BPEO for the Management of Waste Asbestos

Environment and Heritage Service

CONTENTS

BPEO FOR MANAGEMENT OF WASTE ASBESTOS

This report describes various options for the management of asbestos waste in Northern Ireland based on a study carried out by Environmental Resources Management Limited (ERM) on behalf of the Environment and Heritage Service (EHS) in March 2004. The guidance is intended for use by EHS staff in assessing applications for treatment and disposal of asbestos waste and to inform operators on the approach to asbestos waste management in Northern Ireland.

The EHS acknowledges the work carried out by Simon Gandy and Dave Newby of ERM in the preparation of this report.

1 INTRODUCTION

This report describes various options for the management of asbestos waste in Northern Ireland, and performs a systematic evaluation that leads to the identification of the Best Practicable Environmental Option (BPEO). It is structured as follows:

Section 1	*Background information on asbestos and the legislation that affects its handling*
Section 2	*Possible treatment techniques*
Section 3	*The BPEO assessment*
Section 4	*Sensitivity Analysis*
Section 5	*Conclusions*

An Annex is also provided, which gives further information on the legislative perspective.

1.1 ASBESTOS

The key characteristic of asbestos which gives rise to its hazardous nature (H7 – Carcinogenic) is its fibrous nature and the potential release of very fine fibres (at least 5 microns long and less than 3 microns in diameter – for comparison, a human hair is 60 microns in diameter). These fibres are respirable into the very fine passageways in the lungs, where they can lodge and penetrate the tissue, remaining in the lungs indefinitely. This gives rise to *Asbestosis* and can lead to *Mesothelioma*, a severe and often lethal form of cancer. The main risk from asbestos arises from its removal and handling prior to final disposal, as it is these activities that are likely to release the fibres into the air.

Asbestos itself commonly comes in the three following forms (in order of increasing hazard):

- chrysotile ('white');
- amosite ('brown'); and
- crocidolite ('blue').

Asbestos waste is generally classified into one of two categories, 'bonded' or 'unbonded'/'fibrous'.

In bonded asbestos waste, the asbestos is normally chrysotile and is incorporated in a cement matrix in sheet form. In this form, fibres are only likely to be released by physical abrasion or breaking of the sheets. In contrast, in its fibrous form, the asbestos is not bonded and is far more likely to release fibres into the air.

1.2 LEGISLATIVE REQUIREMENTS

There are a couple of legislative requirements that the BPEO must satisfy – the EU Landfill Directive and the Northern Ireland Control of Asbestos at Work Regulations. The *Annex* provides details on these pieces of legislation, as well as some perspective on the implications for handling waste asbestos. There is also an extract from a Defra review of possible treatment options.

From a legislative perspective, one should note that:

- only waste that has been subject to treatment may be landfilled;
- treatment is defined as *'the physical, thermal, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery'*; and
- putting the asbestos in a double plastic sack is considered a suitable 'treatment' technique, perhaps defining the minimum that is acceptable (see *Section 2.1.1* below).

1.3 THE NORTHERN IRELAND CONTEXT

Around 50 000 tonnes of hazardous waste arise in Northern Ireland each year, 10% of which goes to landfill, and 45% of that is asbestos, meaning that Northern Ireland is landfilling around 2500 tonnes of asbestos per annum.

As at March 2004, there are four hazardous waste landfill sites in Northern Ireland, but all four will no longer be taking that waste by 16th July 2004, when co-disposal is banned under the terms of the Landfill Directive. Asbestos wastes have generally been disposed of at NI landfill sites, while substantial quantities of other hazardous wastes have been exported to Great Britain. There are significant transport burdens associated with the latter, which also contravenes the proximity principle. However, if the former is to continue, it will be necessary for NI landfills to develop dedicated hazardous waste cells to accept the asbestos wastes.

The UK Management Plan for Exports and Imports of Waste (1) bans the export of waste for disposal, although a consultation paper (2) from Defra proposed an exception for:

> *Shipments to Ireland as part of sub-regional waste management plans drawn up by Northern Ireland District Councils and which have been agreed by the Department of the Environment for Northern Ireland.*

Until this amendment is formally adopted, it is not possible to transfer the waste across the border to Ireland. Under all these constraints, it is clear that a Northern Ireland solution must be developed for this Northern Ireland issue.

(1) *United Kingdom Management Plans for Exports and Imports of Waste,* HMSO 1996, ISBN 0 11 7531812
(2) See http://www.defra.gov.uk/environment/consult/eximwast/manplan/index.htm [12Mar04 @ 17:55]

2 TREATMENT OPTIONS

The Landfill Directive requires all waste to be treated prior to landfill, unless it can be argued that it is either inert or that further treatment will not reduce its quantity or hazard. A number of options are available for reducing the hazard of the waste. Therefore, EHS view that some form of pre-treatment is mandatory.

Treatment is defined as a *'physical, thermal, chemical or biological'* process. This section considers what treatment options are available for asbestos, under each of these treatment headings.

2.1 PHYSICAL TREATMENT

2.1.1 Double-Bagging

Consideration has been given to whether the existing practice of double-bagging asbestos could be regarded as *'physical treatment'*, and this debate revolved around the basis of whether or not it *'changes the characteristics'* of the waste. On the one hand, the waste itself is unchanged, but, on the other, its potential for releasing hazardous fibres into the air is reduced, and it does *'facilitate its handling'*.

Furthermore, in §2.3.3, Asbestos Waste, of Decision 2003/33/EC, establishing the Waste Acceptance Criteria, it states that:

- *the waste [must contain] no other hazardous substances than bound asbestos, includes fibres bound by a binding agent or packed in plastic*

Therefore, EHS consider that double-bagging does constitute pre-treatment.

2.1.2 Surface Treatment

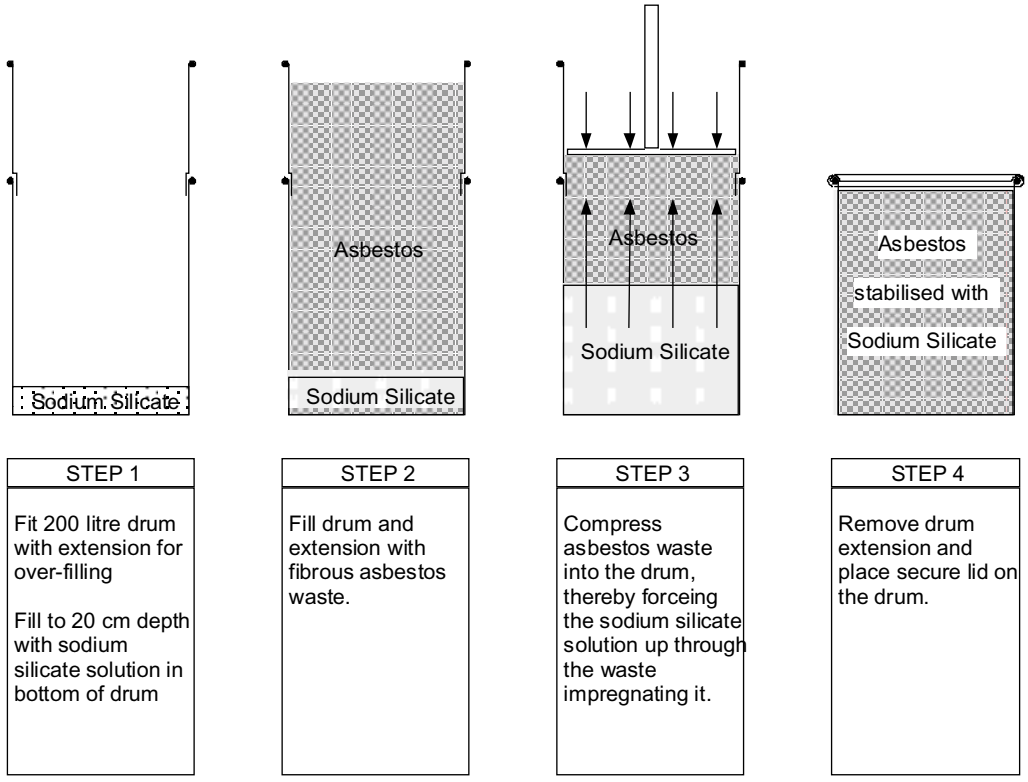
The treatment of the **surface** of the waste material, to reduce its potential for releasing hazardous fibres into the air, may certainly be regarded as *'treatment'*. Therefore, an appropriate form of treatment of the asbestos waste may be to coat or impregnate the waste with a material to reduce the potential for emission of fibres. Such a treatment could, for example, include the spraying of PVA or a sodium silicate solution onto the waste.

In the case of bonded asbestos, the treatment can simply be spraying the surface, so that the surface layers are stabilised and are less susceptible to abrasion and the release of the fibres. It should be noted that this treatment only affects the surface of the bonded asbestos sheet, and so there is still a risk of fibre release if the sheets are broken.

2.1.3 Encapsulation

In the case of fibrous asbestos, the treatment needs to ensure that the asbestos waste is thoroughly impregnated by the treatment agent for the stabilisation process to be effective. This is a practice that has been employed by at least one major asbestos removal contractor in the UK in the past. The methodology used was to compress the waste into a drum containing sodium silicate solution, as illustrated in *Figure 2.1*. A drum extension or "sleeve" is initially fitted to the top of the drum to facilitate over-filling and subsequent compression.

Figure 2.1 Stabilisation of Fibrous Asbestos with Sodium Silicate



The same principle could be adopted using drums smaller than 200 litres, such as using 25-litre drums, for small-scale application.

This treatment process historically used to be (and could be) applied at source, following asbestos removal, or could alternatively be applied at the landfill, as a pre-treatment stage prior to deposit. The process would be undertaken within the 'dirty' area during an asbestos removal operation. If undertaken at a landfill, a dedicated enclosure with filtered air would be required to manage the operation safely.

An alternative treatment method would be to solidify the fibrous asbestos waste in a cement matrix. This would entail a certain amount of pre-processing of the asbestos waste such as chopping or shredding to enable effective admixture with the cement prior to solidification. The amount of

handling would be significantly increased over the sodium silicate solution process described above. Therefore, this option is not considered in the BPEO assessment.

2.2 THERMAL TREATMENT PROCESSES

Two thermal processes could potentially be used for treatment of asbestos wastes; thermal degradation and vitrification.

2.2.1 Thermal degradation

It has been demonstrated that amosite and crocidolite asbestos can be treated by heating to 1100°C (1), when the form changes to non-fibrous; however, the same has not been demonstrated for chrysotile. It should be noted that this has only been demonstrated in the laboratory; to EHS's knowledge, there are no pilot scale or plant scale applications of this technology.

ARI Technologies Inc in the USA was proposing to construct (in the USA) and commission (in Ireland) a large-scale 'thermo-chemical conversion technology' (TCCT) treatment system for processing asbestos (and 'other wastes'). ARI claims that its test facility in Tacoma, Washington, has successfully processed 4.5 tonnes, and that it has supplied a mobile system to the US Department of Defence. The technology would appear to be rotary kiln-based, with emissions control via a wet scrubber followed by mist elimination, pre-filter and HEPA filter. Significant volume reduction (20% to 30%) is claimed with asbestos wastes. No large-scale operating facilities have been identified. It is anticipated that the capital and operating costs would be similar to a dedicated hazardous waste rotary kiln incinerator.

2.2.2 Vitrification

Vitrification is a process whereby materials are mixed with cullet and transformed into a glass-like material. The process was demonstrated for amosite and crocidolite forms of asbestos in the mid-1980s in London. The process utilises a modified glass furnace. The developers, King Taudevin and Gregson (KTG), christened the process 'Vitrifix' (although this name has since been used as a trade name for a glass repair process), and operated a pilot scale (0.5 tonne per day) plant for demonstration purposes in 1984/5. The process was investigated by the Greater London Council's Hazardous Waste Unit (2), and samples of treated product were taken and analysed. No fibrous constituents were identified in the samples, even when finely ground.

The end product from the process is a glass-like substance, in granular form after quenching. The product is inert and may be used as an inert fill material. The GLC investigation concluded that the Vitrifix process could be made

(1) This temperature, reported from 1987 research for DoE, is higher than those stated in WMP18, Asbestos Waste published in 1979.
(2) "A technical evaluation of the 'Vitrifix' process", D. S. Newby, Head of Hazardous Waste Unit, GLC.

technically viable, given sufficient development, but that the cost to the end user might preclude its adoption. Indeed, the Vitrifix process did not find commercial application in the UK due to the high cost of operation, and it is understood that an American investor purchased the rights to the technology. It is not known whether the technology was applied commercially in the USA.

The vitrification process certainly provides the best treatment in the context of reducing the hazard of the waste to zero, but at significant cost.

2.3 CHEMICAL TREATMENT PROCESSES

Asbestos achieved its widespread use because of its excellent thermal insulation properties ***and*** because of its resistance to chemical degradation. Because of this, chemical treatment is very difficult, although it has been demonstrated in laboratory conditions that chrysotile asbestos is susceptible to digestion by strong acids. Effective treatment has been demonstrated using phosphoric acid, sulphuric acid, hydrofluoric acid and fluorosulphonic acid. The fluorine-based acids digest asbestos completely, whereas phosphoric and sulphuric acids partially digest asbestos (affecting the magnesium oxide portions of the structure but not the silica portions). Elevated temperatures (in excess of 50°C) are required with extended processing times in order to digest the asbestos waste.

These acids, particularly those containing fluorine, are very hazardous materials and need extremely careful handling. Investigations have not identified any commercial-scale processes, but it is claimed that a system has been developed in the USA by KAI Technologies that uses a 'high shear' acid digestion ('ABCOV' process), followed by neutralisation and stabilisation with sodium silicate and lime. The end product is claimed to be non-hazardous 'sanitary' waste for landfill.

2.4 BIOLOGICAL PROCESSES

Asbestos is not biodegradable and therefore no options for biological treatment are known.

2.5 SUMMARY OF TREATMENT TECHNOLOGIES

This section has identified a number of treatment options for asbestos, as listed in the table below. Their existence means that landfilling asbestos without some form of pre-treatment is in contravention of the Landfill Directive.

Table 2.1 Possible Treatment Techniques (and their Fates) for Assessment by BPEO

#	Treatment Class	Technique	Fate
1	Physical	Double-Bagging	Landfill
2		Surface Treatment	Landfill
3		Encapsulation (sodium silicate)	Landfill
4	Thermal	Thermal Degradation	Landfill
5		Vitrification	Conversion to construction material (aggregate or building blocks)
6		Vitrification	Landfill
7	Chemical	Acid Digestion	Landfill
	Biological	None Identified	

3 BPEO

In this section, the seven options identified above are assessed, to determine which is the Best Practicable Environmental Option for handling waste asbestos. The number of the landfill site(s), for those options requiring landfill, will be assessed after the treatment method has been identified.

Before embarking upon the assessment, it is necessary to ascertain the decision criteria that will be used to assess the options.

3.1 BPEO DECISION CRITERIA

The decision criteria need to cover all the relevant impacts that the options may have. *Table 3.1* sets out the criteria developed for this specific case.

Table 3.1 Decision Criteria

Criterion	Discussion
Energy Usage	Options that have high energy demands will thereby be responsible for the emission of greenhouse gases and some resource depletion (assuming a non-renewable energy source is used)
Environmental Impact	Putting aside the energy usage, which is covered above, there are still a number of possible environmental impacts, associated with any emissions from the system
Resource Depletion	Options that use non-renewable resources (again excluding energy usage considerations) are placing a burden on the environment
Cost	The cost of the option consists of the initial capital cost of building any treatment facilities, combined with the ongoing operating costs
Practicability	The chosen option must be practicable. The main concerns here are that it can be implemented in time, and that it is of an appropriate scale.
Feasibility	Similarly, the chosen option must be technically feasible. This is slightly different to practicability, and looks for well-proven technologies in preference to ones that, although perhaps theoretically sound, or proven at pilot scale, have not been fully demonstrated
Human Safety	The better the containment of the asbestos – up to and including the complete 'neutralisation' of its risks – the better the option

3.2 EVALUATION MATRIX

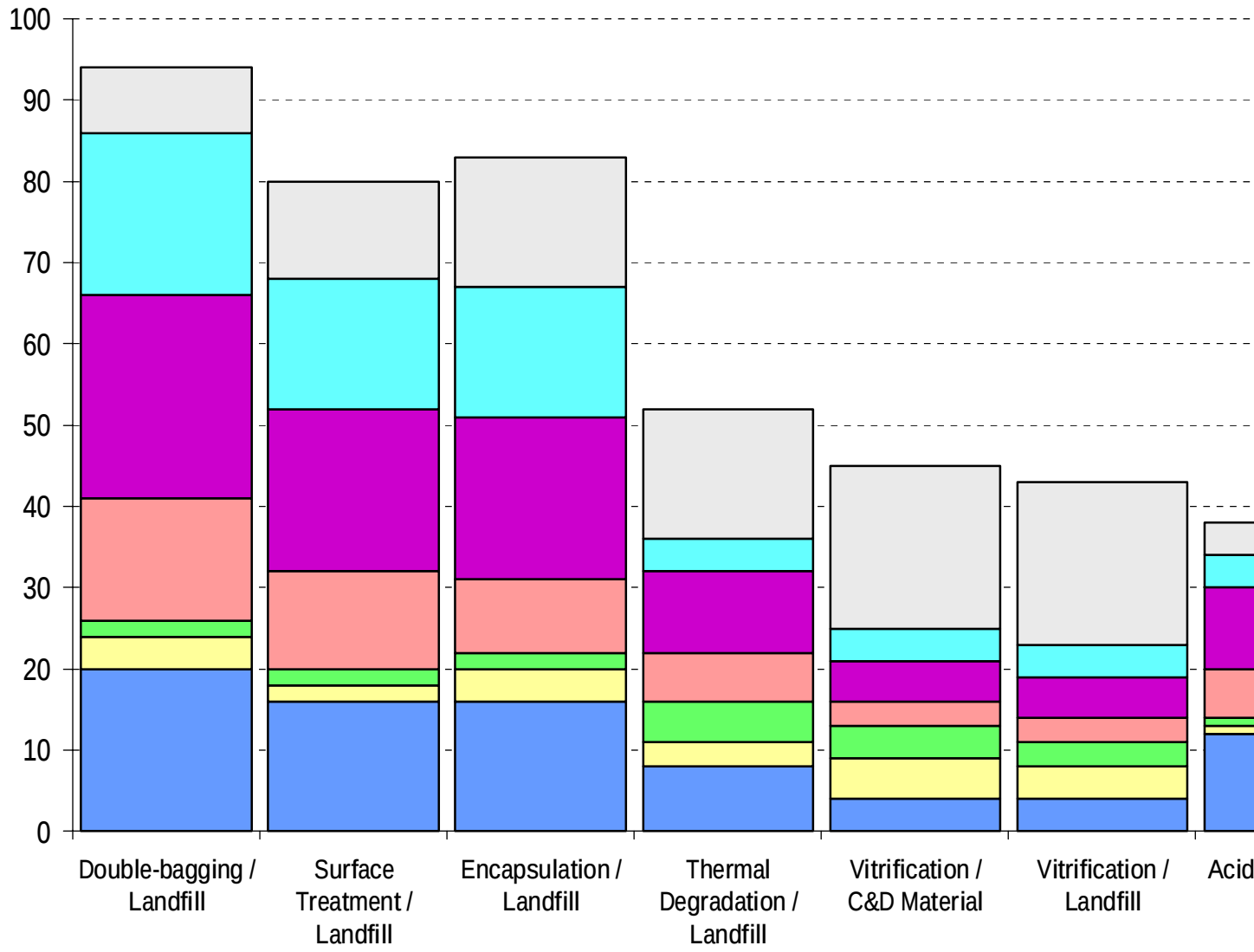
Table 3.2 evaluates each of the options against each of the decision criteria. Options are rated from 1 (worst option for that criterion) to 5 (best option), with intermediates being scored according to their relative position between those extremes. Some text is provided discussing the rating given.

The results shown in *Table 3.2* are presented graphically in *Figure 3.1*. Double-bagging and landfilling the asbestos waste has been assessed to be the BPEO.

Table 3.2 Evaluation Matrix

Criterion [and its weighting]	Option 1 Double-bagging / Landfill	Option 2 Surface Treatment / Landfill	Option 3 Encapsulation / Landfill	Option 4 Thermal Degrad-ation / Landfill	Option 5 Vitrification / C&D Material
Energy Usage Big range; incorporates other impacts **4**	Minimal energy usage **5**	Spraying the surface uses a small amount of energy **4**	Manual operation, so little energy is required to mix the materials **4**	High temperature required **2**	A very energy-inten modified glass furna
Environmental Impact Little difference between options **1**	Little environmental impact **4**	Spraying has to be carefully controlled **2**	Some risk of fibre dispersion during encapsulation, but even less risk after this **4**	Large abatement system reduces potential impacts **3**	Uniquely, no risk of landfill impacts **5**
Resource Depletion Little difference between options **1**	Uses plastic bags **2**	Uses PVA or sodium silicate **2**	Uses sodium silicate **2**	No apparent concomitant resource depletion **5**	Uses glass cullet, converted to C&D material **4**
Cost Moderately important consideration and range **3**	Process is simplicity itself. Only cost is landfill charge, which is common to most options **5**	Fairly simple process; little equipment required; low processing costs **4**	More involved equipment than previous, but much simpler than the following options **3**	High temperature, together with the emission abatement technology is expensive **2**	Very expensive proc
Practicability Very important, as decision needed imminently **5**	Current practice, and flexible **5**	Simple process, can be done at different scales; practicable **4**	Demonstrated in 200l drums; should be practicable in smaller ones **4**	Expensive plant; would benefit from economies of scale that are not appropriate here **2**	A relatively small pl even this has not yet Economies of scale n all, be practicable
Feasibility Also important – must be doable **4**	Current practice, very simple **5**	Simple process, clearly feasible **4**	Has been done by a major UK company **4**	Not been demonstrated at full plant level	
Human Safety Asbestos is hazardous – important to be safe to health **4**	Bags could be punctured, so not the safest option **2**	Although coating the surface, if abraded or snapped would reveal fibres **3**	Some risk of fibre dispersion during encapsulation, but even less risk after this **4**	Apart from high temperature, safe process **4**	Completely neutrali
Total	**94**	**80**	**83**	**52**	**45**

Figure 3.1 Plot of Evaluation Matrix



3.3 NUMBER OF LANDFILL SITES REQUIRED

Having determined that landfilling in Northern Ireland is involved in the BPEO process, the question arises of how many landfill sites will be required to establish hazardous cells for Northern Ireland's waste asbestos. This is not straightforward. The introduction highlighted that around 2500 tonnes of waste asbestos arise each year. However, new health and safety at work legislation is putting pressure on businesses that know they have any asbestos in their buildings to remove that material. EHS therefore expect the amount of arisings to increase.

From the standpoint of environmental impacts and human safety, there are pros and cons to establishing more than one landfill cell for asbestos in Northern Ireland. Having just one site limits the number of people and the area of the environment that may suffer any impacts (transport issues, inconvenience, costs, etc), but, at the same time, increases the potential extent of any impacts that do arise, by concentrating the effect.

Given no clear lead from these considerations, it is necessary to look at other issues for guidance on this matter. The current costs of landfill in Northern Ireland are very high, and the presence of just one landfill cell for asbestos would give the owner significant control over gate fees. In contrast, having two or more sites, especially if run by different companies, would allow some element of competition. On a similar basis, two or more sites, well spread across the region, would reduce transport distances and simplify the handling of the waste asbestos. Reduced transport distances have financial, environmental and safety benefits.

Overall, it is considered that there are pros and cons to establishing just one landfill cell for waste asbestos in Northern Ireland. However, on balance, questions of, in particular, cost and transport make more than one site, preferably owned by different companies and spatially separated, the better option.

3.4 OTHER CONSIDERATIONS

It is recommended above that separate cells on two or more landfill sites within Northern Ireland be employed for the disposal of asbestos. Even with the most judicious selection of their locations, it is inevitable that asbestos waste will frequently need to be transported some distance to the nearest site. In instances where the arisings per day are relatively small, this quickly becomes difficult to justify, both economically and environmentally. If asbestos removers are unable to deliver waste to a relatively local storage facility, the temptation may arise to dispose of the waste illegally.

In the short-term, after the deadline for the co-disposal ban but before some landfill cells are approved to accept asbestos waste, this storage issue will

become more critical, since the only alternative is to transport the waste to GB for landfilling.

To combat these concerns, it makes sense to establish a network of transfer/storage stations. Small quantities of asbestos could be accumulated at these facilities, before being transferred on to the landfills for final disposal. The amount of waste that might be stored should be decided on a case-by-case basis, taking local factors into account.

4 SENSITIVITY ANALYSIS

The analysis in the previous section concluded that the BPEO for the management of waste asbestos in Northern Ireland is to double-bag the waste and then landfill it. This section looks at changing the evaluations underlying that conclusion, to test its robustness.

Three perturbations of the basic analysis were performed, to investigate the sensitivity of the results to changing the weighting of the decision criteria, by:

1. **Merging *Practicability* & *Feasibility*;**
   There are significant synergies between *Practicability* and *Feasibility*, so it could be claimed that separating them out, when the lead option performs so well against these criteria, amounts to biasing the results in that option's favour. This is addressed by dropping *Feasibility*, and accounting for its scores under *Practicability*.

2. **Promoting the importance of *Cost*;**
   Cost is given a medium rating in the main assessment, but cost could be considered to be the most important criterion. In this sensitivity analysis, cost is promoted to the most important consideration, and the others are demoted as appropriate.

3. **Promoting *Environmental Considerations*.**
   The environmental considerations – *Environmental Impact* and *Resource Depletion* – are given low ratings in the initial assessment, as there is little to choose between the options in terms of these criteria. This perturbation ignores that consideration, and gives the two criteria top rating, downgrading the weightings of the others.

The effects of these changes on the weightings of the decision criteria are shown in *Figure 4.1*. These perturbations represent a quite significant change away from the original weighting set.

Their effects on the assessment itself are shown in Figure 4.2. For each of the re-weightings, the resultant assessment scores are plotted for the seven options. What is apparent from this figure is that, despite the quite radical changes in the emphasis of the weightings, option 1 – double-bagging followed by landfill – remains the BPEO; indeed, it remains the BPEO by some margin (10% or more).

Figure 4.1 ***Re-Weighting the Decision Criteria***

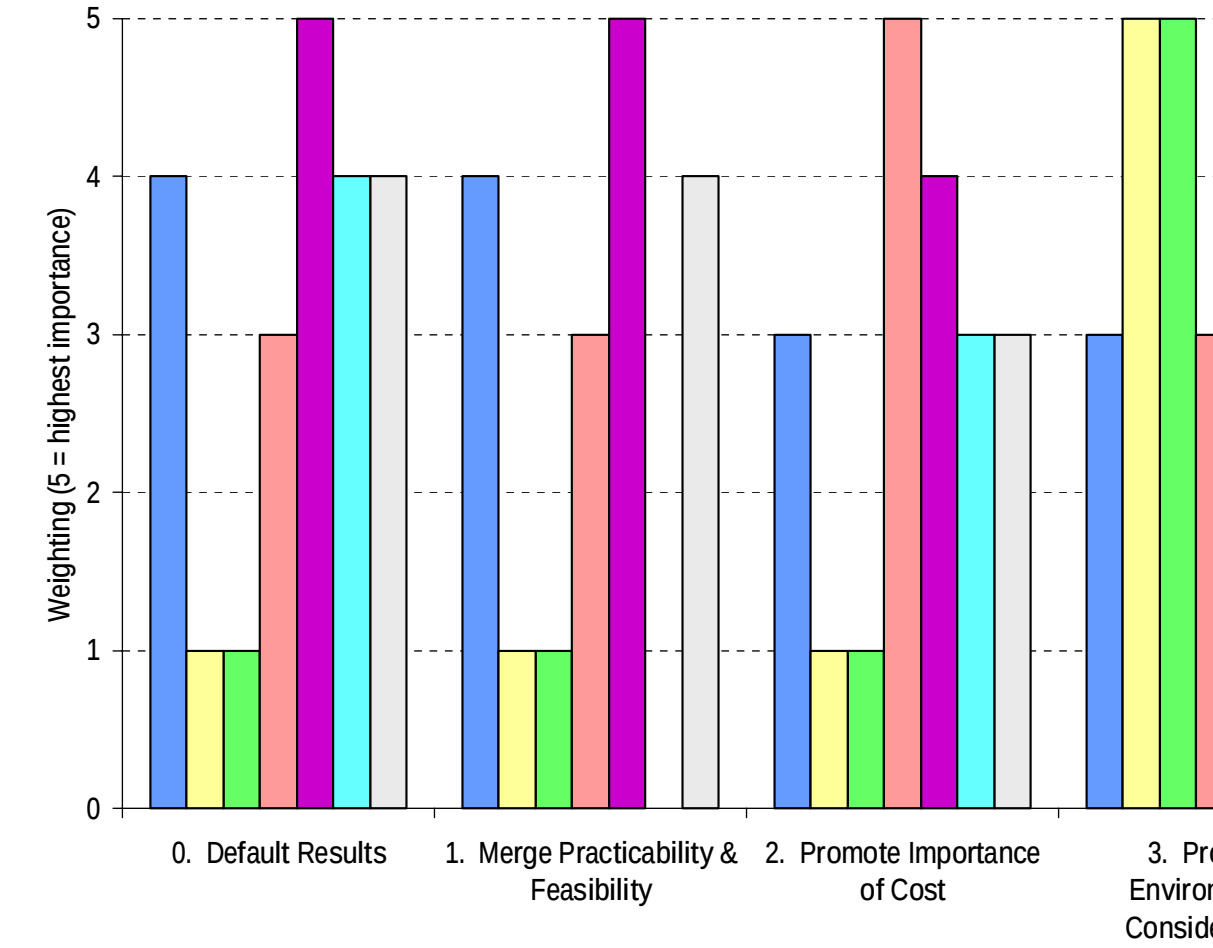
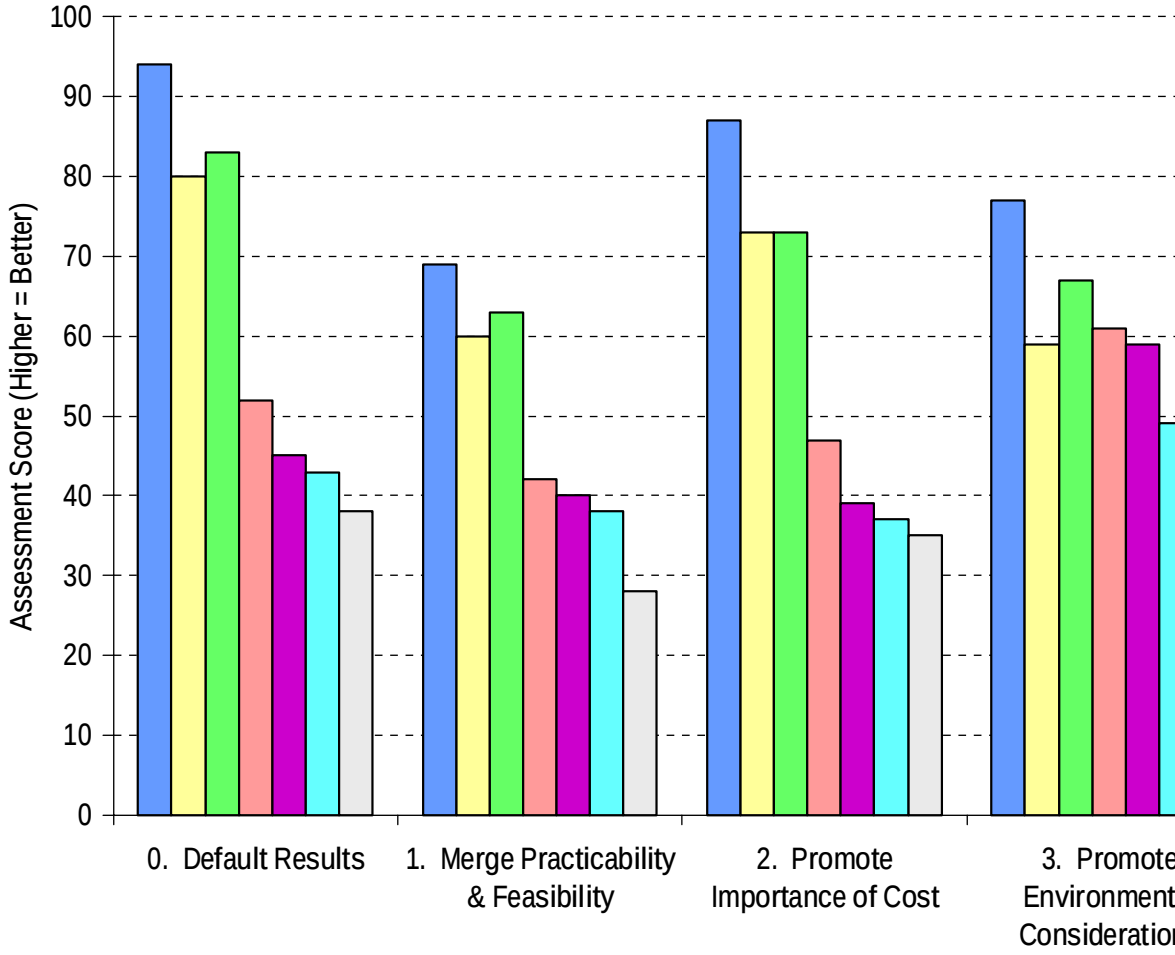


Figure 4.2 ***The Effect of Re-Weighting the Decision Criteria on the Assessments of the BPEO for Handli***



5 CONCLUSIONS

This study sought to identify the Best Practicable Environmental Option for the management of waste asbestos in Northern Ireland, from seven options:

1. Double-Bagging and Landfill
2. Surface Treatment and Landfill
3. Encapsulation in Sodium Silicate and Landfill
4. Thermal Degradation and Landfill
5. Vitrification with use of product as Construction Material
6. Vitrification and Landfill
7. Acid Digestion and Landfill

The BPEO has been identified to be *Option 1*; to double-bag the waste and then landfill it. Furthermore, that landfilling should occur in two or more landfill cells, preferably owned by different companies and spatially well separated within Northern Ireland. To service those landfills, a network of transfer / storage stations should also be established.

Sensitivity analysis, changing the weighting of the various decision criteria used to make the assessment, had no effect on the selection of BPEO.

EHS believe this study is robust, and that the conclusion reached will continue to be BPEO at least in the medium term. However, BPEO is a dynamic process and the conclusions will require re–evaluation in the future. For example, one of the 'high tech' options identified may be able to demonstrate commercial viability and control their energy usage (the main aspects where these options currently perform poorly). For this reason, the Department proposes to revisit this assessment in five years' time.

Annex A

Legislative Requirements

A1 LEGISLATIVE REQUIREMENTS

A1.1 THE EU LANDFILL DIRECTIVE

The EU Landfill Directive (hereinafter the 'Directive'(1)) came into force on 16 July 1999. All new landfills are required to comply with the Directive's requirements, and a transitional period has been allowed for landfills that existed at 16 July 2001, effectively postponing the need to meet certain requirements of the Directive until July 2004.

The Directive requires landfills to be categorised as 'Landfill for Inert Wastes', 'Landfill for Non-Hazardous Wastes' or 'Landfill for Hazardous Wastes'. Furthermore, it requires that hazardous wastes may **only** be deposited in hazardous waste landfills, and only then if they meet defined 'Waste Acceptance Criteria' (WAC). A dedicated 'hazardous waste cell' may be established on an otherwise 'non-hazardous waste' landfill.

The main provisions that affect the way in which asbestos wastes have historically been disposed of to landfill are:

Article 6(a):
'*Member states shall take measures in order that:*

(a) ***only waste that has been subject to treatment is landfilled.*** *This provision may not apply to inert waste for which treatment is not technically feasible, nor to any other waste for which such treatment does not contribute to the objectives of this Directive, as set out in Article 1, by reducing the quantity of the waste or the hazards to human health or the environment;'*

…and **Article 5.4**

'the dilution or mixture of waste solely in order to meet the waste acceptance criteria is prohibited.'

Furthermore, **Article 2** defines 'treatment' as:

'the physical, thermal, chemical or biological processes, including sorting, that change the characteristics of the waste in order to reduce its volume or hazardous nature, facilitate its handling or enhance recovery.'

In order to meet the requirements of the Directive, therefore, asbestos waste must be treated, unless it can be argued that it is either inert or that further treatment will not reduce its quantity or hazard. In the context of the management of asbestos waste, it is logical for the treatment to aim to '*change the characteristics (potential to release hazardous fibres) of the waste'* in order to '*reduce its hazardous nature'* and '*facilitate its handling*'.

(1) Council Directive 1999/31/EC http://europa.eu.int/smartapi/cgi/sga_doc?smartapi!celexapi!prod!CELEXnumdoc&lg=en&numdoc=31999L0031&model=guichett [03Mar04 @ 16:03]

A1.2 THE LANDFILL (AMENDMENT) REGULATIONS (NORTHERN IRELAND) 2004

European Council Decision 2003/33/EC established criteria and procedures for the acceptance of waste at landfills (the Waste Acceptance Criteria, or WAC), and the above regulations, made on 8th July 2004, implement these requirements. Section 16 of Part 3 (Waste Acceptance Criteria) of Schedule 1 to the revised Regulations, is concerned with the 'Criteria for Asbestos Waste'. This is reproduced below.

A1.2.1 Schedule 1, Part 3 (Waste Acceptance Criteria), Section 16 concerning 'Criteria for Asbestos Waste'

The following criteria apply to asbestos waste and to construction materials containing asbestos —

(a) the waste must contain no hazardous substances other than bound asbestos, including fibres bound by a binding agent or packed in plastic;

(b) construction material containing asbestos or other suitable asbestos waste can only be accepted in a landfill dedicated to these wastes or in a separate cell of a non-dedicated landfill, provided it is sufficiently self-contained;

(c) the zone of deposit must be covered daily and before each compacting operation with appropriate material and, if the waste is not packed, it is regularly sprinkled;

(d) a final top cover is put on the landfill or cell in order to avoid the dispersion of fibres;

(e) no works are carried out on the landfill or cell that could lead to a release of fibres (e.g. the drilling of holes);

(f) appropriate measures are taken to limit the possible uses of the land after closure of the landfill in order to avoid human contact with the waste.

A1.3 THE CONTROL OF ASBESTOS AT WORK REGULATIONS

The Control of Asbestos at Work Regulations (Northern Ireland) 2003 (henceforth the Regulations(2)) imposes requirements for the protection of employees who might be exposed to asbestos at work and of other persons who might be affected by such work, and also imposed certain duties on employees concerning their own protection from such exposure.

Regulation 23 concerns the storage, distribution and labelling of raw asbestos and asbestos waste, and states:

(1) Every employer who undertakes work with asbestos shall ensure that raw asbestos or waste which contains asbestos is not -

(a) stored;

(b) received into or despatched from any place of work; or

(c) distributed within any place of work, except in a totally enclosed distribution system, unless it is in a sealed container clearly marked in accordance with paragraphs (2) and (3) showing that it contains asbestos.

(2) Raw asbestos shall be labelled in accordance with the provisions of Schedule 2.

(2) Statutory Rule 2003 No. 33 http://www.northernireland-legislation.hmso.gov.uk/sr/sr2003/20030033.htm [03Mar04 @ 16:35]

(3) Waste containing asbestos shall be labelled -

(a) where the Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996 apply, in accordance with those Regulations;

(b) where the waste is conveyed by road in a road tanker or tank container in circumstances where the Carriage of Dangerous Goods by Road Regulations 1996 apply, in accordance with those Regulations; and

(c) in any other case, in accordance with the provisions of Schedule 2.

Two *Approved Code of Practice and Guidance Notes* interpret the above regulations. Note L27 (3) uses following paragraphs:

149 Waste containers should be designed, constructed and maintained to prevent any of the asbestos escaping during normal handling. For loose fibrous or dusty waste, or other asbestos waste in small fragments, double plastic sacks are suitable, provided they will not split during normal use. The inner sack should not be overfilled and each sack should be securely tied or sealed. Air should be pushed from the sack as far as possible before sealing. Precautions will need to be taken as the exhaust air may be contaminated. Stronger containers are necessary if the waste contains sharp objects which could puncture a plastic bag.

150 Wherever practicable, large pieces of rigid material must not be broken or cut for disposal in plastic sacks. They should be double-wrapped intact in plastic sheeting or other suitable material, or placed in a sealed container such as a lockable skip. If an open skip is used it should be tightly and securely sheeted with tarpaulin or similar strong material.

151 Bags/sacks containing asbestos waste should be appropriately labelled and transported to a licensed disposal site in an enclosed vehicle. Any open-topped vehicle should be securely sheeted or covered to prevent packages from rolling or falling off, and to ensure that no asbestos fibres are released. The requirements of the Special Waste Regulations 1996 should be adhered to as appropriate.

Using similar language, Note L28 (4) interprets the regulations as follows:

199 Waste should be placed in suitable, labelled containers as it is produced. Where practicable, containers should be sealed and the outside cleaned before removal from the enclosure or work area, and they should be taken to a suitable and clearly identified secure storage area if they are not being disposed of at once.

200 Containers must be designed, constructed and maintained to prevent any of the contents escaping during normal handling. For most waste, double plastic sacks are suitable. It is important that the inner bag is not overfilled, especially when the debris is wet, and each bag should be capable of being securely tied or sealed. Air should be excluded from the bag as far as possible before sealing. Stronger packages are necessary if the waste contains sharp metal fragments or other materials liable to puncture plastic sacks.

(3) "Work with asbestos which does not normally require a licence (Fourth edition)", HSE, ISBN 0 7176 2562 1

(4) "Work with asbestos insulation, asbestos coating and asbestos insulating board (Fourth edition)", HSE, ISBN 0 7176 2563 X

201 *Wherever practicable, large pieces of rigid material must not be broken or cut for disposal in plastic sacks. They should be double-wrapped intact in plastic sheeting or other suitable material and placed in a sealed, labelled container such as a lockable skip.*

A1.4 DETR COMMENTS (2000)

These comments are taken from Implications of the Landfill Directive on the Disposal of Hazardous and Liquid Waste in the UK. DETR (2000) [(5)], and provide further context on the options assessed in the main report.

Asbestos cement is not on the current Hazardous Waste List or included in the proposals for additional hazardous categories in the integrated List that are due for ratification in December 2000, but discussions are taking place about its inclusion as a hazardous material at some later date.

Currently, asbestos fibre is wetted and bagged prior to landfill at present to prevent inhalation of the fibre during transport and disposal. If this is acceptable as 'treatment' for the purposes of the Landfill Directive on the basis that it significantly reduces the major health risk, and that asbestos is physically and chemically inert within landfill, then there are small additional costs from implementation of the Directive. The material would still be carcinogenic and thus require disposal in hazardous landfill and there is likely to be a reduction in the numbers of such sites since there are a large number of co-disposal landfills at present that do not take in any hazardous waste other than asbestos. These are very unlikely to continue operation as hazardous landfills after the Directive is implemented, even if existing sites can be easily divided into a hazardous and a non-hazardous component, because of the additional annual costs of operation for a limited waste intake. This could radically increase the distance travelled by asbestos waste prior to landfill, and hence increase costs. However, analysis of transport distances shows that a large quantity of asbestos fibre already travels long distances for disposal and the differences may be small. The only practical alternative treatment options for asbestos fibre are vitrification or solidification, both of which would render the material suitable for non-hazardous landfill, but neither of which is available at present. These could add another £15-£25/tonne to disposal costs for asbestos fibre.

Asbestos cement is a product of asbestos fibre in a bound matrix. There is a risk of asbestos fibres being released if the product is broken or abraded. The Health and Safety Executive (HSE) recommend that wetting the surface with water is the best practice for minimising health effects from asbestos cement removal. **Materials could be coated with resin or emulsion, but the HSE do not feel that this provides any additional health benefits**. If wetting is acceptable as treatment, then the removal and transport systems for asbestos cement need little change, and the variation in overall disposal costs is solely

(5) See http://www.defra.gov.uk/environment/waste/hazforum/actionplan/3.5i.pdf [04Mar04 @ 12:17]

dependent on the type of site considered suitable for asbestos cement. A number of landfill sites in the UK take in no special waste other than asbestos cement at present.

The current discussions at European level suggest the following position. Asbestos cement cannot be deposited in an inert site because it may release fibres after landfilling and contains a significant content of asbestos fibre. Co-disposal of asbestos cement with other non-hazardous waste and biodegradable waste should be prevented due to possible degradation of the cement matrix in acidic leachate conditions and the release of asbestos fibres through landfill gas collection systems. If asbestos cement is classified as a hazardous waste in the future, it may be deposited in a separate cell within a non-hazardous landfill under DRAFT Article 6(c)(iii); if it remains as a non-hazardous waste it will still need to be placed in a separate cell within a non-hazardous landfill to avoid interaction with biodegradable wastes.

The disposal of asbestos cement could be more expensive in future if wetting is not acceptable as treatment or if companies currently accepting asbestos cement do not wish to operate a separate cell within a non-hazardous landfill.

Our aim is to protect and conserve the natural and built environment and to promote its appreciation for the benefit of present and future generations.

An Agency within the Department of the
Environment
www.doeni.gov.uk

Printed and Published by
Environment and Heritage Service
Publishing Unit 2004 08/04.14