5.0 DISCUSSION

The results of the emissions from the sludge drying system are presented in Tables 4.1 to 4.5. The results for each parameter are discussed below:

Odour

The results for the odour sampling are presented in Table 4.2. The odour level of 2,920ou/m^3 is considered elevated. It was described by the odour panel as having a petrol fumes/combustion gas character. On-site observations noted that the odour was choking in nature indicating potentially high levels of both carbon monoxide and organics.

While the odour level from the final emission point is elevated it is important to put these results into perspective by attempting to relate them to ambient guideline values. There are no odour limit values or guidelines in Ireland for this particular type of industry. In such an absence attention may be paid to accepted and adopted guidelines for odour. These guidelines are most applicable to WwTWs. However, they may be used for the purposes of this baseline survey.

By definition 1ou/m^3 is the detection threshold of 50% of a panel of trained observers working in an odour free environment. The recognition threshold is about 5 times this concentration i.e. 5ou/m^3. The background for this stems from a publication entitled 'Odour Control - a concise guide' by Valentin F. H. H. and North AA. Warren Spring Laboratory, 1980. In this publication, it was stated that it is generally accepted that odour concentrations between 5 and 10ou/m^3 above the baseline concentration give rise to a faint odour and that only a distinct odour (concentrations greater than 10ou/m^3) gives rise to a nuisance. Furthermore, Nielson et al[Note 1] proposed that a faint odour was an acceptable threshold criteria for the assessment of odour as a nuisance. This report stated that it was generally accepted that odour concentrations of between 5 and 10ou/m^3 would give rise to a faint odour only and that only a distinct odour (concentration greater than 10ou/m^3) would give rise to a nuisance.

While these guidelines are most applicable to the ambient odour environment, they are nevertheless important goalposts for qualitatively assessing whether emissions from point sources impact on the receiving environment. In relation to this point, there is a strong probability that odour emitted at such levels will have a negative impact on the receiving environment. The extent of this impact will depend on a number of factors including meteorological conditions, topography, nearest sensitive receptors, building heights etc. To determine such an impact quantitatively, the most useful tool to employ is air dispersion modelling. Modelling will clearly indicate the extent of any impact on the surrounding locality. Furthermore, the nature and location of this emission point hampers any adequate dispersion.

The final emission point of the rotary evaporator at the Castlebar WwTW is located at the rear of and outside the Sludge Dewatering building. The stack itself is approximately 3m in height and sits on top of a water/citric acid bath. Its efflux height is approximately 10m which is much lower than Sludge Dewatering Building. These nearest sensitive receptors are a cluster of 8 houses situated approximately 20-30m to the west of the emission point across a stream. These houses are private and newly built and situated higher relative to the WwTWs. The prevailing wind direction in the area is westerly i.e. from the WwTWs to these new houses. Therefore, due to the nature and location of this emission point, there is likely that the emission may cause a nuisance at this location.

Organics

The levels of organics detected are relatively low. Any water soluble organics have been absorbed in either the condensers or the water/citric acid bath. The results indicate that organics are not contributing significantly to the odour levels.

Amines and Ammonia

Levels of ammonia and aliphatic amines were detected at low concentrations. It is unlikely that ammonia, due to its high odour threshold of 33mg/m^3 Note 2 will contribute to the overall odour loading. In relation to the amines, low levels were also detected. However, some of these amines may have low odour detection thresholds and hence at such levels contribute to the odour concentration detected.

Hydrogen Sulphide and Mercaptans

The sulphur compounds including dimethylsulphide were not detected above the analytical limits of detection. They are likely to have been knocked out in the sludge drying process.

Combustion Gases

Diesel is used to power the sludge drying system. 18 -20 gallons per hour are consumed. As a result combustion gases are produced. The level of carbon monoxide is considered high and indicates that the system is not running efficiently. For efficient combustion using diesel as a fuel, the oxygen level should be around 3%.

Carbon monoxide is a colourless, odourless gas which is insoluble in water. It is produced whenever carbon or carbon containing compounds are burnt in air. It is also very poisonous as it combines with haemoglobin in the blood, making the blood unable to transport oxygen around the body. The fact that it is odourless makes it particularly dangerous. However, as a constituent of petrol fumes, in combination with organics arising from combustion, it creates a choking sensation in the throat. It is quite likely that this will cause a nuisance at the nearest sensitive receptor.

In summary, the results indicate that the odour concentration is elevated and may give rise to a nuisance at the nearest sensitive receptor. The utilisation of air dispersion modelling techniques would assess whether an impact exists. The characterisation of the odour indicates that it is comprised of a complex mix of organics and nitrogen compounds such as amines, ammonia and the oxides of nitrogen. Furthermore, there are high levels of carbon monoxide emitted from the process which strongly indicates that combustion is not efficient.

Note 1: Clarkson C.R. and Misselbrook T.H. (1991). Odour Emissions from broiler chickens in: Odour and ammonia emissions from livestock farming. Nielsen V.C., Voorburg J.H. and L'Hermite P. (eds) Elsevier Applied Science Publishers London.

Note 2: 'Odour Control - a concise guide' by Valentine F. H. H. and North A.A. Warren Spring Laboratory, 1980

6.0 OPTIONS

The abatement options described below are based on the results of the air quality analysis carried out on the final emission point. The results indicate that odour and carbon monoxide emissions are the main problems areas that need to be addressed.

Odour Treatment

6.1 Water Scrubbing

The odorous air from may be extracted via a fan system through a packed tower water scrubber or equivalent. This will succeed in removing any soluble odorous compounds present in the air such as ammonia, and other soluble organics. This may in itself be sufficient to reduce the odour to levels which will not create a nuisance depending on the location of the nearest receptor. Typical odour removal efficiencies of water scrubbing systems are 50-70% removal of total odour. This level of treatment would not generally be considered to be efficient. However, the installation of a high level stack may be sufficient to give adequate dispersion. Water scrubbing will not remove relatively insoluble compounds such as organic sulphides which are known to have relatively high odour thresholds. Water scrubbing systems are generally 'once-through' and thus water consumption can be an issue as can the creation of a secondary effluent.

6.2 Biological Treatment

The waste gas stream may be extracted through a biological odour control system. The biological system would be inoculated with specific bacterial cultures to oxidise volatile organics, ammonia and organic sulphides. A biological system utilises a biochemical process by which the odorous compounds are biologically oxidised and any acidic by-products are neutralised by the shell packing material. Ammonia is also oxidised to its aqueous nitrate and nitrite forms.

Typical odour removal efficiencies of biological systems can be in the order of >95%. Generally the capital cost of biological treatment installations is higher than of dry scrubbing systems. However, running costs are usually significantly lower and biological systems 5 to 10 year life cycle costs compare favourably with other technologies. The available footprint on-site can be a factor when deciding which solution to implement. It is important to point out that biological systems generally have a larger footprint than other technologies. The water usage for biological systems is significantly lower than once-through water scrubbing as the water in continuously recycled through a sump with only a very small fresh water top-up.

Carbon Monoxide Removal

6.3 Carbon Monoxide Catalyst

The monitoring results have revealed high levels of carbon monoxide emitted from the process. This has indicated that the combustion process is not efficient. The most effective way of reducing carbon monoxide is to install a catalyst. This abatement technology is based on the carbon monoxide to carbon dioxide conversion which takes place on platinum plates. The features of this technology include a high surface area and low pressure drop across the plates. The system requires a high operating temperature of greater than 450°C to work efficiently. Typical removal efficiencies are in the order of 99.9%. It is a very efficient system with little running costs once installed. However, it is extremely costly and is dependent on the volume flow throughput.

6.4 Flame Optimisation

In order to improve the combustion efficiency of the process and lower the level of carbon monoxide emitted, the flame dynamics should be assessed. This may be done by reducing the temperature of the flame. If this is the preferred method of carbon monoxide reduction, it is recommended that the services of a boiler engineer be employed.

In conclusion, any of the above options may be suitable to meet requirements. The decision should be made taking all factors into account including removal needs i.e. efficiencies, water usage and availability, space requirements and any potential future expansion and development. Furthermore, consideration should be made for dispersion requirements, nearest sensitive receptors and stack heights. Once an abatement technology has been chosen, a stack height can be assessed to ensure adequate dispersion of emissions and compliance with ambient air quality guidelines at the nearest receptors using advanced air dispersion modelling techniques.

Roto Spiral Ltd.

KNOCKTOPHER, CO. KILKENNY, IRELAND.
Tel: (056) 68619. Fax: (056) 68996. E-mail: rotospir@iol.ie

TOBIN CONSULTING ENGINEERS
MARKET SQUARE
CASTLEBAR
CO. MAYO.

4th April 2003

Attn: Mr. Michael Garrick

Re: Carbon Filter at Castlebar Waste Water Treatment Plant

Dear Michael,

With regard to your e-mail of Thursday 3rd April. I reply to the issues that you raised in you letter.

i) The carbon filter system at Castlebar Waste Water Treatment Plant was designed by Carbon Link (UK) Limited. The air volume and odour content from the dryer was identified from odour analysis test carried out by Bord na Mona at this plant in 2002. With this information Carbon Link (UK)Limited advised the type and quantity of carbon to be used.
This System contains two types of carbon media, one layered above the others with a cavity between. Carbon A – Filtracarb SA62 is used for odour removal and carbon B - Filtracarb EX64 for final polishing.

ii) The quantity of carbon initially installed was sufficient for twelve months operation. With the inability of the fan to push the exhaust through this quantity of media, Carbon Link (UK) Limited advised us to remove a quantity of the media and replace as required. We therefore removed three quarters with the remaining quarter to be replaced every three months. The carbon does not discolour or reduce and the only physical way to identify that the media is spent is by the re-occurrence of odour. The present quantity of carbon was installed in the second week of January 2003.

iii) The carbon media has to be removed manually and replaced using a screw conveyor. This replacement will be carried out by Roto Spiral Limited on the week beginning Monday 7th April 2003.

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If you have any other queries please do not hesitate to contact me at the above number.

Yours sincerely,

pp D. Farrelly
DAMIEN WALSH
SALES & DEVELOPMENT MANAGER

Pg 2.

A Proposal to carry out Odour Sampling and subsequent Chemical Characterisation of the Odour from two Carbon Scrubbers at a Sewage Treatment Works in Castlebar on behalf of Rotospiral Ltd.

Quotation No: QC031040

Attention: Mr. Larry Doyle
Rotospiral Ltd.
Knocktopher
Co. Kilkenny

Prepared by: Ms. Joan McCormack
Environmental Scientist

Date: 30th October 2003

Pg 3.

1.0 INTRODUCTION

Following a recent conversation with Mr. Larry Doyle of Rotospiral Ltd., Bord na Móna, Technical Services are pleased to present a proposal for odour monitoring and its characterisation.

The following scope of work has been proposed:

Monitoring of two emission points for the following compounds:

- Odour
- Hydrogen sulphide
- Mercaptans
- Ammonia
- Amines
- Organics
- Combustion Gases

2.0 METHODOLOGY

2.1 Odour Sampling and Olfactometry

Samples of gas of approximately 80 - 100 litres will be collected via Teflon tubing into Tedlar® gas sampling bags by means of the "lung principle" method. Using this method, the sample bag is housed in a sealed carbuoy that is evacuated using a small air pump. The volume of air removed from the carbuoy is replaced by sample gas entering the bag, thus avoiding contamination of sample by pumps or meters. Sampling shall be carried out in accordance with German Standard Method VDI 3881 (1987).

The samples will be analysed by Dynamic Olfactometry. The instrument used will be an Olfactomat-e Olfactometer (Project Research Amsterdam) and the analytical procedures were in accordance with the CEN Standard TC264 (1999) using a trained panel of 8 assessors. The odour concentration of the sample is expressed in odour units per cubic metre of gas (ou/m^3). These values, sometimes referred to as "dilutions to threshold" are equivalent to the number of times the sample gas required dilution with odour free air to reach the panels odour threshold (i.e. the concentration at which there is a 50% probability of the panelists detecting the odour). The results are expressed in ou/m^3.

2.2 Ammonia

Sampling and analysis is conducted in accordance with NIOSH standard procedures which involve collection of samples into a solution of dilute sulphuric acid and analysis using ammonia ion selective electrode. Samples are collected through a series of four impingers using specialised SKC sampling pumps at a flowrate of approximately 1l/min. The first two impingers contain 0.1N H_2SO_4 (Sulphuric Acid), the third impinger is empty and the fourth contains silica gel. Sampling is carried out over a 30 minute period. The results are expressed in mg/Nm^3.

2.3 Organic Compounds

The sampling and analysis of Organic Compounds will be conducted based on NIOSH standard methods. A measured volume of sample air is drawn through a adsorption tube at a known flow rate of between 150 – 250 ml/min. by means of an intrinsically safe SKC air pump. Sampling will be carried out over a 30 minute period.

After exposure, the tubes are delivered to the Bord na Móna Technical Services analytical laboratory where they will be desorbed using an appropriate solvent and analysed using Gas Chromatography Mass Spectrometry. This system consists of an

Agilent 6890N Gas Chromatograph interfaced with an Agilent 5973 Network Mass Spectrometer and equipped with a high resolution capillary column allowing for the detection and resolution of those components expected to be present. The results are expressed in mg/m^3.

2.4 Aliphatic Amines

Sampling and analysis of aliphatic amines are conducted in accordance with the following method: a measured volume of headspace air is drawn through an impinger containing approximately 10mls of distilled water by means of a specialised SKC sample pump at a flow rate of approximately 1L/min approximately. Sampling will be carried out over a period of approximately 30 minutes. After sampling, the impinger solution is returned to the laboratory for analysis by Gas Chromatography with Flame Ionisation Detection. This system consists of a Hewlett Packard Gas Chromatograph equipped with a packed column specific for the separation of individual amine components in a solution. The results are expressed in mg/m^3.

2.5 Mercaptans and Hydrogen Sulphide

Sampling and analysis of sulphur components (to include hydrogen sulphide, dimethyl sulphide and mercaptans) is conducted in accordance with the following method: a known volume of headspace air was drawn onto a molecular sieve tube by means of a SKC pump at flow rate of approximately 100ml/min. Sampling will be carried out over a period of approximately 30 minutes. Following desorption in the laboratory, the samples are analysed by gas chromatography with mass spectrometry. The results are expressed in mg/m^3.

2.6 Combustion Gases

A Profilyser Gas Analyser is used to measure combustion gases. This is a technically perfected multimeter containing a number of electro-chemical sensors specific for Oxides of Sulphur, Nitrogen Oxides (as NO_2), Oxygen and Carbon Monoxide. The results are expressed in mg/m^3.

3.0 COMMITMENT TO QUALITY

3.1 ILAB Accreditation

Bord na Mona Technical Services analytical laboratories were awarded ILAB accreditation by the National Accreditation Board (NAB) in 1997. It has always been the policy of the laboratories to achieve and maintain a high standard of quality consistent with client's requirements in all aspects of the work carried out within the laboratory.

NAB as a member of the International Laboratory Accreditation Cooperation (ILAC) and the European Co-operation for accreditation (EA) have adopted ISO 17025 as the new standard for its laboratory accreditation programme. All laboratories have been required to implement a transfer programme from ILAB accreditation to ISO 17025. From January 2002 NAB will assess laboratories against ISO 17025 only.

3.2 Accredited to ISO 17025

This new standard contains all of the requirements that testing laboratories have to meet if they wish to demonstrate that they operate a quality system, are technically competent, and are able to generate technically valid results. ISO 17025 incorporates all those requirements of ISO 9001 and ISO9002 that are relevant to the scope of testing services that are covered by the laboratory's quality system. Thus a laboratory that complies with ISO 17025 will therefore also operate in accordance with ISO 9001 or ISO 9002.

Bord na Mona Technical Services Analytical Laboratory implemented a transition plan to ISO 17025. The NAB audited the laboratory's transition to ISO 17025 in September 2001. Following this audit the NAB approved Bord na Mona Environmental Consultancy Services laboratories for transfer of accreditation to ISO 17025 on the 16th of November 2001.

3.3 Interlaboratory Proficiency Schemes

To ensure the accuracy of the analytical testing we participate in several external proficiency schemes. The ongoing competence of the laboratory and its staff is assessed by participation in various inter-laboratory proficiency testing schemes, such as Aquacheck and WASP (UK) and the EPA scheme organised for environmental laboratories throughout Ireland.

3.4 EPA Quality Control Register

Bord na Mona Technical Services Analytical Laboratories performance in this scheme has allowed its listing on the EPA's register of Quality Controlled Laboratories. Both accredited and non-accredited test methods are assessed by these schemes.

3.5 Quality Control Audits

Bord na Mona Environmental Ltd. consistently strive to improve the quality of the analytical work out in its laboratories. The laboratory has a full time Quality Control Manager who assists in the organisation and execution of the extensive programme of internal Quality Audits. These quality audits examine all aspects of the laboratory's Quality System, with particular focus on auditing of test methods, and enable potential problems to be highlighted and immediate corrective action to be taken.

3.6 Control Chain of Custody

As part of the Quality System in place at Bord na Móna, Environmental Limited, measures are taken to ensure controlled chain of custody. An outline of the chain of custody is given overleaf.

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BORD NA MÓNA

BORD NA MÓNA ENVIRONMENTAL LIMITED

TELEFAX

To:	Majella	From:	Lisa Blyth
Company:	Rotospiral	Company:	Bord na Móna Environmental Ltd
Fax No:		Fax No:	045 434207
Tel No:		Tel No:	045 439518
Date:	12/12/3	Pages:	
Ref:	12/12/3		

Majella

Please find attached preliminary results.

The laboratory have not yet released the amine, Mercaptan or H_2S results. We shall have them early next week.

I hope these results assist the client today

I will forward the results as soon as I receive them.

Rgds Lisa

MAIN STREET, NEWBRIDGE, CO KILDARE, IRELAND
TELEPHONE: +353 45 431201, FAX: +353 45 434207

4.0 **RESULTS**

DRAFT

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Table 4.1: Volume Flows and Temperatures Note 1			
Date Sampled	**Stack ID**	**Volume Flow (Nm^3/hr)**	**Temperature (°C)**
20/11/03	Sludge Drying Stack	1,300	16

Note 1: Results referenced to 0 °C and 1013.25kPa.

Table 4.2: Odour Results			
Date Sampled	**Stack ID**	**Concentration (ou/m^3)**	**Mass Emission (kg/hr)**
20/11/03	Sludge Drying Stack	7639	9.9
20/11/03	Ambient at Housing Estate Perimeter	<40	<0.05

Table 4.2: Ammonia Impinger Results Note 3			
Date Sampled	**Stack ID**	**Concentration (mg/Nm^3)**	**Mass Emission (kg/hr)**
20/11/03	Sludge Drying Stack	<10	
20/11/03	Ambient at Housing Estate Perimeter	<10	

Note 2: Results are referenced to 0 °C and 1013.25kPa

Table 4.3: Amine Impinger Results Note 3			
Date Sampled	**Stack ID**	**Concentration (mg/Nm^3)**	**Mass Emission (kg/hr)**
20/11/03	Sludge Drying Stack	< Note 3	
20/11/03	Ambient at Housing Estate Perimeter	<10	

Note 2: Results are referenced to 0 °C and 1013.25kPa

Note 3: Result to be confirmed, possible elevated level of diethylamine