COMPOST PRODUCTION

IN THE FALKLAND ISLANDS

FEASIBILITY STUDY

by

ECOLOGICAL SCIENCES LTD.

Re-working of appropriate pages
for Abbatoir Composting using
"Plus Grow Systems"

ECO SCI LTD.

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PlusGrow Systems

A new cost effective in-vessel composting system for Waste Management Operators

PlusGrow turner/shredder, at start position

The PlusGrow agitated bay composting system is a space efficient, and extremely economical method for processing a variety of organic wastes.

The heart of the system is the versatile diesel powered hydraulically driven PlusGrow turner, which both shreds and mixes ensuring a high degree of aeration.

The PlusGrow turner operates within a series of purpose-built reinforced concrete bays, housed within a clear-span building.

into the new feedstock

Due to the vigorous action of mixing and turning on a regular basis, composting conditions are optimised and the processing of organic waste can be achieved in 28 days.

As each bay is separate, different organic waste streams can be treated independently. Typical waste types include greenwaste, food waste, paper mill sludge, sewage sludge and municipal solid waste.

A two-bay system in a clear-span building

As the process is contained within a building, regulatory requirements related to planning and licensing issues can be more readily fulfiled, and hence the location for a PlusGrow facility is acceptable to urban as well as rural locations.

Depending upon the organic matter being processed, each bay can compost approximately 2,500 tonnes of input material per year. The system can be constructed in modular fashion; with up to six bays in parallel, enabling some 15,000 tonnes per year of input waste to be processed by a single PlusGrow turner.

The technical aspects of the PlusGrow system

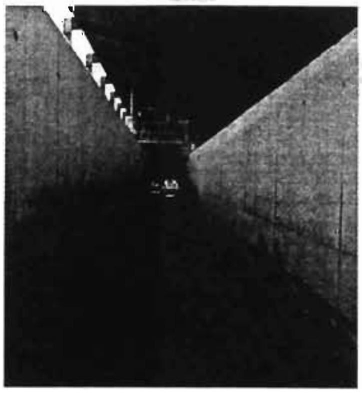
- The front end feeder tines 'eat' into waste, dropping it on the conveyor and thence to the integrated mixer/shredder unit.
- There are a number of in-built safety devices, including overload detectors, which both prevent damage and ensures the safe running of the machine. The hydraulic drives are powered by a diesel engine ensuring both reliability and flexibility of design.
- The PlusGrow machine travels along the top of the bay walls, progressively moving composting material down the bays in 5 metre increments at each pass.
- Transfer of the machine from one bay to the next is achieved by means of a cross-bay transporter unit.
- Pre-cast/pre-stressed concrete blocks slot into each other forming bay walls that are specially designed for maximum strength and resilience to subsidence or other stresses.
- Routine maintenance is minimal and service contracts can be arranged with the manufacturer if required.

The benefits of the PlusGrow Composting System

■ Space efficient with small footprint - very important in urban or industrial environments. A typical installation for 15,000 tons per year input material occupies 1,500 m^2.
■ Low operating costs enable economic processing of a wide range of waste materials.
■ The vigorous action of the robust turner, enables normally difficult-to-handle materials to be readily mixed and aerated.
■ Leachates, if produced, are readily re-circulated into the composting material.
■ Flexibility to treat multiple waste streams simultaneously in different bays.
■ The operator is relatively free to tend to other tasks such as loading material into bays at the front-end and removing the finished compost.
■ Optimal composting conditions are continually maintained due to the high volume-to-surface-area ratio. Heat is thus conserved within the composting material regardless of weather conditions. This is reflected in shorter processing times and hence greater throughput.
■ The PlusGrow system is both fully contained and highly space efficient. Taking into consideration its versatility and low operating costs, the PlusGrow system is at the forefront of in-vessel composting technology.

Material moves down the bay in 5 metre increments each time the turner passes

Final composted material is removed from the back-end of the bay for maturation



Emptied bay awaiting intake of new material for composting

Who to contact

For more detailed information regarding any aspect of the PlusGrow Composting System, please contact the PlusGrow Systems Business Development Manager.

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3.0 PROGRAMME OF MEETINGS AND VISITS

The programme of Camp visits had been pre-arranged by Jim McAdam in conjunction with Bob Reid of the Department of Agriculture. The first five days were spent based in Stanley, followed by a visit to Saunders Island and Port Howard, allowing for a final 2 days in Port Stanley for wrap-up meetings. Unfortunately, exceptionally severe winds curtailed all FIGAS flying for 3 days so the wrap-up meetings had to be abandoned and the return flight to the UK entailed an eleventh hour flight from Port Howard direct to Mount Pleasant and a kind landlady at Stanley packing our belongings! Fortunately, with the exception of Simon Hardcastle, who was on leave during the first week, it proved possible to have brief discussions with most people who are likely to be directly concerned with any composting project.

Specifically meetings were held with:-

- Bob Reid - Director, Department of Agriculture
- Andrew Coe - Senior Vet, Department of Agriculture
- Hugh Normand - Managing Director, Falkland Islands Development Corporation
- Ian Dempster - Deputy MD Falkland Islands Development Corporation
- Manfred Keenlyside - Public Works Department
- Colin Horton - Managing Director Falkland Holdings Ltd
- Colin May - Butchery
- Alec Smith - Estates Branch Mount Pleasant
- Tom Eggling - Environmental Planning
- Tim Miller - Stanley Growers
- John Lee - Manager Goose Green Farm

In addition visits were made to:-

- Eliza Cove Landfill Site
- The existing Slaughterhouse
- Provisional site for new Abattoir
- Mount Pleasant - Estates Office
- Goose Green Farm
- Kidney Island
- Saunders Island
- Port Howard
- Recording studio - interview on radio

All concerned were extremely co-operative, very supportive of the principle of recycling, and generally enthusiastic about the possible production of compost.

4.0 OVERVIEW

Composting is the aerobic digestion of organic matter and the process, together with a summary of the beneficial properties of compost, is described in general terms in Appendix B. The microbial activity in the composting process generates heat and drives off moisture with temperatures in excess of 60°C maintained for a number of weeks. The Falkland Islands climate should not be a major problem provided the process is well insulated and the volumes are of sufficient size in relation to the surface area to contain heat loss. For this reason, small scale garden composting is likely to prove difficult.

It was apparent from the outset that the whole approach to both the economics and the practical aspects of compost production would differ radically as between Port Stanley and the Camp.

The basic raw material for producing compost in the Camp would be the annual "cull" of sheep, supplemented by cast kelp and peat, in order to ensure adequate "structure" and the necessary balance in the feedstock as between carbon and nitrogen - known as the Carbon/Nitrogen (C:N) ratio.

Although a composting plant at Port Stanley could be viewed as an environmentally friendly means for disposing of domestic waste, the quantities generated by a population of 1,800 are so trivial in terms of a conventional composting plant that it would be difficult to justify on economic grounds - even after taking into account the high cost of imported compost. However, it is understood that the new abattoir is likely to go ahead but that it is unlikely to incorporate a plant for treating the offal - as was originally envisaged. Slaughterhouse waste from the abattoir could therefore represent a disposal problem but would be a superb feedstock material for composting. This would be an important factor when considering the design, location, and the economics of a composting plant in the Stanley area.

For the purposes of this report, composting at Port Stanley will thus be treated as an entirely separate issue from composting at the various stations in the Camp.

5.0 COMPOSTING PLANT - STANLEY AREA

5.1 Sources of raw material

Various sources of putrescible waste which might be made available for composting in the Stanley area are:-

- Household waste
- Garden Waste
- Slaughterhouse offal
- Cast Kelp
- Peat
- Cookhouse waste from MPA
- Sewage Sludge from MPA

5.1.1 <u>Household waste</u>

A study was commissioned recently by the Falkland Islands Government into waste disposal and undertaken by Sir William Halcrow and Partners (Falkland Islands Waste Disposal February 1998). The study indicated that some 800 tons of domestic waste is collected annually in Stanley by the Public Works Department. At present this is landfilled at Eliza Cove. Eliza Cove is not a "controlled" landfill site and the diversion of the putrescible element of the waste stream from Eliza Cove, or from any landfill site that may be planned, would be a distinct advantage, both from an environmental and an economic standpoint.

The waste composition analysis in the Halcrow report indicates that food and garden waste comprises 40% of the total, with paper and board amounting to a further 12%. Theoretically, it would be possible to recover this putrescible material, thus composting over 50% of the domestic waste stream, with a corresponding reduction in the disposal of waste to landfill.

In order to achieve this, it would be necessary either to introduce a source separated collection or establish a centralised sorting operation. Typically, a source separated collection would allow for kitchen waste, garden waste, paper and cardboard to be collected on alternate weeks, with the remainder of the household rubbish collected during intervening weeks. Experience of source separated collection in the UK has been, on the whole, fairly unsatisfactory. However most of these schemes in the UK relate to large centres of urban population and the few schemes that have been introduced in rural areas have been markedly more successful. It would be fair to assume that a source separated collection in Stanley should work well, given the nature of the community. A key factor would be a well organised educational programme to explain the benefits - staring with the school.

The alternative to a source separated collection would be a centralised pre-sorting site. Although perhaps 75% of the available putrescible waste stream could be recovered by pre-sorting the mixed household waste arisings from a non source separated collection (as at present), this operation is both messy and labour intensive and would also require a building - bearing in mind the wind-blow effect.

As there is no indigenous market for any of the dry recyclables (glass, metals and plastics) which would normally be recovered and help to pay for the costs of pre-sorting, a source separated collection of putrescible waste would seem to be the preferred option.

5.1.2 Garden Waste

Household garden waste is included with domestic waste in the figures quoted in the Halcrow report. However, there is an estimated further 200 tons per year of garden waste produced by Stanley Growers. At present this is used as pig food or dumped on site. This would be an excellent material for composting.

5.1.3 Slaughterhouse Offal

This would be an excellent feedstock for co-composting with other wastes. As it has a high nitrogen content there would be a requirement for similar quantities of domestic waste and/or peat. The elevated temperatures (over 60°C) maintained over a period of several weeks during the composting process would be sufficient to ensure destruction of any harmful pathogens. It was difficult to obtain any reliable forecast of the likely throughput for the projected new abattoir. The best guess would appear to be an output of some 400 tons of offal per year based on a throughput of some 30,000 carcasses. This would balance well with 200 tons of garden waste and 200 or 300 tons of organic domestic waste.

5.1.4 Cast Kelp

This would be an excellent material to co-compost with the offal and domestic waste. The kelp holdfast would add much needed physical "structure" together with beneficial trace elements. The analysis of samples of the kelp collected during the visit is shown in Appendix C.

Following an onshore gale, a tractor, fitted with a front loader, could drag kelp above the tide mark, so that it is not carried back out to sea. It could then be left to "weather" in situ for an indefinite period and could subsequently be collected for composting with a tractor and trailer. The "weathering " process has two benefits:

1. The dry matter is increased from less than 10% typically to more than 70%. Not only does this transform the economics of subsequent transport, but also the physical nature of the cast kelp is such that it would act as a bulking agent and help to provide the necessary "structure" when mixed with slaughterhouse offal.

2. The leaching action of any rainfall will reduce the salt content.

Although seemingly labour intensive, the relatively small scale requirement for this purpose, means that collecting cast sun/wind dried kelp from the shoreline adjacent to Stanley would be infinitely more cost effective than any attempt at harvesting fresh kelp. Fresh kelp, even at 8% dry matter, would require to be artificially air dried before composting and would lack the physical properties of a bulking agent. Although some cast holdfasts are tough a, they will break down with the vigorous regime of turning entailed in the composting process.

5.1.5 Peat

This will need to be at least part dry in order to add "structure". The analysis of a typical sample is shown in Appendix C. As with cast kelp, there would be a cost entailed with this material - possibly in the region of £5 per air dried ton. The preferred balance of feedstock would be determined by practical trials, but a reasonable guess at this stage would probably be approximately equal proportions of, respectively, domestic waste, slaughterhouse waste, cast kelp and semi-dry peat. However it is unlikely that the exact balance will prove to be critical and could be dictated to some extent by the economics and availability.

5.1.6 Cookhouse Waste - MPA

In discussions with the Estates Department of MPA, it became clear that it would be a relatively simple matter to arrange a separate collection of cookhouse waste and, for that matter, possibly paper waste. Although the costs of transport of this waste material from MPA to Stanley would not be trivial, there would be corresponding savings in the cost of landfill at MPA. Depending on the size of the garrison, this could be a potential source of a further 400 tons per year of putrescible waste.

5.1.7 Sewage Sludge

At present the sewage sludge from Stanley is discharged untreated into the harbour. It appears that there are no immediate plans for a treatment plant at Port Stanley but there does exist a sewage treatment plant at MPA. In theory, sewage sludge cake (25% dry matter) would be an excellent material for co-composting and, from EcoSci's experience with co-composting trials in the UK, this would add to the nutrient value of the compost. There was, however, insufficient time to investigate this matter further during my visit to MPA, so its inclusion should be treated as a possible added bonus rather than a core factor in evaluating the viability of a composting plant.

5.2 Location of Stanley Composting Plant

The new abattoir and its location is likely to prove a key factor in deciding the location of a composting plant. The proposed location for the slaughterhouse is to be just off the road to MPA overlooking Port Harriet on the Stanley side (photograph - Appendix F). There are good reasons for locating a composting plant adjacent to the abattoir as this would minimise the transport cost of a major element of the waste stream and allow for shared infrastructure and overheads. It also has the advantage that there is an ample supply of peat nearby which could be harvested mechanically. The availability and proximity of cast kelp would require further investigation but it is unlikely that this would prove to be a key factor in deciding the location of the plant.

5.3 Design of Stanley Composting Plant

When space is not a major consideration, the most cost effective method of composting is the traditional method of turned windrows. These are elongated piles and are usually some 3 metres at the base and 2 metres high. They are built on open level ground and turned approximately once every 2 weeks over a 12 week period. However, this method is not recommended for composting domestic waste and sewage sludge as consistent high temperatures cannot always be maintained at the surface of the windrows and therefore pathogen kill cannot be assured. More importantly, the prevailing winds in the Falkland Islands would create unacceptable wind-blow of extraneous material and maintaining the correct moisture level could prove difficult. Some form of "contained" composting system would therefore be required.

There are numerous variations on the theme of "contained" systems that are currently available. In order to maintain the oxygen level required for aerobic conditions these rely either on forced aeration or mechanical turning. Bearing in mind the nature of the feedstock and the lack of any conventional "bulking agent" such as wood chips , a system based on mechanical turning would be more suited to prevailing conditions. There are numerous proprietary systems based on both mechanical turning and forced aeration or a combination of the two . The choice of system should be dictated by considerations of simplicity, reliability and economics.

Examples of systems based on forced aeration and mechanical turning are shown in Appendix D and Appendix E. The Plus-Grow system (Appendix E) is a simple low cost system which is manufactured in the UK and would certainly be worthy of consideration. Forced aeration has lower capital costs but higher running costs; however, such systems perform better at ambient temperatures that are higher than those prevailing in the Falkland Islands and, accordingly these systems are unlikely to prove satisfactory.

5.4 Costings

5.4.1 Assumptions

For the purposes of this exercise it is assumed that:-

1. The plant will be based on the "Plus-Grow" design scaled down for an input of some 1,600 tons per year of mixed waste material, yielding some 800 tons per year of compost.

2. Waste material will comprise :-
400 tons of source separated domestic waste (kitchen waste and paper)
400 tons of slaughterhouse offal
400 tons of air dried peat
300 tons of air dried cast kelp
100 tons of green waste from Stanley Growers

3. Ideally the plant would be operated 5 days per week for 50 weeks per year (i.e. not at weekends or on Public Holidays) but, bearing in mind the seasonal nature of some elements of the feedstock, the most cost effective mode of operation will require further examination.

4. Paper and cardboard would require shredding prior to composting.

5. A simple bag ripping device followed by a 50 mm rotary screen will be used for the source separated domestic waste. Any overtails from the screen should be less than 15% of input material and would be sent for incineration or landfill. The composting system would be a single bay Plus-Grow enclosed in an agricultural type building. This relies on mechanical turning to maintain aerobic conditions.

6. Two operators should be more than sufficient to operate the plant but, in order to provide cover for sickness and holidays, a third operator is assumed for costing purposes.

7. The slaughterhouse offal and the domestic waste are assumed to be delivered at "nil cost" in view of the fact that there would otherwise be a disposal cost to landfill.

8. Semi-dried peat, mechanically harvested, would be delivered in bulk from a nearby peat bed at an assumed cost of £5 per ton.

9. The cost of air dried cast kelp (collection and transport) has been estimated at £10 per ton.

5.4.2 Capital Costs

A single bay Plus-Grow has a capacity of approximately 2,500 tons of input material per year and, erected in the UK, would cost approximately £200,000 inclusive of site preparation and building. In addition to the Plus-Grow system the "front end" treatment would include a bag ripper, paper shredder and rotary screen. In the UK this plant would cost in the region of £80,000 but, with a throughput of around 10 tons per week, would be running well within it's design capacity.

Assuming an additional 50% for transport of machinery and most materials to Port Stanley and for the additional cost associated with construction in the Falkland Islands, the total capital cost for such a plant is likely to be in the region of £450,000.

In addition a teleloader and trailer would also be required at an assumed capital cost of £35,000.

5.4.3 Operating Costs

The figures shown below are really only "guesstimates" to enable some conclusions to be drawn as to whether or not the concept is worth pursuing at some later stage. Clearly, before embarking on a project of this nature, a proper feasibility study should be undertaken to compare the merits of different systems and to verify and update the assumptions that have been made in this report.

Some further assumptions have been made as follows:

1. The buildings and structures have been depreciated over 20 years and the plant and machinery over 10 years.

2. An allowance equivalent to 15% per year of capital cost of plant and machinery has been made to cover repairs and maintenance.

£/year		**DESCRIPTION**
23,000		Repairs & maintenance - plant and machinery (15% of £150,000)
5,000		Repairs and maintenance of building (5% of £100,000)
500		Fuel for mechanical turner
36,000		Labour (3 operators @ £12,000 p.a.)
5,500		Fuel, Repairs & Maintenance for telehandler
5,000		Cast kelp and peat
70,000	**75,000**	**Sub total - direct operating costs**
15,000		Write-off of capital costs of plant (£150,000 over 10 years)
15,000		Write-off of capital costs (civils and building)
7,000		Write off of tractor, trailer and telehandler (£35,000 over 5 years)
37,000	**37,000**	**Sub total - depreciation**
	112,000	**TOTAL COST**

With an estimated output of 800 tons compost per year, a ton of compost would cost, theoretically, £140. However, it is likely that the labour costs for collection of kelp and peat could be offset by savings made in the diversion from landfill of both the slaughterhouse waste and the domestic waste.

Although compost produced in this manner may represent an expensive means of acquiring soil nutrients when compared with imported artificial fertiliser, it is difficult to place a value on the long term benefits gained through adding much needed organic matter and trace elements to the soil.