Environment Protection Authority

Consultancy report:

Diversion of putrescible waste from landfill

Government of South Australia

Final Report

Diversion of Putrescible (Food) Waste from Landfill

Prepared for the Waste and Resource Management Committee (Formerly SA Waste Management Committee)

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January, 2002

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Executive Summary

Trials conducted with a simple in-vessel composting system at the Flinders University of South Australia campus showed that it is possible to convert mixed food waste into a product that can be used on site as a beneficial soil amendment. The in-vessel composting system tested, the BiobiN, was developed in South Australia by Peats Soil and Garden Supplies originally for the treatment of poultry mortalities at intensive poultry farms.

Mixed food waste including both pre- and post-consumer materials, cooked and uncooked vegetables, fruit, meat, fish etc were collected from the University Hall kitchen and cafeteria throughout semester 1 in 2001. All the food waste collected was processed using the BiobiN in two major trials. In the first trial the food waste was processed initially in the BiobiN over a period of 6 weeks with subsequent transfer of the vessel to the commercial composting facility at Willunga at which the residue was mixed with other organic wastes for further composting. Localised problems in latter stages of the trial with odours and fly attraction were attributed to escape of vessel gases from poor seals on the lid of the vessel as a result of back pressure from the biofilter system that was subsequently remedied to improve performance.

In the second trial a stable, product with no residual offensive odour was produced by processing mixed food waste (in excess of 1,000 kg over 6 weeks) in the BiobiN vessel, with further treatment by forced aeration and static maturation (without forced aeration) within the vessel for a further 4 and 8 weeks, respectively. Improved performance was attributed to use of additional bulking agent and minimisation of moisture build up in the vessel. There was no additional advantage apparent from further processing via a worm farm on-site. Worm farming may be considered to complete processing of partially treated materials arising from shorter periods of treatment in the BiobiN vessel, but this will be investigated in further trials.

The success achieved with the system during the trial will now lead to expansion of the processing of food wastes at the FUSA campus to include additional food outlets with the objective of diverting all food waste produced on the campus away from landfill resulting in significant environmental benefit and reductions in waste transport and disposal costs. There is the potential to extend such systems to other campus facilities, including major schools in the area.

The major overriding issue identified in a questionnaire to schools and commercial outlets that would limit acceptance of an on-site composting system is the additional time taken to separate food waste. Other issues identified as important include cost and training. Whilst the BiobiN system is relatively inexpensive compared to other commercially available in-vessel composting systems, it does require correct management on-site to minimise potential problems with odours and fly attraction, especially in Summer. It is important that a good supply of suitable bulking agent is available on-site or supplied regularly to assist the composting process and leachate absorbance. If managed correctly the system provides a viable alternative to landfill disposal for organic waste. A major saving is the reduction in frequency of general waste collection if organics are removed from the mixed waste stream and bins do not have to be collected when only partially full due to odour problems.

1. Introduction

Organic waste represents a significant proportion of the landfill waste stream in South Australia and other states. Organic wastes include green organics, putrescible wastes such as food wastes, animal wastes and biosolids. The South Australian landfill audit conducted in 1998/9 by Waste Audit and Consultancy Services (Aust) Pty Ltd and C.R. Hudson and Associates Pty. Ltd. showed that 23% of the Commercial and Industry (C&I) waste stream disposed of at metropolitan landfills in South Australia comprised food/kitchen waste. Over a period of 7 days, 1350 tonnes of food/kitchen wastes were identified in the landfill stream, which extrapolates to 70,000 tonnes per year. This figure is higher than the estimated 55,000 tonnes of “other organic materials” including food wastes estimated from the Review of Recycled Organic Wastes prepared by Nolan ITU in 1999. Irrespective of these discrepancies, it is clear that large volumes of potentially recyclable organic wastes are still being landfilled in South Australia.

To date most effort at diversion of organic wastes has centred on the green organics stream, in particular that resulting from kerbside collections by local metropolitan councils. A large percentage of this stream is currently being composted to produce a mulch/compost product that has a significant local market. Despite the success of this initiative it has been estimated (Waste Management in South Australia Discussion Paper, 2000) that about 70% of the waste currently disposed of to landfill is potentially recyclable or compostable. Putrescible (food) waste represents a significant proportion of this stream in both the C&I and domestic waste streams which together account for 43% of the total waste stream. Organic waste makes up 57.9% of the domestic waste stream in South Australia (Beverage Industry Environment Council, 1997). To achieve the long-term vision of zero waste put forward in the Waste Management in South Australia Discussion Paper it will be important to find alternative beneficial uses for food waste. Interstate a number of major initiatives have either been implemented or are undergoing research including the use of forced aeration composting at centralised facilities (Victoria), in-vessel composting, large scale vermiculture and production of biomass (Queensland and New South Wales).

1.1 On-site composting

An alternative to centralised processing of organic wastes is to treat the waste on site and minimise costs associated with transport and collection. In the case of domestic households this can be achieved through the use of backyard composting or vermiculture (worm farm) systems. For larger facilities generating larger quantities of organic wastes there is still the potential to treat waste on-site. One effective method for stabilising putrescible organic wastes on-site is the use of in-vessel composting. Putrescible wastes have the potential to generate noxious odours so it is important that any on-site treatment has a high degree of process and odour control. In-vessel vertical composting units (VCU) are being used at a number of facilities throughout Australia to treat food wastes, including Compaq Computer Headquarters in Sydney, the University of New South Wales and Lord Howe Island. VCU units, originally developed in New Zealand are effective, continuous flow composting units that give rapid stabilisation of organic wastes, including food wastes such that a usable product can be produced over a period of approximately 6-8 weeks (minimum of 14 days within the vessel + stabilisation/maturation period). The main disadvantage of the VCU system is the relatively high unit cost which may limit its applicability to many sites.

The Peats Soil and Garden Supplies BiobiN system was originally developed for use in the poultry industry for the treatment/stabilisation of mortalities on-site prior to off-site composting. The unit is now being used on >100 poultry farms throughout Australia. In addition the BiobiN has been trialled for the treatment of greengrocer waste at the Colonnades Shopping Centre in Noarlunga, South Australia and the treatment of food waste at the Santos Tirrawarra camp in Northern South Australia. The BiobiN system is a simple Bi-fold skip with a sealable lid and integral forced aeration system which can be used to recirculate the gases within the vessel or to introduce fresh air to support the aerobic composting process. In the use of the system on chicken farms the system is used in a recirculation mode to minimise odours on-site and allow a build up of temperature and ammonia which combine to kill off pathogens very effectively. For food wastes that contain a high percentage of water the use of a recirculation mode limits the potential to drive off moisture and can lead to formation of odours during extended operation. In a previous project funded by Recycle 2000, a simple forced aeration system operated in a flow through mode was shown to be effective for food wastes generated at the FUSA campus.

1.2 Flinders University Campus Waste

FUSA produces about 220 tonnes of compacted waste per year that is disposed of to landfill. Of this it has been estimated that 40% is readily recyclable and whilst significant progress has been made with the recycling of paper and cardboard, the organic waste stream represents a major residual component which can be targeted for diversion from landfill. Most organic materials collected from the extensive grounds are mulched and used on-site. The major other source of organic waste is from a number of food outlets/cafeterias including the University Hall cafeteria, main student union cafeterias and a number of smaller outlets throughout the campus. Currently each outlet/cafeteria uses one or more industrial waste collection bins and all organic waste is disposed of with the general waste stream to landfill. The environmental officer employed by the university from 1995-1998 collected some organic waste from the Student Union for off-site composting. This program was initiated to assist with implementation of an on-site composting process at the FUSA campus that could be set up to minimise the amount of organic waste disposed of at landfill.

1.3 Trial Objectives

The long term objective of the research program being conducted at FUSA is to establish an ongoing process for treating/stabilising organic waste on-site such that landfill disposal of this waste stream can be averted. Specific objectives were as follows:

- Evaluate and optimise the performance of the BiobiN for on-site treatment of food waste at the FUSA campus
- Determine typical treatment times to either stabilise wastes for off-site composting or for further processing on-site

- To determine if food waste can be treated completely within the BiobiN to produce a usable product
- To compare full composting within the BiobiN to partial stabilisation followed by vermiculture
- To determine management requirements for effective processing and control of environmental parameters such as odour, leachate and vermin attraction
- To assess the potential for implementing similar on-site composting/stabilisation processes at other facilities within the City of Mitcham via a questionnaire.

2. Trial Methodology

Two major sets of trial were conducted with both pre and post-consumer waste generated from the University Hall kitchen and flat units. Organic food/putrescible waste was collected from the Flinders University Hall Residence Cafeteria where approximately 250 students are catered for 3 meals per day, 5 days per week. At the weekends students use communal kitchens from which organic wastes were also collected by student volunteers. During the trial period a system for collection of a wide range of other recyclables (paper, cardboard, plastics and bottles) was also established at the Hall with the assistance of the student environmental group.

2.1 Trial 1

Food waste was collected in 60 L bins lined with biodegradable bags (starch-based). These bins were collected on a daily basis and the contents emptied without mixing into a 4.5 m^3 BiobiN vessel. For the first major trial the base of the bin was filled with wood chips covering the aeration pipes (to a depth of about 30cm). Food waste was then added for just under 6 weeks stopping on May 5th. The amount of food waste produced by the kitchen varied from week to week, but averaged about 200kg/week. A total of 1153.4kg of waste went into the composting vessel along with dry shredded garden waste as a bulking agent at regular intervals (2 x 60L bins per week). Cardboard boxes were also put into the vessel regularly as additional moisture absorbant/bulking agent.

Each day between 2 and 6 bins were collected from the University Hall kitchens. Instructions to both kitchen staff and students were provided at the initiation of the trial. All organic materials were composted including cooked/uncooked meat, fish and post-consumer scraps. At the end of the trial period the residual material within the BiobiN was transported to the Willunga composting site for further processing by windrow composting.

Figure 1: BiobiN™ showing pump and aeration system (trial 1)

2.2 Trial 2

For the second trial a number of modifications were made to the processing methodology. The objective was to support a more active composting process within the vessel and determine whether mixed food waste could be converted to a usable product within the vessel itself. To initiate more active composting, the empty vessel was prepared with a layer of woodchips at the base and an additional layer (30 cm) of dry, composted green organics. The internal sides of the vessel were lined with flat cardboard to act as a small insulating layer. Organic waste was added as before except that every 3 days a layer of green organics (approximately 15 cm) was placed over the food waste on the surface of the material. This layer acted as an odour and moisture absorbant and stimulated active composting early after addition of fresh materials.

A modification was also made to the biofilter with a 2 m stack being added such that exhaust gases were released from the system at a higher level, reducing the potential for odour impact on staff working in the vicinity of the trials. Over the period of the second trial during which food waste was added to the vessel (6 weeks) 1020 kg of organic waste was added to the vessel and approximately 300 kg of green organics.

For both sets of trials the vessel was run in a flow through mode with air entering the vessel at the base, passing through the organic substrate and exiting via the top, back of the vessel, through a moisture trap and biofilter (200 L drum with a mix of woodchips and compost) to the atmosphere. The aeration regime was controlled with a timer and was varied depending on aeration requirements during the trials.

Figure 2: BiobiN™ showing pump and aeration system + biofilter stack (trial 2)

2.3 Worm Farm

Earthworms stabilise organic wastes primarily through the action of bacteria in the earthworm gut. They decrease pathogens and odours, increase water holding capacity and aeration and also encourage beneficial bacteria, enzymes, fungi and natural antibiotics. Through these processes they have the ability to produce a valuable fertiliser, plant growth medium, and/or soil conditioner product. There may be problems with feeding food waste directly to worms, especially if shock loads of particular materials are applied or if the material is too active and temperature increases within the worm farm occur through composting.

A simple metal frame worm farm was set up near the BiobiN to experiment with further processing of partially composted waste with worms. The division of the worm farm and removable front allowed easy harvesting of worm castings, and the leachate collection system enabled collection of a liquid fertiliser product. Initially any liquid harvested was fed back to worms.

The worm farm is set up in the shade with a metal roof to keep out rain and minimise direct sunlight. The worms were fed on a mixture of compost, horse manure and some food waste to stimulate proliferation. The farm was then fed with partially composted food waste from the BiobiN vessel.

Figure 3: Worm Farm

3. Trial Results

3.1 Trial 1 Operation

For trial 1 food waste from the University Hall canteen was collected daily for just under 6 weeks and put into the BiobiN with approximately 2-5 60L bins per day being collected. At the end of each week an additional 2 bins of green waste were also added to increase the amount of bulking agent (in addition to cardboard boxes added regularly during processing). The typical bin contents are shown in Figure 4.

Signs clearly stating what can and cannot be composted were used as labels on the kitchen and cafeteria bins at the University Hall canteen. Overall the contamination of organic waste was minimal.. Posters were located at each collection area (see example Appendix 1), and a newsletter (Appendix 2) was delivered to each room in the Hall to help students understand the program and hopefully improve participation and motivation.

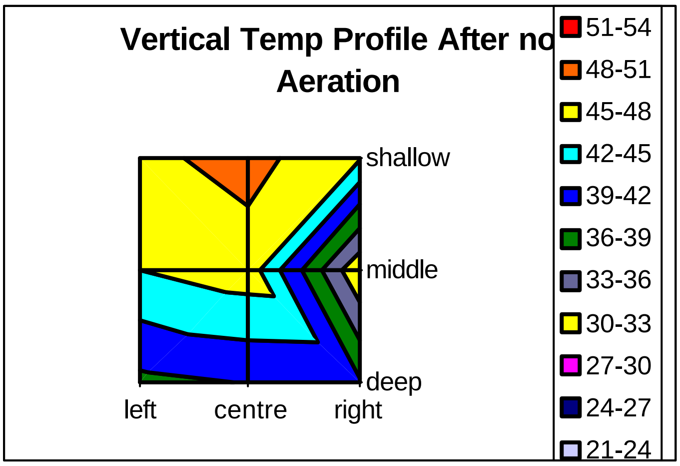
In early stages of operation there were minimal problems with flies or odour.
By week 4 flies and odour had become a localised issue, primarily due to escape of exhaust gases through gaps in the sealed lid such that untreated gases were released direct to the atmosphere at low level without treatment through the biofilter. A major cause of the problem was identified as resistance to air flow arising from the material in the biofilter causing gases to escape through gaps in the lid seal and measures were taken to improve the seal of the bin, especially the lid where air was escaping and flies thought to be entering. In week 5 the contents of the biofilter were replaced with coarse wood chips with a larger particle size (about 1.5cm^2), moistened with water before reassembling. This improved the performance of the unit reducing the localised impact and fly attraction which was managed using commercial fly traps. There was still an ongoing issue with release of gases during pump operation without treatment through the biofilter.

Figure 4. Typical Food Waste from University Hall Kitchens Added to BiobiN Vessel.

3.2 Temperature Profiles

Temperature probes were inserted into the pile at 3 different depths, 20cm, 40cm, and 60cm down from the surface and temperature was recorded at intervals during the aeration cycle. Overall the pile increased in temperature by a few degrees throughout the pile after aeration (pump on).

The vertical profiles below show that the pile is hottest at about 20cm below the surface (the shallow probe) and decreases toward the bottom of the bin (60cm below the surface being approximately 5 cm above the aeration pipes). The variation on the right side of the bin represents an uneven patch where perhaps anaerobic conditions have predominated.



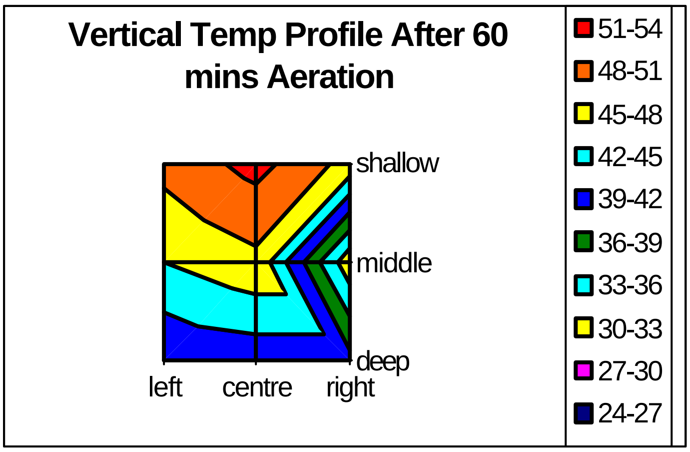


Figure 4: Vertical Temperature Profiles of the Compost Pile Before and After Aeration.

Temperatures within the vessel varied from 30°C up to 55°C close to the surface of the material. The cooler regions were close to the walls of the vessel that were not insulated and therefore in direct contact with ambient air temperatures. The aeration system was maintained until May 22nd (week 6) when it became apparent that there was a break or leak in the base aeration pipes in the back right hand corner of the vessel. This resulted in air was just bubbling straight up in one corner without effectively aerating the bulk of the material. As a result of this ineffective aeration it was decided that the trial would be terminated and the material removed to Willunga for incorporation into large scale compost windrows. The residual material from trial 1 had a strong unpleasant odour associated with it, was saturated with leachate and of a quality which required careful management. It would not have been material suitable for removal at the FUSA site or further processing via eg worm farm. The poor quality of the residue may have been exacerbated by the problems with the aeration system but for the second trial it was decided that the level of bulking agent would be increased significantly to improve process performance.

3.3 Gas Sampling

In the early stages of trial 1, gas samples were taken from regions within the BiobiN and the composition of the gases was monitored using a landfill gas monitor (to measure oxygen, carbon dioxide and methane simultaneously). This was undertaken to determine optimal aeration procedures and to monitor the rate of decomposition of the material. Measurement of gas composition deeper in the vessel after 4 weeks became problematic due to excessive moisture build up and fluid entering the gas sampling tubes after a short time (requiring cleaning every 15 mins). Preliminary results were obtained from early time points to enable optimisation of the aeration regime (Figure 5).

The pump draws air through the waste from the base and out of the system through a bio-filter. Originally the pump timer was set at 120 minutes on and 48 minutes off. Preliminary results from Gas sampling of the compost indicated that the pile was re-oxygenated after only 30 mins but that possibly the longer aeration times were not required and probably causing temperature to remain low, so the pump timer was changed to 48 mins on and 120 off for ongoing operation.

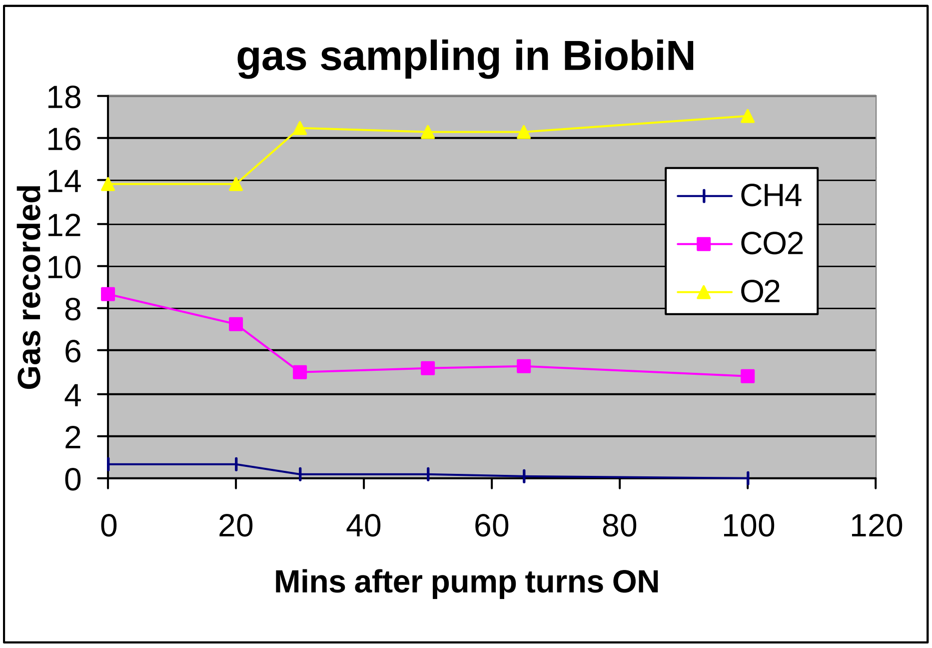


Figure 5: Gases Recorded in BiobiN™ at week 3

The levels of oxygen throughout the aeration cycle remained reasonable and rose as expected on operation of the pump. The presence of low levels of methane within the vessel before operation of the pump suggests the presence of localised anaerobic pockets (methane generation only occurs at very low oxygen levels)

3.4 Trial 2

A number of operational changes were made for trial 2 to assess whether it was possible to complete a compost cycle within the BiobiN at least to the stage where material could be emptied safely on site without causing an odour nuisance for further processing by either composting (eg open windrow) or by worm farming. To maximise the opportunity for more effective composting a layer of 'starter' material (composted green organics) was placed in the base of the BiobiN vessel prior to starting the addition of food waste. In addition a thin layer of green organics was placed over the organic waste every 3 days to act as an additional biofilter and moisture absorber (Figure 6). The aeration cycle was also altered to a regime of 12 minutes on, 30 minutes off (30% aeration frequency).

Figure 6. Layer of Coarse Green Organics Used as Cover Within BiobiN Vessel.

Food waste from the University Hall canteen was added over a 6 week period after which no further material was added but aeration was continued for 4 weeks. After a further 8 weeks of maturation within the vessel the material was removed and screened with oversize material being returned to the vessel. The screened fines (Figure 7) were used as a feedstock for the worm farm and subjected to a full nutrient analysis by Collex Laboratories. After 4 weeks processing in the worm farm the residual worm farm processed material was also subjected to independent nutrient analysis. The analyses

indicated that the nutrient content of the residual compost material and vermiculture product were similar with total nitrogen and total phosphorus contents for the compost of 1.2 and 0.38%, respectively and for the vermiculture product of 1.4 and 0.4%, respectively. A key feature of trial 2 was the low amount of leachate collecting in the base of the BiobiN vessel in comparison to the first trial. The maximum depth of free leachate measured was 60 mm, much less that in the first trial where there was in excess of 500mm of free leachate collected at the base of the vessel by the end of the trial.
The product direct from the vessel after maturation for 8 weeks was characteristic of a stable, dry non-odorous compost product, suitable for immediate use (Figure 7).

Figure 7. Residual Compost Product from BiobiN Trial 2 (Top-unscreened; Bottom-screened).

Most of the original food waste was unrecognisable and demonstrated extensive degradation of stabilisation of all components, including meat, fish, bones etc. The only residual materials recognisable as input materials were pineapple stalks and materials such as pasta and rice which were extremely dry and therefore protected from microbial attack (Figure 8).

3.5 Temperature/Gas Measurements

Temperature and gas analyses conducted throughout trial 2 gave results consistent with the initial trial with temperatures up to 50°C being recorded near the surface of the organic material and lower temperatures being observed near the sides of the vessel. After ceasing addition of food waste after 6 weeks temperatures within the vessel gradually declined such that final temperatures during maturation were all below 25°C, approximately 10°C above ambient air temperature.

Analysis of oxygen, carbon dioxide and methane using the landfill gas analyser showed no evidence of methane production. The lowest oxygen levels and highest carbon dioxide levels recorded near the base of the vessel were 10.8 and 6.3%, respectively, 25 days after starting addition of food waste. After this timepoint levels of oxygen recorded throughout the vessel were consistently above 17%.

3.6 Contamination

The level of contamination in the processed material was very low. The only items recovered from the screened material were rubber gloves used by kitchen staff for handling foods, some plastic cutlery, plastic bags, plastic ties used for wrapping vegetables and a milk carton which had undergone significant degradation of paper but which had a residual plastic layer remaining (Figure 8).

Figure 8. Residual Contaminating Items in Compost Product.

The final product from the complete composting and maturation cycle within the BiobiN vessel was suitable for direct use on the FUSA campus without requirement for further processing. Importantly the final mass of material was much lower than in trial 1, even with a similar input of material, due to the effective removal of moisture that helped minimise odours and increase stability of the product.

4. Questionnaire

As part of the WMC project a questionnaire was developed and used to assess the potential and limitations of instigating similar on-site composting processes at other sites within the City of Mitcham area (as a typical Metropolitan Council). Interviews were conducted by telephone with a range of Primary and High schools, commercial organisations such as shopping centres and hotels and residential homes/nurseries. The full questionnaire used is included as Appendix 3.

A number of major facilities exist within the City of Mitcham area that could use an on-site composting system such as the BiobiN. Even at the FUSA campus there is the potential to extend the system to include all food waste being produced by the numerous University cafeterias and the extensive facilities at the Flinders Medical Centre and Flinders Private Hospital. The other major campus within the Mitcham area is the Waite campus which services the University of Adelaide with approximately 1,500 personnel comprising undergraduates and a significant number of scientists and other staff from the University, CSIRO, SARDI, the Australian Wine Research Institute and other organisations such as Cooperative Research Centres. There is a single cafeteria at the waite campus, the Lirra Lirra Café servicing all the host institutions and simplifying the possibility of establishing a single organic waste treatment facility.

Questionnaire responses from 19 schools were received, all of which generated food waste. Of those that responded, 5 schools already separated organic waste and a further 5 indicated they would be willing to consider separating organic waste for composting. 7 schools had either composting systems or worm farms in operation. Of the 19 respondents, 17 replied that they would be willing to convert their current organic waste disposal to a more environmentally friendly process if it was cost neutral and 8 replied that they would consider doing so even if the cost were higher.

The most important issue raised by respondents was the extra time required to implement such a system (10 of 17 respondents rated time as very important). The remaining issues of odour, space, OH & S, vermin attraction and leachate were considered as either important or neutral by the majority of respondents.

Key responses from the schools surveyed are as follows:

1. Does your business/organisation produce organic waste. Eg food/garden waste.

   19 Yes 0 No

2. What type/amounts of organic waste do you produce in a typical week.

WASTE TYPE	YES/NO
Food Waste	17
General Garden Waste	17
Non-waxy Cardboard or Paper	17
Other Organic Wastes - Specify	2

4. Do you currently separate your organic waste from your general waste?

   5 Yes 12 No

   a) If no, would you be prepared to separate different waste material?

   5 Yes 5 No (5 possibly)

   b) If no, what are the factors inhibiting separating different waste material? Educating children/staff, time (X4) management, personnel

5. How do you currently dispose of your organic waste material?

   10 Council Bin 1 Organic Industrial Collection Bin

   15 Mixed Waste Industrial Collection Bin 7 Composting/Worm Farm

6. Would you consider changing your current practice of organic waste disposal to accommodate an environmentally friendly mode of organic waste disposal if:

   a) The cost is neutral? 17

   b) The cost is less than current disposal practice? 12

   c) The cost is more than current disposal practice? 8

7. How would you rate the following issues in regard to implementing a change of organic waste disposal? (Tick where appropriate).

Issues	Very Important	Important	Neutral	Not Important
Odour	1	9	7	
Space	3	1	12	1
OH&S	2	11	4	
Vermin Attraction	3	10	4	
Leachate	2	7	8	
Time Required to Separate Waste	10	4	3	

List any other issues that may influence your choice. Good system, cost, OH &S, management, resources, people, training

Of 10 commercial operation responding to the questionnaire, none currently separated food/organic waste and only 3 were prepared to consider doing so. Again the major issue was time requirement on staff with the remaining issues being regarded as important rather than very important. Six of the respondents expressed an interest in a more environmentally friendly waste disposal process if it was cost neutral.

Key responses from commercial properties (5 hotels, 2 caravan parks, 2 shops/shopping centres, 1 other) were as follows:

1. Does your business/organisation produce organic waste. Eg food/garden waste.

9 Yes 0 No

2. What type/amounts of organic waste do you produce in a typical week.

WASTE TYPE	YES/NO
Food Waste	9
General Garden Waste	3
Non-waxy Cardboard or Paper	9
Other Organic Wastes - Specify	0

4. Do you currently separate your organic waste from your general waste?

0 Yes 9 No

a) If no, would you be prepared to separate different waste material?

3 Yes 6 No

b) If no, what are the factors inhibiting separating different waste material? Not practical, space , time (X2)

8. How do you currently dispose of your organic waste material?

5 Council Bin 0 Organic Industrial Collection Bin

9 Mixed Waste Industrial Collection Bin 0 Composting/Worm Farm

9. Would you consider changing your current practice of organic waste disposal to accommodate an environmentally friendly mode of organic waste disposal if:

a) The cost is neutral? 6

b) The cost is less than current disposal practice? 4

c) The cost is more than current disposal practice? 0

10. How would you rate the following issues in regard to implementing a change of organic waste disposal? (Tick where appropriate).

Issues	Very Important	Important	Neutral	Not Important
Odour	1	4		
Space	2	2	2	
OH&S		5	1	
Vermin Attraction		6		
Leachate		6		
Time Required to Separate Waste	6	1		

List any other issues that may influence your choice. Simple system, cost, education, time

Residential homes are not considered a good target for establishing on-site composting, primarily because of the prevalence of insinkerator systems required for accreditation purposes. The limited number of child nurseries approached also did not consider that they produced enough food waste to warrant setting up an on-site system.

5. Conclusions

The trials conducted with the BiobiN in-vessel composting system showed that it is feasible to treat diverse food waste generated at the FUSA campus to the stage where it generate a beneficial soil product which can be used on-site as a compost/mulch.

The 4.5m^3 unit was capable of treating all the food waste generated from the University Hall canteen with a treatment cycle comprising 4 weeks in-vessel composting and 8 weeks of maturation (after the last addition of fresh material). By optimising the process further it is likely that the maturation period could be reduced significantly. Ideally a continuous process could be set up with 2 vessels used in parallel with one vessel used for addition of materials whilst stabilisation/maturation occurs in the second vessel. In trial 2 material was added to the compost vessel over a 6 week period without problems being encountered with either odours or vermin/flies. After 6 weeks the vessel was less than two thirds full and additions could have continued over a longer period. Trials conducted with the BiobiN at Tirrawarra in South Australia have shown that the BiobiN can be operated for periods in excess of 3 months with food waste, although in that trial the final product was not suitable for immediate use.

The quality of the material produced by composting alone was very good indicating that subsequent processing by additional windrow composting or vermiculture was not necessary, although the use of two-stage processes may be considered preferable to minimise in-vessel processing time. The use of starch-based biodegradable bags as bin liners was highly effective and considered good by kitchen staff, however the high cost of these bags may prohibit ongoing use, although alternative lower cost biodegradable bags are now available in Australia.

The assessment of the potential for on-site composting at other facilities requires additional use of questionnaires/interviews to follow up on preliminary results. Initial indications are that many schools are active in organic waste treatment, though in most cases this was primarily targeted at green organics rather than food waste. Commercial outlets were varied in their response and the overriding issue considered most important by both commercial and school respondents was the issue of additional staff time required to manage such a system.

The next stage of the project will be to implement a food waste processing system to treat all the food waste being produced at the FUSA campus. The University has indicated a willingness to expand the current system and in 2002 the BiobiN system will be extended to treat food waste from a variety of sources, including the Student Union cafeterias that generate the largest volume of waste.

6. References

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Appendix 1- Information Sheet Used for Students

Flinders University Hall Recycling Program

With the aim of significantly reducing waste to landfill by recycling, we are setting up a program to continue collecting all recyclable materials from University Hall and the Residence Cafeteria.

Collection of the following re-cyclable materials has already begun and is detailed below:

Recyclable Plastics, Cartons, Glass and Metal

10 extra black plastic crates were obtained from Mitcham Council and clearly labelled with explanations of what the council can and cannot re-cycle.
Location of Collection Points:

- 6 crates at Re-cycling Stations on level 3 and 4 of University Hall
- 2 crates at Re-cycling Station on ground floor at back of Units
- 1 crate at Re-cycling Station on ground floor University Hall
- 1 crate in University Hall Common Room

These will be collected twice weekly and separated and stored in the loading bay under the University Hall Cafeteria to be collected by Mitcham Council, as part of their kerb-side recycling program (Envirolink). The University Hall Recycling Group is planning on separating refundable bottles and taking them to another recycling depot to raise some money for other projects.

Newspapers

One 240 L 'wheelie' bin located in the University Hall Common Room for collection of newspapers only. This bin will be collected weekly and newspapers will be recycled by the School of Biological Sciences Animal House.

Clean office paper

Two 240 L 'wheelie' bins located in both computer rooms, are collected as part of the whole-campus University re-cycling.

Cardboard

Collected in loading bay under Uni Hall Cafeteria in wool bales, will be shredded and fed to worms with the composted food waste.

Food Waste Composting Program

Location of Collection Points:

- 16 x 60 Litre bins in Residence Cafeteria during the week only
- 8 x 60 Litre bins in each University Hall kitchen at weekends only
- 1 x small bin for each flat and unit
  to be emptied into:
- 1 x 60 Litre bin at Re-cycling station on Ground floor University Hall
- 1 x 60 Litre bin at Re-cycling station on ground floor at back of Units

Appendix 2:
Nutrient Analyses of Compost and Vermiculture Products from Trial 2.

Appendix 3

MITCHAM CITY COUNCIL AREA ORGANIC WASTE DISPOSAL QUESTIONNAIRE

Contact Person/Position:____

Contact Details:____

Business/Organisation Name:____

Business/Organisation Address:_____________________________________

1 Does your business/organisation produce organic waste. Eg food/garden waste.

ℜ Yes ℜ No

2. What type/amounts of organic waste do you produce in a typical week.

WASTE TYPE	YES/NO	ESTIMATED AMOUNT (Volume or Weight per week)
Food Waste		
General Garden Waste		
Non-waxy Cardboard or Paper		
Other Organic Wastes - Specify		

Note: The volume or weight can be estimated by using the number of bins filled and the frequency in which they are emptied. Bins can include normal kitchen waste bins, large metal bins emptied by trucks, or wheelie bins.

If details not known, estimate the number of meals served per week.

____

3. Are there specific times of the week/month/year when organic waste volume dramatically increases or decreases. ______________________________________

____

4. Do you currently separate your organic waste from your general waste?

ℜ Yes ℜ No

a) If no, would you be prepared to separate different waste material?

ℜ Yes ℜ No

b) If no, what are the factors inhibiting separating different waste material? ___________________
____
____

11. How do you currently dispose of your organic waste material?

ℜ Council Bin ℜOrganic Industrial Collection Bin

ℜ Mixed Waste Industrial Collection Bin ℜ Composting/Worm Farm

12. Would you consider changing your current practice of organic waste disposal to accommodate an environmentally friendly mode of organic waste disposal if:

a) The cost is neutral? ℜ

b) The cost is less than current disposal practice? ℜ

c) The cost is more than current disposal practice? ℜ

13. How would you rate the following issues in regard to implementing a change of organic waste disposal? (Tick where appropriate).

Issues	Very Important	Important	Neutral	Not Important
Odour				
Space				
OH&S				
Vermin Attraction				
Leachate				
Time Required to Separate Waste				

List any other issues that may influence your choice. ____
____

8. Any other related issues? ____
____