids is not permitted. The pH-value and electric conductivity are subsequently measured in the filtrate or centrifugate.

7.2 Multiple elution

Water is added again to the residue of the sample treated according to Section 7.1 and subsequently the process is continued as described in Section 7.1; if necessary, the elutriation is carried out once more or repeatedly.

7.3 Further treatment of the obtained eluate

The eluate obtained according to Section 7.1 or Section 7.2 should be fully clear. Otherwise, it must be filtered once again through a membrane filter which has been pre-washed with water (according to Section 5) with a depth of the pores of 0.4 µm, if necessary, the use of a pressure filtration device which includes a stirrer (see drawing) is necessary in order to remove finely dispersed substances from the eluate. The volume of each eluate is measured to an accuracy of 10ml. The concentration of the dissolved substances is determined according to the methods of the water analysis.

8 Evaluation

8.1 The portion of the mass of an eluated substance, relative to the original sludge, is calculated according to equation (1):

$$\omega_{ES} = \frac{\beta . V_E}{m_s} \qquad (1)$$

The following are the constituents:

ω_{ES} Portion of the mass of a substance eluated from the aqueous sludge sample, in mg/kg

ß Mass concentration of the eluated substance in the eluated result in mg/l

V_E Volume of filtered eluate, in l
m_s Mass of the weighed in original sample of the aqueous sludge in kg
Note: If each individual eluated result of a series of elution processes is examined, the sum is obtained from the individual results. If in case of a highly fluid sludge the separated sludge water is examined in order to establish the mass portion of a substance (ω_{ES}), see Table), the equation uses ß for the mass concentration of this substance in the sludge water, V_E represents the volume of the separated sludge water and m_s the mass of the weighed-in sample.

8.2 The mass share of the eluated substance in relation to the dry residue is calculated according to equation (2).

$$\omega_{ET} = \frac{\omega_{ES} \cdot f}{\omega_T} \qquad (2)$$

The following are the constituents:

ω_{ET} Mass share of the eluated substance as dried residue of the examined sample in mg/kg
ω_{ES} Mass share of the eluated substance in the aqueous sample, in mg/kg
ω_T Dried residue of the examined sample in %
f conversion factor; $f = 100\%$

8.3 If the ratio of the eluated portion of the substance in relation to the total content of this substance as dried residue of the sample is of interest, Equation (3) applies:

$$\omega_R = \frac{\omega_{ET} \cdot f}{\omega_{GT}} \qquad (3)$$

The following are the constituents:

ω_R Mass share of the eluated substance relative to its total content as dried residue of the sample, in %
ω_{ET} Mass share of the eluated substance in dried residue of the sample in mg/kg
ω_{GT} Total mass share of the substance in the non-eluated dried residue of the sample, in mg/kg; to be determined by a separate examination
f conversion factor; $f = 100\%$

9 Result

The mass shares are stated in cases of values of greater or less than 1 mg/kg to, at the most, 2 significant digits, greater than 1 mg/kg to, at the most, 3 significant digits.

Examples:

Mass share of the eluable zinc in the sludge, ω_{ES} = 2.2 mg/kg
Mass share of the eluable zinc relative to the dried residue of the sludge ω_{ET} = 6.7 mg/kg
Mass share of the eluable zinc relative to the total zinc content of the dried residue ω_R < 0.1 %

See also the statements in the example for an elution graph (appendix A) page 8 DIN 38 414 Part 4

In addition, the following details are given:

- Nature of sample pre-treatment
- Number of elutions
- Elution temperature
- PH-value of sludge before the elution
- PH-value and electric conductivity of the eluate

All deviations from this method, in particular the treatment in special cases, as well as possibly occurring disturbances must also be taken into account.

10 Characteristic Quantities of the Method

The ring test (5) shows that the area of distribution of the individual parameters is not small enough in order to differentiate between random and errors technically caused during elution.

Drawing - Determination of the leachability by water S 4
DIN 38 414 Part 4 Page 7

1 Pump
2 Connection for use with pressurised gas
3 Pressure meter (piezometer)
4 Filler socket
5 Filter bracket
6 Membrane stirrer
7 Filtrate draw-off

Drawing: pressure filtration by using a stirring cell

Table 1

Sample: Clearing Sludge of _____ taken on _____

Dried residue ωT (see method DIN 38 414-S2)	32.6	%
Mass of the weighed in original sample ω_T	0.325	kg
Corresponding dry mass	0,326 . 325g = 106	g
Added volume of elution agent	1,00	l

	-	Concentration in Eluate									
	-	1.02	0.98	0.99							
	β_w mg/l	β_1	β_2	β_{w3}	ϖ_e	ϖ_{ES1}	ϖ_{ES2}	ϖ_{ES3}	ϖ_{ES} bzw $\sum(\varpi_e+\varpi_{ES})$ mg/kg	ϖ_{ET} mg/kg	ϖ_B %
CSB	-	415	290	176	-	-	-	-	-	-	-
Ammonium Nitrate	-	74	40	11	-	232	121	34	387	1190	-
Chloride	-	84	20	11	-	264	60	34	358	1100	79
Sulphate	-	1600	1100	320	-	5020	3320	975	9315	28660	60
Copper	-	0.08	0.44	0.16	-	0.3	0.1	0.5	0.9	2.8	0.1
Nickel	-	0.72	0.77	0.74	-	2.3	2.3	2.3	6.9	6.9	0.3
Zinc	-	0.08	0.22	0.4	-	0.3	0.7	1.2	2.2	6.7	0.1
Cadmium	-	0.004	0.003	0.003	-	0.01	0.01	0.01	0.03	0.09	0.1
Lead	-	0.007	0.009	0.003	-	0.02	0.03	0.01	0.06	0.18	0.1
Chromium	-	0.009	0.005	0.003	-	0.03	0.02	0.01	0.06	0.18	0.1
pH of Eluates	-	7.3	7.6	7.6	-						
Conductivity of Eluates (µS/cm)	-	2510	1630	690	-						

For the user of this standard Appendix A is not subject to the reprint marginal note on page 1

Cited Standards and other documents

DIN 19 261 pH measuring; terms for measuring method and use of galvanic cells

DIN 38 404 Part 8 DIN methods for the examination of water, waste water and sludge; physical and physical-chemical characteristic quantities (group C); determination of the electric conductivity (C 8)

DIN 38 414 Part 2 DIN methods for the examination of water, waste water and sludge; sludge and sediments (group S); determination of the water content and of the dried residue/ dry substance (S 2)

1. National working group "waste disposal"; guidelines for the procedures of physical and chemical examinations in connection with the elimination of wastes: "determination of the leachability by solid and sludge wastes with water (EW/77), Hösel/Kumpf: Technical rules for the disposal of waste (Technische Vorschriften für die Abfallbeseitigung), Erich-Schmidt-Verlag, Nr. 11-150 (publishers).

2. DIN methods for the examination of water, waste water and sludge examination; group S, sludge and sediments, sample taking (S 1);

   clearing sludges – according to the Regulations for the clearing of waste sludges (AbfKlärV) dated 25.06.1982, Official Gazette 1982 Part 1, pages 734-739

3. National working group "Waste disposal", guidelines for the procedures of physical and chemical examinations in connection with the disposal of wastes: "Taking and preparation of samples from solid and aquaeous wastes (PN 2/78)" as well as the "Basic rules for the taking of samples from wastes and deposited substances (PN 2/78k)", Hösel/Kumpf: Technische Vorschriften für die Abfallbeseitigung (as above), Erich-Schmidt-Verlag, (Publishers) Nr. 11-150 and the following.

4. Ring tests for the determination of the leachability by wastes and sludges with water; v. Ammon, F. und Dietz,F. / Water, waste water research 14, 2, 51-60 (1981)

Comments

The standard currently discussed includes the German Standard Methods "Examination for the leachability by water" jointly set up by the Standards Commission "Wasserwesen" (NAW) in the DIN and by the expert group Wasserchemie (Water Chemistry) in the German Chemistry Society.

Furthermore, all standard methods contained in the brochure "Deutsche Einheitsverfahren zur Wasser- und Abwasser- und Schlammuntersuchung" (German Standard Methods for the examination of water, waste water and sludge) by the expert group "Wasserchemie" are adopted successively into the DIN system so that after a transition period all standard methods are available as DIN standards. The standard methods published as DIN standards are available individually or collected in the Beuth Verlag GmbH (publishers) The loose-leaf collection, published in the Verlag Chemie GmbH, Weinheim, will continue to publish the standard methods.

Standards and standard drafts with the group title "Deutsche Einheitsverfahren zur Wasser-, Abwasser- und Schlammuntersuchung" (German standard methods for the examination of water, waste water, and sludge) are divided into following sections (main areas):

General Definitions (Group A)	DIN 38 402
Physical and physical-chemical Characteristic quantities (C)	DIN 38 404
Anions (group D)	DIN 38 405
Cations (group E)	DIN 38 406
Jointly collatable substances (group F)	DIN 38 407
Gaseous components (group G)	DIN 38 408
Summary characteristic quantities of Effects and for substances (group H)	DIN 38 409
Microbiological methods (group K)	DIN 38 411
Testing methods with water organisms (gr. L)	DIN 38 412
Single components (group P)	DIN 38 413
Sludges and sediments (group S)	DIN 38 414

On request you will receive further information on currently published parts of these Standards from the offices of the Normenausschuss Wasserwesen (NAW) in the DIN Deutsches Institut für Normung e.v. (reg. Assoc.), Telephone (030) 2801-423 (Berlin/Germany) or from the Beuth Verlag GmbH, P.O. Box 11 07, 1000 Berlin 30 (the postal code of this address is obsolete).

International Patent Classification
G 01 N 33-18

This translation was commissioned by Indaver Ireland

Attachment H11.4 **Typical Analyses of Boiler Ash and Flue Gas Cleaning Residues from a similar Indaver Facility in Belgium**

A9084

A15001 Ketelas ROx

GENERAL PARAMETERS
PENETRATION
DRY DUST
FLY ASH
IGNITION LOSS
WATER CONTENT

WATER Soluble PART

JAAR	1998			1	2	3	4	5	6	7	8	9	10	11	12	COUNT	MIN	MAX	AVG	STD
PARAMETER	EENHEID UNIT	DUTCH NORM Vlarem II	AVG 1997																	
ALGEMENE PARAMETERS				geen staal																
Penetratie	mm	15														9	84	100	97	6
Droge stof	% DS	20	100	100		99	100	99		100	99	84	88	100		9	98	100	99	1
Asrest	% DS		99	100		99	100	100		98	98	100	100	100		9	0	2	1	1
Gloeiverlies	% DS	10	1	0		1	0	0		2	2	0	0	0						
Watergehalte	%		0	0.0		0.8	0.3	0.7		0.0	0.0	0.0	0.0	0.0						
VOC	%	3	0	0		0	0	0		0	0	0	0	0						
TOC vast	% DS	6	0	0		0	0	0		0.0	0.0	0.0	0.0	0.0						
W.O.G.	%	10	12	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0						
UITLOOGPROEF				8.8		8.7	6.1	28.4		5.9	7.9	17.9	22.9	10.3		9	5.9	28.4	13.0	8
pH		4 - 13	12.0	12.1		12.3	11.8	12.2		12.2	10.9	12.4	12.4	12.6		9	10.9	12.6	12.0	0
NH4+	mg/l	1,000	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
F-	mg/l	50	0.0	0.0		0.0	1.7	2.0		0.0	11.9	7.0	3.3	6.0		9	0.0	11.9	4.0	4
Cl-	mg/l		4,000	1606		2100	2978	15700		1503	2973	5760	5444	2190		9	1503	15700	4000	3000
NO2-	mg/l	30	0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
Br-	mg/l		60	0		0	0	148		28	47	50	31	0		9	0	148	60	60
NO3-	mg/l		0	0.0		0.0	0.0	8.0		0.0	175.0	0.0	0.0	0.0		9	0.0	175.0	20.0	50
PO4---	mg/l		0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
SO4--	mg/l		1,600	2170		1550	2346	1160		1194	1513	590	728	1195		9	590	2346	1600	400
B	mg/l		0.3	0.0		0.0	0.0	0.2		0.0	8.5	5.5	0.0	0.0		9	0.0	8.5	2.0	3
Mn	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Fe	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.2	0.0	0.0	0.0		9	0.0	0.2	0.0	0
Mo	mg/l		0.2	0.4		0.0	0.4	0.3		0.2	0.3	0.0	0.0	0.3		9	0.0	0.4	0.0	0
Cr	mg/l		0.3	0.2		0.0	0.0	0.0		0.6	0.7	0.0	0.3	0.1		9	0.0	0.7	0.0	0
Al	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.5	11.8	0.0	0.0		9	0.0	11.8	1.0	4
V	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Be	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Zn	mg/l	10.0	1.8	2.8		2.3	1.4	10.3		1.1	0.0	3.2	1.8	3.6		9	0.0	10.3	3.0	3
Cu	mg/l	10.0	0.0	0.0		0.0	0.0	0.0		0.0	0.0	2.5	0.0	0.0		9	0.0	2.5	0.0	1
Bi	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Ni	mg/l	2.0	0.0	0.0		0.0	0.0	0.0		0.0	0.1	0.6	0.0	0.0		9	0.0	0.6	0.0	0
Cd	mg/l	0.5	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Co	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
As	mg/l	1.0	0.0	0.0		0.0	0.0	0.0		0.0	0.2	0.0	0.0	0.0		9	0.0	0.2	0.0	0
Sn	mg/l		0.0	0.0		0.0	0.0	0.8		0.0	0.0	0.0	0.0	0.0		9	0.0	0.8	0.0	0
Tl	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Se	mg/l		0.0	0.0		0.0	0.0	0.0		2.2	0.1	0.0	0.0	0.0		9	0.0	2.2	0.0	1
Sb	mg/l		0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
Pb	mg/l	2.0	20.6	6.0		15.5	3.0	150.3		0.4	0.0	0.0	0.0	14.8		9	0.0	150.3	20.0	50
Hg	mg/l	0.1	0.0	0.0		0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0		9	0.0	0.0	0.0	0
TOTAAL METALEN																				
Mn	mg/kg DS		1,300	1420		1600	1300	0		2900	3800	1800	1800	1200		9	0	3800	1800	600
Fe	mg/kg DS		40,000	31170		32000	26600	8300		20500	19170	12200	9900	46100		9	8300	46100	23000	14000
Mo	mg/kg DS		0	140		0	0	0		0	0	0	0	0		9	0	140	10	40
Cr	mg/kg DS		390	440		0	0	0		500	800	0	0	0		9	0	800	200	120
Al	mg/kg DS		48,000	54270		50100	53700	17400		21500	30900	14300	14700	45500		9	14300	54270	34000	12000
V	mg/kg DS		80	0		0	0	0		0	0	0	0	0		9	0	0	0	120
Be	mg/kg DS		0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
Zn	mg/kg DS		11,000	15620		9300	9200	8400		10000	12200	6300	12900	6700		9	6300	15620	10000	3000
Cu	mg/kg DS		770	740		500	0	0		1200	1300	0	0	3700		9	0	3700	800	1100
Ni	mg/kg DS		40	180		0	0	0		0	0	0	0	0		9	0	180	20	60
Bi	mg/kg DS		0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
Cd	mg/kg DS		0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
Co	mg/kg DS		600	170		0	1500	1500		1900	3000	0	0	0		9	0	3000	900	900
As	mg/kg DS		0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
Sn	mg/kg DS		240	270		500	0	500		0	0	0	0	0		9	0	500	100	50
Tl	mg/kg DS		1,400	0		0	0	0		0	0	0	0	0		9	0	0	0	2000
Se	mg/kg DS		0	0		0	0	0		0	0	0	0	0		9	0	0	0	0
Sb	mg/kg DS		600	800		1000	500	600		0	0	0	0	600		9	0	1000	400	400
Pb	mg/kg DS		1,800	1960		2000	1800	2400		1600	1000	0	1800	1400		9	0	2400	1500	500
Hg	mg/kg DS		7	0		0	0	0		nb	nb	nb	nb	nb		9	0	nb	0	nb
Ca	mg/kg DS			179800		177000	175700	324300		256100	146000	353300	303400	188700		9	146000	353300	234000	70000
Mg	mg/kg DS			16600		12500	12800	6900		8300	10800	6600	6500	16300		9	6500	16600	11000	3800
Ba	mg/kg DS			2100		2100	2300	700		1600	1600	0	600	2000		9	0	2300	1400	800
K	mg/kg DS			27000		22000	21600	17900		16300	13500	6900	17300	17500		9	6900	27000	18000	5300
Br	mg/kg DS			500		0	0	1000		0	0	0	1500	0		9	0	1500	300	500
Cl	mg/kg DS			18500		22900	21200	140600		75200	14000	66000	148100	25300		9	14000	148100	60000	50000
S	mg/kg DS			32400		29500	25000	23600		21000	17300	15300	18000	21100		9	15300	32400	23000	5000
Sr	mg/kg DS			0		0	0	0		0	0	0	0	0		9	0	0	0	0
P	mg/kg DS			5000		5000	4500	1300		3500	4700	0	900	4000		9	0	5000	3200	1800
Ce	mg/kg DS			0		0	0	0		0	0	0	0	0		9	0	0	0	0
Gd	mg/kg DS			0		0	0	0		0	0	0	0	0		9	0	0	0	0
W	mg/kg DS			0		0	0	0		0	0	0	0	0		9	0	0	0	0
Si	mg/kg DS			143700		142300	191400	41600		65900	102500	49300	35700	147000		9	35700	191400	100000	50000
Ti	mg/kg DS			14200		12900	12000	4300		9200	10000	5600	4100	13700		9	4100	14200	10000	3800
Y	mg/kg DS			0		0	0	0		0	0	0	0	0		9	0	0	0	0
ORGANISCHE																				
EOX	mg/kg DS	1,000	0																	
Extraheerbare KWS	% DS	5	0.00																	

0 = < dl

Typical Boiler Ash Analysis from a similar Indaver Facility

A15002 Rookgaszuiveringsresidu ROx

GENERAL PARAMETERS
PENETRATION
DRY DUST
FLY ASH
IGNITION LOSS
WATER CONTENT

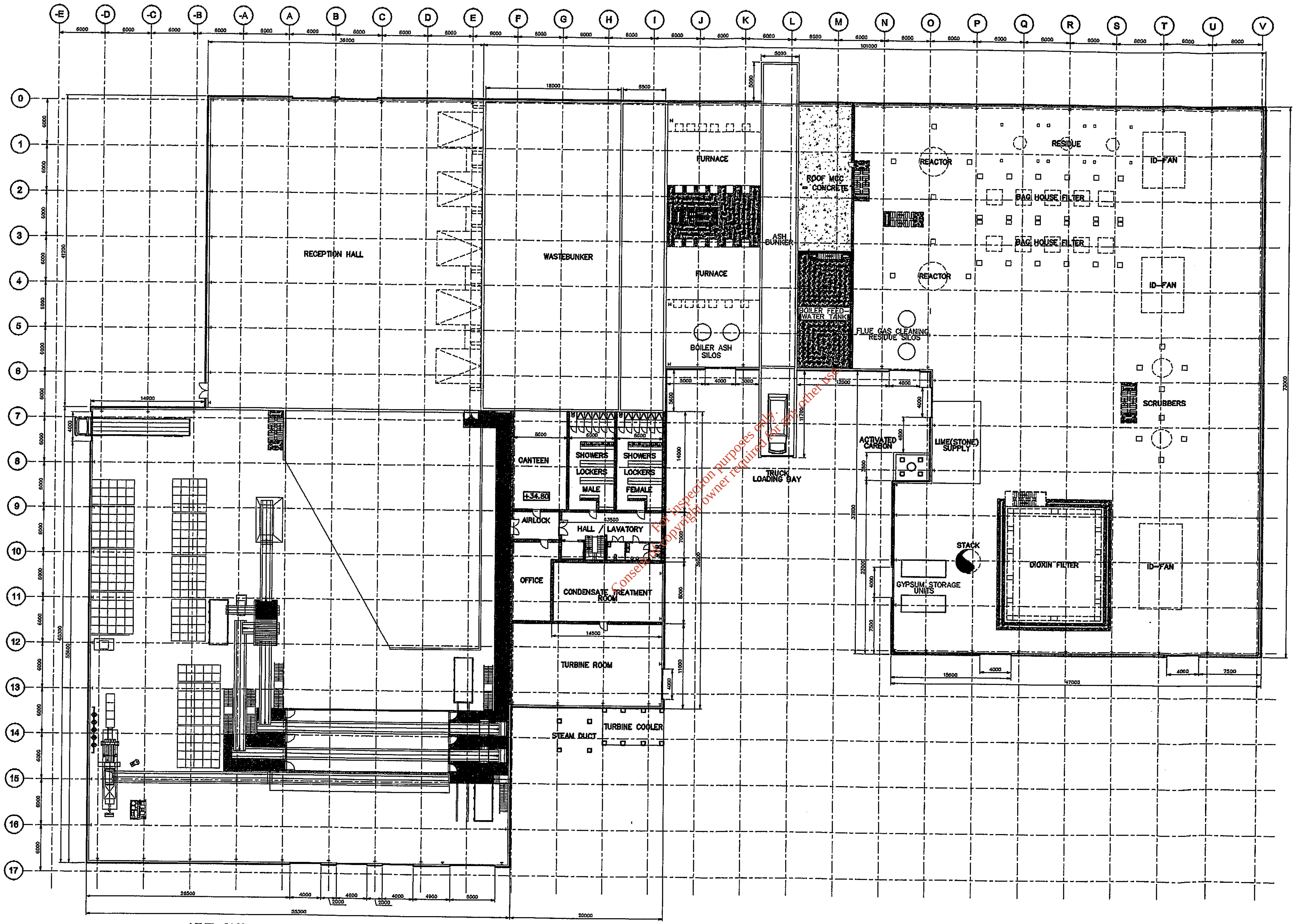
WATER SOLUBLE PART

JAAR	1998			1	2	3	4	5	6	7	8	9	10	11	12	COUNT	MIN	MAX	AVG	STD
PARAMETER	EENHEID UNIT	DUTCH Reg NORM Vlarem II	AVG 1997																	
ALGEMENE PARAMETERS																				
Penetratie	mm	15																		
Droge stof	% DS	20	83	99	87	96	95	94		88	93	95	96	96	96	11	87	99	94	3
Asrest	% DS		97	98	99	100	98	100		97	97	97	100	100	97	11	97	100	98	1
Gloeiverlies	% DS	10	5	2	0	0	2	0		3	3	3	0	0	3	11	0	3	1	1
Watergehalte	%		0	0.0	12.8	2.7	4.4	6.4		0.0	0.0	0.0	0.0	0.0	0.0	11	0	13	2	4
VOC	%	3	0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
TOC vast	% DS	6	0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0	0	0	0
W.O.G.	%	10	30	33.6	35.1	29.7	23.8	25.0		22.6	28.5	30.6	43.8	38.9	30.0	11	22.6	43.8	31.0	6
UITLOOGPROEF																				
pH		4 - 13	12.0	12.0	11.8	12.1	12.0	12.2		12.1	12.2	12.3	12.4	12.3	13.1	11	11.8	13.1	12.0	0
NH4+	mg/l	1,000	0.0	5.5	6.0	10.2	5.6	0.0		21.0	0.0	1.3	0.0	0.0	0.5	11	0.0	21.0	5.0	6
F-	mg/l	50	0.0	0.0	0.0	0.0	1.9	3.1		26.0	0.0	80.0	3.7	3.1	1.8	11	0.0	80.0	11.0	23
Cl-	mg/l		14,000	12700	17236	1400	10534	11400		9166	9268	12600	11860	12700	14716	11	1400	17236	14000	3000
NO2-	mg/l	30	0	0		0				0		0	0	0	0	11	0	0	0	0
Br-	mg/l		300	180	212	80	0	0		53	111	170	120	87	131	11	0	212	300	230
NO3-	mg/l		0	0.0	0.0	0.0	0.0	134.0		0.0	30.5	0.0	0.0	0.0	6.0	11	0.0	134.0	20.0	40
PO4---	mg/l		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
SO4--	mg/l		1,190	2510	1350	2200	2376	1174		1064	2482	1360	1360	1400	1544	11	1064	2510	1200	500
B	mg/l		0.6	0.6	0.5	0.0	0.0	0.6		0.0	0.4	0.9	0.6	2.8	1.6	11	0.0	2.8	1.0	1
Mn	mg/l		0.0	0.0	0.2	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.2	0.0	0
Fe	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.4	0.0	0.0	0.0	11	0.0	0.4	0.0	0
Mo	mg/l		0.0	0.2	0.2	0.0	0.2	0.0		0.0	0.1	0.0	0.0	0.2	0.0	11	0.0	0.2	0.0	0
Cr	mg/l		0.0	0.0	0.0	0.0	0.2	0.0		0.1	0.1	0.3	0.0	0.0	0.0	11	0.0	0.3	0.0	0
Al	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.1	0.0	0.0	0.0	0.0	0.0	11	0.0	0.1	0.0	0
V	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Be	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Zn	mg/l	10.0	10.6	3.8	7.0	8.4	2.3	5.4		1.9	5.5	4.5	4.2	5.5	5.5	11	1.9	8.4	5.0	2
Cu	mg/l	10.0	0.4	0.2	0.0	0.1	0.0	0.0		0.0	0.0	0.0	0.0	0.4	0.0	11	0.0	0.4	0.0	0
Bi	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Ni	mg/l	2.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.1	0.0	0.0	0.0	0.0	11	0.0	0.1	0.0	0
Cd	mg/l	0.5	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Co	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
As	mg/l	1.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Sn	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Tl	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Se	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Sb	mg/l		0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
Pb	mg/l	2.0	90.0	67.4	48.0	120.0	26.5	46.2		2.0	8.2	0.0	1.2	36.3	21.9	11	0.0	120.0	90.0	90
Hg	mg/l	0.1	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	11	0.0	0.0	0.0	0
TOTAAL METALEN																				
Mn	mg/kg DS		240	440	0	0	0	0		0	0	0	0	0	0	11	0	440	100	170
Fe	mg/kg DS		9,000	7110	10200	5200	11500	9900		9800	7100	6200	9900	4800	9200	11	4800	11500	8000	2000
Mo	mg/kg DS		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Cr	mg/kg DS		130	140	0	0	0	0		0	0	0	0	0	0	11	0	140	10	120
Al	mg/kg DS		13,700	3860	19100	11900	16900	16200		12500	15100	11000	14700	6500	14700	11	3860	19100	13000	2500
V	mg/kg DS		0	0	0	0	0	500		0	0	0	0	0	0	11	0	500	40	140
Be	mg/kg DS		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Zn	mg/kg DS		9,000	10370	13900	10800	9600	9600		13600	7000	20700	12900	7300	7200	11	7000	20700	11000	4000
Cu	mg/kg DS		400	670	0	0	0	0		900	1300	1400	0	0	3600	11	0	3600	700	400
Ni	mg/kg DS		1,800	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Bi	mg/kg DS		0	0	0	500	0	0		0	0	0	0	0	0	11	0	500	50	140
Cd	mg/kg DS		40	90	0	0	0	0		0	0	0	0	0	0	11	0	90	10	50
Co	mg/kg DS		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
As	mg/kg DS		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Sn	mg/kg DS		240	350	500	500	500	500		0	0	0	0	0	0	11	0	500	200	260
Tl	mg/kg DS		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Se	mg/kg DS		0	0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Sb	mg/kg DS		800	740	600	1500	1200	500		600	0	600	0	0	0	11	0	1500	500	700
Pb	mg/kg DS		1,300	2550	2100	2900	1900	1500		1600	1600	1100	1800	1600	2500	11	1100	2900	1900	1100
Hg	mg/kg DS		17	0	0	0	0	0		nb	nb	nb	nb	nb	nb	11	0	0	0	0
Ca	mg/kg DS			329300	283900	343900	314300	332500		326000	313300	267500	303400	352900	340100	11	267500	352900	320000	25000
Mg	mg/kg DS			7200	5100	5500	6200	6300		5600	6600	5500	6500	5900	6300	11	5100	7200	6000	600
Ba	mg/kg DS			600	800	0	0	0		0	0	0	600	0	0	11	0	800	200	300
K	mg/kg DS			24000	23000	17500	17200	14200		16200	15700	23000	17300	15100	18900	11	14200	24000	18000	3000
Br	mg/kg DS			1500	2000	4000	1600	1000		1400	1200	2300	1500	1600	1300	11	1000	4000	1800	800
Cl	mg/kg DS			159400	142600	167700	132500	118100		135000	110000	178100	148100	142800	152400	11	110000	178100	144000	19000
S	mg/kg DS			28500	28700	24900	20200	20000		22000	17600	25000	18000	19200	19400	11	17600	28700	22000	3800
Sr	mg/kg DS			0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
P	mg/kg DS			1000	1000	0	700	0		0	1100	900	900	0	1000	11	0	1100	600	400
Ce	mg/kg DS			0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Gd	mg/kg DS			0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
W	mg/kg DS			0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
Si	mg/kg DS			29500	38100	24900	44500	38100		39500	44600	28600	35700	20100	27200	11	20100	44600	34000	8000
Ti	mg/kg DS			3700	4700	3100	3900	4100		3900	4700	3500	4100	3000	4900	11	3000	4900	4000	600
Y	mg/kg DS			0	0	0	0	0		0	0	0	0	0	0	11	0	0	0	0
ORGANISCHE																				
EOX	mg/kg DS	1,000	0																	
Extraheerbare KWS	% DS	5	0.00																	

0 = < dl

Typical Flue Gas Cleaning Residue Analysis from a similar Indaver Facility

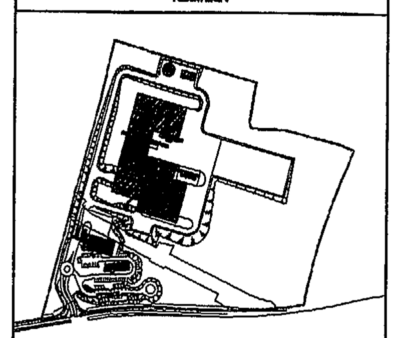
Attachment H11.5 **Drawing No. 2666-22-DR-021: Location of Ash/Gypsum Storage**



LEVEL +34.80
SCALE 1:200

THIS DRAWING WAS CREATED USING AUTOCAD R14

KEYPLAN



NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS
2. DO NOT SCALE – USE FIGURED DIMENSIONS ONLY
3. ALL DIMENSIONS ARE GIVEN IN MILLIMETRES
4. LEVELS ARE GIVEN IN METRES AND RELATE TO O.S.DATUM (MALIN HEAD)

ISSUE	DESCRIPTION	DRN	ORIG	AUTH CHK	APP	DATE
A	PRELIMINARY					

INDAVER IRELAND
4 HADDINGTON TCE
DUN LAOGHAIRE
CO. DUBLIN
TEL: +353 1 2145830
FAX: +353 1 2807865

Project Management Group
Cork - Dublin

WILSON ASSOCIATES
architects

PROJECT: WASTE MGMT FACILITY - CARRANSTOWN

TITLE: ASH / GYPSUM STORAGE LOCATIONS

CLIENT REF.
PROJECT No. 2866
A0 SCALE 1:200
CLIENT DRG No.
CONTR DRG No. 2866-22-DR-021

2866_22_DR_021