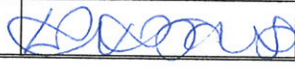
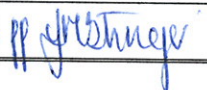
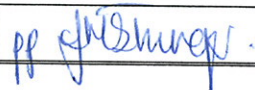


Dunbar Energy from Waste (EfW) Facility

Application for a Permit to Operate Under the Pollution Prevention and Control (Scotland) Regulations 2000

Options Appraisal for Acid Gas Removal

| | Written by: | Checked by: | Authorised by: |
|------------|---|---|---|
| Name: | Laura Jones | Dan Smyth | Dan Smyth |
| Job Title: | Environmental Consultant | Technical Director | Technical Director |
| Date: | October 2008 | October 2008 | October 2008 |
| Signature: |  |  |  |

RPS

6-7 Lovers Walk
Brighton
East Sussex
BN1 6AH

Tel 01273 546800
Fax 01273 546801
Email rpsbn@rpsgroup.com

The preparation of this report by RPS has been undertaken within the terms of the Brief using all reasonable skill and care. RPS accepts no responsibility for data provided by other bodies and no legal liability arising from the use by other persons of data or opinions contained in this report.

Contents

| | | |
|----------|-------------------------------------|-----------|
| 2 | BAT Options Appraisal..... | 3 |
| 3 | Acid Gas Reduction..... | 5 |
| 4 | Quantifying Impacts | 7 |
| 5 | Costs..... | 12 |
| 6 | Benefits and Costs | 14 |
| 7 | Summary and Conclusions..... | 16 |

References

Tables

Tables

| | |
|--|----|
| Table 2.1 : Relevant Environmental Issues | 3 |
| Table 3.1 : Summary of Acid Gas Abatement Options..... | 6 |
| Table 4.1 : Assumed long-term emission concentrations (mg/Nm ³)..... | 7 |
| Table 4.2 : Air Emission Impacts..... | 8 |
| Table 4.3 : Raw Material Use..... | 9 |
| Table 4.4 : Estimated Residues Produced and Disposal Costs..... | 9 |
| Table 4.5 : Comparison Energy Use..... | 10 |
| Table 4.6 : Comparison of POCP Values | 11 |
| Table 5.1 : Summary of Acid Gas Abatement Costs (£) using H1 Methodology..... | 12 |
| Table 5.2 : Comparison of Costs per Tonne of Acid Gas Abated | 13 |
| Table 5.3 : Comparison of Costs per Unit of POCP avoided..... | 13 |
| Table 6.1 : Significant Issues related to Acid Gas, Reduction | 15 |
| Table 7.1 : Summary Ranking..... | 16 |

1 Introduction

Background

- 1.1 Dunbar Energy from Waste (EfW) and Combined Heat and Power Facility is a proposed energy from waste facility which will utilise moving grate combustion technology and include a boiler to generate superheated steam to pass through two steam turbines to generate electricity, exported to the Grid at 25.6 MW. The Installation will be located at Dunbar Landfill, Oxwellmains, 4.5 km south of Dunbar town centre and will be operated by Viridor Waste Management Limited.
- 1.2 For the BAT assessment of acid gas abatement three options were considered, namely:
- no acid gas abatement;
 - semi wet scrubbing using lime;
 - double dry system using hydrated lime; and
 - dry system using sodium bicarbonate.
- 1.3 Each scenario assumed the Installation operating at 7,800 hours per annum after routine shutdowns and maintenance.
- 1.4 For all four options it is assumed that the same primary measures are in place (see Section 3 for details). These options are assessed using the IPPC Environmental Assessment Methodology¹
- 1.5 The option for no acid gas abatement (option 1 – base case, representing the “worst case” as this will not include secondary flue gas treatment.) cannot meet the requirements required by the Waste Incineration Directive (WID) and therefore is not discussed further as an option as the legally required emission limits would not be complied with. However, the base case is used as a benchmark to evaluate other abatement option.
- 1.6 Realistic emission concentrations expected through the use of each technique are based upon information provided by the technology provider.

¹ SEPA (2003) Integrated Pollution Prevention and Control (IPPC) Environmental Assessment and Appraisal of BAT

Scope of Assessment

1.7 This report comprises an assessment, which has been undertaken in response to the requirements of IPPC Sector Guidance Note IPPC S5.01². Specifically this study considers the requirements referred to in the guidance note, section 2.2.1.2.

1.8 With reference to acid gas control, IPPC Sector Guidance Note S5.01 states that:

'The Operator should provide a cost benefit study using the methodology in IPPC Environmental Assessments for BAT to demonstrate the relative merits of the selected primary and secondary measures for the installation with the alternatives outlined. The comparison will include the cost per tonne of acid abated (as HCl) over the projected life of the plant using the asset lives and typical discount rates given in that document.

As some technological options will be mutually exclusive, it will be acceptable to assess the overall viable installation design alternatives in relation to that selected, whilst providing comment regarding the reasons why any apparently better individual process stages are not selected on grounds over overall incompatibility.'

1.9 This assessment comprises a review of available processes and techniques for the reduction of acid gas emissions from Dunbar EfW Facility, by way of a Best Available Technique (BAT) or 'BAT' appraisal, and makes recommendations for the proposed way forward.

Facility Description

1.10 The proposal is for the development of a two line EfW Facility with a total proposed capacity of 300,000 per annum.

1.11 The operational components will consist of a moving grate combustion technology and boiler which will generate superheated steam. Steam will pass to two steam turbines (one for each line) and generator which will generate electricity at a nominal rated output of 25.6 MW at design capacity. The output for sale to the Grid, net of auxiliary loads will be 22.7 MW.

1.12 Assuming shutdown periods and annual maintenance required, the design of each of the EfW lines will ensure an availability of 7,800 hours per annum.

² IPPC Sector guidance Note S5.01 Guidance for the Incineration of Waste and Fuel Manufactured from or Including Waste (2004)

2 BAT Options Appraisal

Overview

- 2.1 The essence of PPC is that operators should demonstrate that the best option (or combination of options) has been chosen to achieve a high level of protection of the environment, taken as a whole. This is done by demonstrating that the technique or techniques chosen constitute BAT, and that taken together, they give the least environmental impact and meet all the statutory environmental quality standards, whilst not creating costs that are excessive for the protection they provide.

Approach

- 2.2 The IPPC Guidance for Environmental Assessment requires a review of the emissions from each abatement option presented. The rationale for the scope of the assessment is set out below in Table 2.1. Factors which are not considered relevant to the BAT assessment for acid gas removal techniques are identified and justified where necessary.

Table 2.1 : Relevant Environmental Issues

| Impact | Relevant to Assessment? | Justification |
|----------------------------------|-------------------------|--|
| Emissions to air | ✓ | The techniques result in different concentrations of SO ₂ HCl and HF being emitted to air and therefore this will be a key factor in the BAT decision. |
| Emissions to surface water | ✗ | There are no releases to water from either technique, so this factor is not relevant. |
| Deposition from air to land | ✗ | Deposition % for SO ₂ is provided in Table 4.2. |
| Noise and vibration | ✗ | No significant difference between the techniques as all would be able to meet noise levels of < 85 dB(A) in 1 m distance, thus this factor is not relevant to the assessment. |
| Odour | ✗ | No significant difference between the techniques. |
| Risk of accidents & consequences | ✗ | There will be similar impacts between the options as no hazard to the environment would result from loss of containment or unplanned shutdown. Appropriate measures to control the consequences of bag filter failure are discussed in section 2.8 of the main PPC application |

| Impact | Relevant to Assessment? | Justification |
|------------------------------|-------------------------|---|
| | | ('accidents'). |
| Visual impacts | ✘ | The options identified will have similar impacts, so this factor is not relevant. |
| Global warming and energy | ✓ | Potentially significant differences between options, therefore relevant. |
| Ozone creation | ✓ | Potentially significant differences between options, therefore relevant |
| Waste treatment and disposal | ✓ | Potentially significant differences between options, therefore relevant |

- 2.3 A summary of the findings of above impacts with regard to each abatement option is presented in Table 7.1.
- 2.4 In reviewing the options available to Dunbar EfW Facility in each of the areas, consideration has been given to each of the environment impacts (given in Table 2.1) and discussed in the Sections 4 and 5 of this document.

3 Acid Gas Reduction

Overview

- 3.1 The BAT for acid gas abatement at the Installation was evaluated using IPPC Guidance. The assessment assumes primary measures are in place for each option and therefore this assessment evaluates only secondary abatement technique options which are discussed further below.

Primary Measures for Acid Gas Reduction³

- 3.2 PPC guidance indicates that acid gas problems can occur where loads of wastes of a particular material (e.g. large quantities of PVC or plasterboard) are not well mixed. In the first instance the nature of the incoming wastes, namely household waste and commercial/industrial wastes similar to household wastes should minimise the potential for such problems. In addition, operators will be responsible for blending of the waste and ensuring controlled introduction of potentially problematic wastes, should this occur. Thus upfront waste management in this form will minimise the potential for peaks of acid gas generation.
- 3.3 A Directive on the sulphur content of certain liquid fuels (99/32)⁴ was formally adopted in April 1999 and had to be implemented by 1st July 2000. It maintains the limit for the sulphur content of gas oil at 0.2% by weight (as set in Directive 93/12⁵) as a minimum standard, reducing to 0.1% from 1st January 2008. The 1999 Directive has been implemented in England, Wales, Scotland and Northern Ireland through Regulations⁶ made under the European Communities Act 1972.

Secondary Measures for Acid Gas Reduction

- 3.4 Table 3.1 summarises the options that have been identified as having potential for reducing acid gas emissions and impacts from the Installation. The options include the base case and the three options.

³ Excerpt from Dunbar EfW Facility PPC Application

⁴ Council Directive 1999/32/EC relating to a reduction in the sulphur content of certain liquid fuels and amending Directive 93/12/EEC

⁵ Council Directive 93/12/EEC relating to the sulphur content of certain liquid fuels

⁶ Statutory Instrument 2000 No. 1460. The Sulphur Content of Liquid Fuels (England and Wales) Regulations 2000

Table 3.1 : Summary of Acid Gas Abatement Options

| Option | | Technique |
|--------|---------------------------------------|--|
| 1. | Base Case | No secondary flue gas treatment measures in place. |
| 2. | Semi wet scrubbing using lime | Implementation of a semi wet scrubbing system using lime. Lime is added to the flue gas flow in an aqueous solution (i.e. lime milk). The water solution evaporates, allowing reagent products to be reused. |
| 3. | Double dry system using hydrated lime | Lime is injected at the inlet of the bag filter. The dose rate of reagent may depend on the temperature as well as on reagent type. The reaction products generated are solid and need to be deposited from the flue-gas as dust in a subsequent stage, normally a bag filter. High removal rates achievable. |
| 4. | Dry system using sodium bicarbonate | Dry sodium bicarbonate is injected at the inlet of the bag filter. Sodium bicarbonate decomposes into a porous sodium carbonate to react with acid compounds in the flue gases to form salts. The use of sodium bicarbonate has the following advantages: <ul style="list-style-type: none"> • produces less residues than other abatement techniques; • grinding of sodium bicarbonate allows good dispersion to ensure faster reactivity; and • uses less energy and water than other abatement methods. |

Abatement Type

3.5 Both dry and semi-dry scrubbing systems have been considered as part of this options appraisal. Following discussions with the technology provider for the Installation, a wet scrubbing system has not been assessed. A wet system was considered a less sought after option, and although the abatement system can achieve good performance, with low reagent consumption and production of solid residues, disadvantages of the system include a requirement for effluent treatment and disposal, thus introducing an additional process emission and increasing investment with additional energy and water requirements. A wet system would not be practicable at the Dunbar site as at present there are no water discharge points. Therefore, it is assumed that this would not represent BAT.

4 Quantifying Impacts

Introduction

- 4.1 This section assesses each of the abatement options with regard to the relevant environmental impacts, previously identified in Table 2.1.

Emissions to Air

- 4.2 Table 4.1 provides the long term emission concentrations used in this assessment. Estimated concentrations for each option were sought from the technology supplier, with the base case flue gas concentrations being derived from BREF document for crude flue gases.
- 4.3 Table 4.1 below summarises the air quality performance of each of the options considered with respect to control of acid gases. With regard to emissions to air, all options offer improvement on the base case. It should be recognised that in assessing the relative performance of each of the options there is a trade off to be made. Lower emissions than those specified within the assessment will be possible for all options; however, this is achieved at the expense of excessive reagent use and corresponding increased residue formation. This would be undertaken during the commissioning phase of the project to optimise reagent use and emissions.
- 4.4 Semi-wet systems typically struggle to control SO₂ levels and therefore typical long term levels only slightly lower than WID limits are common. All other options can achieve similar long term SO₂ performance. The wet system has the best performance in terms of control of HF.
- 4.5 The long term emission concentrations provided for the dry system with sodium bicarbonate are close to the WID limit for all acid gases.

Table 4.1 : Assumed long-term emission concentrations (mg/Nm³)

| Option | | Sulphur Dioxide (SO ₂) | Hydrogen Fluoride (HF) | Hydrogen Chloride (HCl) |
|---|------------------------------|------------------------------------|------------------------|-------------------------|
| WID Limit (daily average values) | | 50 | 1 | 10 |
| 1 ^(a) | Base case | 200-1000 | 5-20 | 500-2000 |
| 2 ^(b) | Semi wet scrubbing with lime | 49 | 0.2 | 10 |
| 3 ^(b) | Double dry system using | 11 | 0.4 | 4 |

| Option | | Sulphur Dioxide (SO ₂) | Hydrogen Fluoride (HF) | Hydrogen Chloride (HCl) |
|------------------|-------------------------------------|------------------------------------|------------------------|-------------------------|
| | hydrated lime | | | |
| 4 ^(b) | Dry system using sodium bicarbonate | 46 | 1 | 9 |

Notes: ^(a) Crude flue-gas concentrations taken from BREF, Table 3.6
^(b) Emission concentrations provided by Keppel Seghers

4.6 Table 4.2 summarises the predicted air emission impacts for each option. Short term emission concentrations are based on short term WID emission limits.

Table 4.2 : Air Emission Impacts

| Option | 1 | 2 | 3 | 4 |
|--|--------------|-----------------|-------------------|------------|
| | No Abatement | Semi-wet system | Double dry system | Dry system |
| Mass Emissions tpa | | | | |
| SO ₂ | 304.3 | 74.55 | 16.74 | 69.99 |
| HCl | 760.74 | 0.3 | 0.61 | 1.52 |
| HF | 7.61 | 15.21 | 6.09 | 13.69 |
| Long term % Process Contribution (PC)/Environmental Assessment Level (EAL) | | | | |
| %PC/EAL SO ₂ | 7.41 | 2.47 | 0.373 | 3.32 |
| %PC/EAL HCl | 46.3 | 1.26 | 0.342 | 1.26 |
| %PC/EAL HF | - | - | - | - |
| Long term % Predicted Environmental Concentration (PEC)/Environmental Assessment Level (EAL) | | | | |
| %PEC/EAL SO ₂ | 13.5 | 8.47 | 0 | 8.32 |
| Deposition % Predicted Environmental Concentration (PEC)/Environmental Assessment Level (EAL) | | | | |
| %PEC/EAL SO ₂ | 7.41 | 2.47 | 0.373 | 2.32 |

Note: Based on an background concentration of 3 mg/Nm³ for SO₂

Raw Materials

4.7 Raw material consumption and estimated costs are summarised in Table 4.3. Using sodium bicarbonate in a dry system represents the most expensive option with regards to reagent use.

Table 4.3 : Raw Material Use

| Options | | Consumption (tonnes/yr) ^(a) | | | |
|---------|---------------------------------------|--|-----------------------------------|--------------------|----------------------------|
| | | Lime (dry) | Hydrated Lime (calcium hydroxide) | Sodium Bicarbonate | Water (m ³ /yr) |
| 2 | Semi wet scrubbing with lime | 4,945 | - | - | 40,560 |
| 3 | Double dry system using hydrated lime | - | 5,943 | - | - |
| 4 | Dry system using sodium bicarbonate | - | - | 8,814 | - |

Note: ^(a) 7,800 hours operation/yr

Waste

- 4.8 Residues arising from each abatement option are provided in Table 4.4. These figures include unspent residues, which are similar for each option considered. Option three produces the lowest amounts of residues.

Table 4.4 : Estimated Residues Produced and Disposal Costs

| Option | Residue production (kg/hr) | Total residues produced (tonnes/per annum) (estimated) ^(a) | Estimated Costs (£ per annum) ^(b) |
|--|----------------------------|---|--|
| 2. Semi wet scrubbing with lime | 1516 | 11,824 | 961,995 |
| 3. Double dry system using hydrated lime | 1552 | 12,105 | 984,839 |
| 4. Dry system using sodium bicarbonate | 1422 | 11,091 | 902,346 |

Notes ^(a) expected 7,800 operating hours per year

^(b) based upon an estimated FGT residue disposal cost of £0.081/kg

Energy

- 4.9 The double dry system will require the greatest energy inputs out of the three options. The single stage reactors have lower energy requirements than complex multi-stage treatment systems which will require greater energy input as the pressure will drop across the two bag filters creating energy demand. <<Where is the data? This has implications on GWP>>

Table 4.5 : Comparison Energy Use

| Option | Energy Consumption (MWh/yr) |
|---------------------------------------|-----------------------------|
| Base Case | - |
| Semi wet scrubbing with lime | 6,396 |
| Double dry system using hydrated lime | 5,148 |
| Dry system using sodium bicarbonate | 3,900 |

Note: Energy consumption provided by Keppel Seghers

Global Warming Potential

- 4.10 In this assessment for acid gas abatement, global warming potential (GWP) is considered through the energy requirements associated with the selected abatement plant options (in terms of CO₂) and also the CO₂ liberated by way of the reaction of the acid compounds with the sodium bicarbonate reagent. The emissions associated with the reaction assumes all carbon is converted to CO₂ which is a worst case scenario as some reagent does pass through un reacted_with the additional energy requirements associated with the selection of abatement plant.
- 4.11 In terms of the GWP, the dry system using sodium bicarbonate has a GWP value of 5,667.50, due to greater energy requirements of the system, while semi-dry has a GWP of 1,312.74 and the double dry abatement system has a GWP value of 1,630.98, providing the best option.

Photochemical Ozone Creation Potential

- 4.12 According to IPPC guidance, for this assessment sulphur dioxide is considered and a Photochemical Ozone Creation Potential (POCP) factor for SO₂ of 4.8 was derived from the guidance. The calculated POCP for each option are given below in Table 4.6.

Table 4.6 : Comparison of POCP Values

| Option | Annual Rate of SO ₂ (tonne/yr) ^(a) | POCP ^(b) |
|---------------------------------------|--|---------------------|
| Base Case | 304.3 | 1460.64 |
| Semi wet scrubbing with lime | 74.55 | 357.84 |
| Double dry system using hydrated lime | 16.74 | 80.35 |
| Dry system using sodium bicarbonate | 62.99 | 302.35 |

Notes: ^(a) assuming operating hours of 7800 per annum
^(b) using a POCP factor of 4.8 for SO₂ specified in IPPC Guidance

- 4.13 These figures indicate that the POCP is significantly reduced in the case of the double dry system compared to the other abatement systems. The costs associated with each option and the equivalent cost per tonne of POCP abated is discussed in Table 5.3.

5 Costs

Annualised Costs

- 5.1 Estimated capital and operating costs were provided by Keppel Seghers, the technology advisers for the Facility.
- 5.2 The costs associated with the three options have been annualised for comparison and presented in Table 5.1. The upper level of capital expenditure estimates have been used to give the annualised costs. The calculation is as follows:

$$\text{Equivalent Annual Cost Factor} = \frac{r}{(1+r)^n - 1} + r$$

where: r = discount rate expressed as a fraction, in this case 2.75% or 0.0275

n = operating life of the abatement equipment, in this case 25 years
(maximum recommended typical asset / plant life)

$$\text{Present Value Factor} = 1 / \text{Equivalent Annual Cost Factor}$$

$$\text{Present Value Cost of Option} = (\text{Annual average operating costs} \times \text{Present Value Factor}) + \text{Capital costs}$$

$$\text{Equivalent Annual Cost} = \text{Present Value Cost of Option} \times \text{Equivalent Annual Cost Factor}$$

Table 5.1 : Summary of Acid Gas Abatement Costs (£) using H1 Methodology

| Option | Description | Capex ^(a) | Opex / year ^(a) | Present Value Cost | Equivalent Annual Cost |
|--------|--------------------------|----------------------|----------------------------|--------------------|------------------------|
| 2. | Semi Wet Scrubbing | 7,662,297 | 3,051,455 | 62,308,723 | 3,479,317 |
| 3. | Double Dry Hydrated Lime | 8,275,089 | 2,046,278 | 44,920,504 | 2,508,360 |
| 4. | Sodium Bicarbonate | 6,372,968 | 2,712,378 | 54,947,096 | 3,068,244 |

Note: Capex = capital expenditure. Opex = operational expenditure.

Based on 2 lines

^(a) provided by Keppel Seghers

Costs provided in 2007 and updated using inflation rate of 4.3%

- 5.3 The cost per tonne of acid gases abated using each option has been calculated and is presented in Table 5.2.

Table 5.2 : Comparison of Costs per Tonne of Acid Gas Abated

| Option | Description | Tonnes of Acid gas abated per annum | Equivalent annual cost (£) | Equivalent annual cost per tonne of Acid gas abated per annum (£) |
|--------|-------------------------------------|-------------------------------------|----------------------------|---|
| 2 | Semi-dry scrubbing | 1049.21 | 3,479,317 | 3,316.13 |
| 3 | Double Dry hydrated lime | 982.59 | 2,508,360 | 2,552.80 |
| 4 | Dry system using sodium bicarbonate | 987.45 | 3,068,244 | 3,107.24 |

Note: Acid gases avoided is based on a comparison with the acid gases (comprising SO₂, HCl and Hf) produced from Option 1 (no abatement) at 1072.65.

- 5.4 Based on this calculation value, semi wet scrubbing is shown to cost more than the other two options, without providing an improvement in acid gas abatement. Dry hydrated lime is considered BAT for the Installation, providing greater acid gas removal rates at a lower cost.
- 5.5 A comparison of the relevant costs/benefits associated with POCP for the three abatement options is summarised in Table 5.3.

Table 5.3 : Comparison of Costs per Unit of POCP avoided

| Option | Description | POCP ^(a) | Equivalent annual cost | Equivalent annual cost per unit of POCP avoided (£) |
|--------|-------------------------------------|---------------------|------------------------|---|
| 2 | Semi-dry scrubbing | 357.84 | 3,479,317 | 3,154.98 |
| 3 | Dry hydrated lime | 80.35 | 2,508,360 | 1,817.27 |
| 4 | Dry system using sodium bicarbonate | 335.95 | 3,068,244 | 2,728.08 |

Note: ^(a) POCP avoided is based on a comparison with the POCP of Option 1 (no abatement) at 1460.64.

- 5.6 The dry hydrated lime abatement system offers better performance in relation to POCP avoided.

6 Benefits and Costs

Overview

- 6.1 The benefits and costs of each of the identified options have been tabulated below (see Table 6.1). Some of the benefits are intangible and some of the costs relate to negative aspects of the options, rather than only increased monetary costs. Practicality of the options has also been assessed, along with the contribution the option will make to reduction and management of acid gases. For each option a monetary cost range has been estimated. Benefits are based upon industry experience of the likely change in performance.

Table 6.1 : Significant Issues related to Acid Gas, Reduction

| Option | Semi-dry System | Double Dry (using hydrated lime) | Dry system (using sodium bicarbonate) |
|--------------------------------------|---|---|--|
| Benefit (Positive) | No effluent treatment requirements as required for wet systems. | Achieves high rates of acid gas removal (11 mg/Nm ³). | Sodium bicarbonate is highly reactive and effective for acid gas absorption. Effective over a wide temperature range. |
| Cost (Negative) | High opex costs The annual equivalent cost is £3,479,317 proving the most expensive option in terms of per tonne of acid gas abated. | Highest Capex costs of the options presented. Low costs per reagent consumption. | Increased reagent costs. Lower capex than other acid gas abatement alternative options considered. |
| Practicality and Contribution | High residue production. | Large area required for plant. Produces significantly lower emissions of acid gases. | Small area footprint for plant. Low solid residue production than with dry lime systems. Potential opportunities to recycle the reagent. |

7 Summary and Conclusions

7.1 To establish BAT for the proposed Installation the performance of each of the potential options needs to be considered for each of the relevant environmental areas considered. To summarise the assessment above, the performance of each abatement option for each of the relevant issues are ranked in Table 7.1.

Table 7.1 : Summary Ranking

| | Ranking | | |
|--|------------------------------|--------------------------------------|-------------------------------|
| | Semi-dry scrubbing with lime | Double dry with hydrated lime system | Dry sodium bicarbonate system |
| <i>Performance Ranking</i> | | | |
| Acid Gas performance | 3 | 1 | 2 |
| GWP performance | 2 | 3 | 1 |
| POCP performance | 3 | 1 | 2 |
| Waste | 2 | 3 | 1 |
| Energy | 2 | 3 | 1 |
| Raw Materials | 1 | 2 | 3 |
| <i>Performance Ranking including Cost Benefit Considerations</i> | | | |
| Acid Gas cost benefit | 3 | 1 | 2 |
| POCP cost benefit | 3 | 1 | 2 |
| Overall | 19 | 15 | 14 |

Note: Scoring 1 – best option 3 – worst option

7.2 The scores given in Table 7.1 indicate that the semi-dry system does not represent BAT in terms of emissions achieved and costs.

7.3 Based upon the performance under each of the areas considered, the dry system using sodium bicarbonate achieves a marginally improved score than the double dry system. This is due to the higher energy requirements and residues produced using the double dry abatement system.

7.4 However, based upon the achievable emission concentrations associated with each abatement option, the double dry system represents a significantly improved option for acid gas removal compared to other options.

- 7.5 If costs associated with these releases are considered, then double dry system provides a better cost benefit performance on an annual equivalent costs basis than the dry sodium bicarbonate system.
- 7.6 The double dry system and the dry sodium bicarbonate system are both are both capable of reliably achieving acid gas emissions below the emission limits specified within the WID. Whilst it is recognised that a dry system using sodium bicarbonate as a reagent does have benefits in performance of releases to air this comes at additional costs compared to the benefits achieved. Overall it is therefore concluded that a double dry abatement system is BAT for this Installation.

References

1. IPPC Sector guidance Note S5.01 Guidance for the Incineration of Waste and Fuel Manufactured from or Including Waste (2004)
2. Dunbar EfW Facility PPC Application
3. BREF for Waste Incineration (2005)