

Composting in the SUB vs. Composting via UBC Waste Management

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APSC 261 Sustainability Project
Composting in the SUB vs. Composting via UBC Waste Management

Submitted to Dr. Carla Paterson and the UBC Stakeholders
By: Ian Loo, Kelvin Siu, Kevin Brooks



Source: Vermiculture Canada, < <http://www.vermica.com/tat-g/standardinfo.pdf>>

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ABSTRACT

"A triple-bottom-line assessment on Composting in the SUB vs. Composting via UBC Waste Management"

By: Ian Loo, Kelvin Siu, Kevin Brooks

This report analyzes composting in the Student Union Building (SUB) vs. Composting via University of British Columbia (UBC) Waste Management. After collaborative research on the method of composting, this report recommends composting in the new UBC SUB. The various methods of composting are researched: composting with red-wiggler worms, offsite composting with UBC Waste Management, and roof-top composting via organic digester.

Composting with red wiggler worms is highly economical. It is environmentally friendly, and it has low initial and maintenance costs. However, this setup is difficult to maintain due to temperature and acidity. Otherwise, the worms would operate inefficiently.

In-Vessel composting uses an enclosed system to control temperature, moisture and oxygen levels for an optimal composting rate. It produces compost within 2 weeks, and processes 5 tonnes of compost daily. Although, its location at South Campus requires high transportation costs and increases carbon footprint. Any soil needed by UBC is bought back from UBC Waste Management.

The roof-top composting via organic digester is the most sustainable and cost-efficient means of composting at the SUB, incorporating the beneficial aspects of the previous methods. It utilizes worms in a temperature controlled environment, and is self-sustained through a solar panel. The incorporation of urine into the composting process is beneficial to the nutrient composition of the soil, and reduces water use. By using flushless urinals, each urinal will help to conserve approximately 150,000 litres of water per year.

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1.0 INTRODUCTION

Due to an increase in sustainability awareness, our project focuses on a sustainable approach to compost food waste produced in the UBC SUB. Various composting methods are discussed, with a primary focus on using an Eco-Verm Onsite Organic Digester. The audience for this paper is APSC 261 instructor Carla Paterson, and the stakeholders for the new UBC SUB. To obtain an understanding of the waste produced at the SUB, we obtained a copy of the 2009 Waste Audit from the AMS Sustainability Coordinator, Justin Ritchie.

Composting is the process of biodegrading organic material such as food waste until it has matured into a decomposed soil-like matter. Composted material can be rich in nutrients, and can be used for gardens, agriculture, as well as landscaping. There are several methods to compost organic material, such vermi-composting, and in-vessel composting.

Currently, the waste produced at the UBC SUB is transported to a composting facility located on the South Campus of UBC. This facility utilizes a large-scale in-vessel compost unit, capable of processing 5 tonnes of organic waste daily. It helps reduce the amount of waste being sent to landfills. This method is environmentally, socially, and economically sustainable, but to aim for net-zero waste at the new SUB, we recommend composting onsite.

Our recommendation for composting is to use an Eco-Verm On-Site Organic Digester which utilizes an earthworm processing technology based on vermi-composting. This unit operates using a solar-powered control systems for temperature control, as well as a unique shape to shield from the sun. By using these features, it provides the most suitable environment for worms to compost material as efficiently as possible.

2.0 VARIOUS COMPOSTING METHODS

There are various composting methods available to decompose organic waste. These methods include, vermi-composting, and in-vessel composting.

2.1 Vermi-Composting

The method of vermi-composting is the practice of using worms to process organic material, and turn it into a natural fertilizer.

2.1.1 Red-Wiggler Worms



Figure 1: Red Wiggler Worms

Source: Urban Garden Magazine <www.urbangardenmagazine.com>

Red Wiggler worms (see Figure 1 above), also known as *Eisenia foetida*, are among the favourite worm species for vermi-composting organic materials. Like most other worms, Red Wiggler worms like to be kept in dark area with the moisture level like a wrung-out sponge and with sufficient air flow. These cold-blooded, hermaphroditic creatures are ideal for composting because they can withstand conditions which other worms may not survive. Red Wiggler worms are also able to consume half of their body weight in just one day under the right condition.

(Nair, Jaya et al., 2006)

Red Wiggler worms are able to survive anywhere between 16 to 28 degrees Celsius. When the temperature falls below this range, they become sluggish and eat less or whither. The vermi-composting process creates thermal energy, increasing the temperature of the contained environment. Furthermore, Red Wiggler worms become more active and increase their sexual

activities, allowing them to reproduce faster, doubling their population every 90 days. Red Wiggler worms may live up to 4 to 5 years, but this may shorten due to stressful conditions.

There are two types of organic materials which the worms are able to compost: nitrogen-rich and carbon-rich. There are several products which should be avoided when composting. Meat and dairy produce odours and attract pests. Also, bread should be avoided because it creates mould. See Table 1 for is a list of materials which should and should not be placed in a worm bin. (UBC Waste Management)

YES	NO
raw fruit scraps	cooked food waste
raw vegetable scraps	dairy products
coffee grounds and filters	meat and bones
tea bags	fats, grease, oils
egg shells	grains, bread, pasta
grass	liquids
plant clippings	weeds that have gone to seed
hay and straw	dog and cat feces
leaves	kitty litter
	plastic, metal, glass

Table 1: Worm Bin Materials
Source: UBC Waste Management <www.recycle.ubc.ca>

Red Wiggler worms require a pH level of approximately 7.0 in order to operate efficiently. Although raw fruit scraps are great for composting, orange and lemon peels, and other citrus fruits must be limited in the worm bin. These citrus fruits can increase the pH level in the soil. When the environment is carefully maintained, it allows the Red Wiggler worms to be self-sustaining for several years. (Nair, Jaya et al., 2006)

2.1.2 Advantages



Figure 2: Vermi-Composting
Source: How Stuff Works < www.HowStuffWorks.com >

The advantages of vermi-composting with Red Wiggler worms (see Figure 2) would be the simplicity, cost, and natural decay of food into compost. Unlike some advance modern composting techniques, this does not require a high initial cost. In fact, the cost to start this operation would be the cost for the space and shelter as well as the worms (\$20/lb). With the right knowledge, this setup can continue to work for years.

There are no hidden costs in the process of vermi-composting. The worms do not need any electrical energy or chemicals to function. Red Wiggler worms are very active creatures when the temperature is within their comfort zone. The outputs of the worm composting process are nutrient-rich composted soil and thermal energy. Neither of the outputs is harmful in anyway. In fact, they have a natural positive effect to the environment. (Elcock, Gillia, Martens, 2010)

In circumstances where this composting process should be removed and disposed, the worms can be sold as fishing bait or released into the wilderness. Even in this case where the worms are no longer needed, the environment can benefit from them.

2.1.3 Disadvantages

A disadvantage of vermi-composting is that it can take many months to years to build up a working amount if there are initially very few worms; however this would not financially be the case if this were to be implemented at the new SUB. Aside from the number of worms, the living condition for the worms has to be carefully maintained by a knowledgeable person. The worms' metabolism would slow down in lower tolerable temperatures, which could result in build up of food waste. In situations where conditions are too acidic or damped, or the food is short supply, the worms tend to escape the area through ventilation holes, cracks, or any escape routes. Another disadvantage would be the odours from the decaying food waste. (Gokce, Kocasoy, 2003)

2.2 In-Vessel Composting via UBC Waste Management

The method of In-Vessel composting is an industrial process which utilizes air flow and temperature control in a mechanized fully enclosed vessel to accelerate decomposition of organic material. This large-scale method of composting is currently being used at UBC South Campus. The In-Vessel composting system comes from Wright Management Inc and was set up in 2004. (UBC Waste Management)

2.2.1 Advantages

The fully enclosed system design allows for a controlled environment to maximize the rate of microbial decomposition, without the use of chemicals to achieve optimal temperature, moisture, and oxygen levels. Odours are mostly contained within the vessel, eliminating the risk of rodents and pests, allowing for the decomposition of meat, dairy, and grain products. See Table 2 for is a list of materials which can and cannot be placed in the In-Vessel . (UBC Waste Management)

YES	NO
cooked food waste	juice boxes
meat and bones	milk cartons
dairy products	plastic bags
grains, bread, pasta	plastic cutlery
paper towels and napkins	styrofoam
paper cups and plates	glass
raw fruit and vegetable scraps	wooden chopsticks
coffee grounds and filters	wood
tea bags	sand
egg shells	metal
grass, leaves, plant clippings	biosolids
hay and straw	

Table 2: In-Vessel Materials
Source: UBC Waste Management <www.recycle.ubc.ca>

Any air exhaust is passed through a proprietary biofilter system, which filters the remaining odours through naturally-occurring bacteria before it is passed to the environment. The amount of air needed to be treated by the biofilter is a fraction of that in containment building systems. The in-vessel produces compost within 2 weeks, and processes 5 tonnes of organic waste daily. (Wright Environmental)

2.2.2 Disadvantages

Since the In-Vessel is located on South Campus, transportation to and from the new SUB will take fuel, produce emissions, and requires regular labour hours. The compost from UBC is shipped to South Campus, and any soil UBC needs is bought back from UBC Waste Management. The In-Vessel also requires external energy to function.

3.0 ECO-VERM (TAT-G) ON-SITE ORGANIC DIGESTER

The Eco-Verm (Tat-G) On-Site Organic Digester is a composting unit which incorporates ideas from both aspects of composting. This unit provides an optimum controlled environment for vermi-composting, utilizing worms for quicker decomposition of organic waste. In order to maintain an optimal internal temperature environment for an acceleration of the breakdown, the composting unit is self-powered by a 5-watt solar panel, feeding into a 7 amp hour batter, with a regulator for battery protection. The temperature and moisture reticulating system are controlled electronically, and can be adjusted for different climatic regions. Optimal conditions for worms can be achieved by electronically minimizing variations in the internal temperature of the digester. (Vermiculture Canada)

We recommend purchasing a single unit of the Eco-Verm On-Site Organic Digester, and placing it on the SUB rooftop for composting organic food waste. The UBC SUB produces 40kg of compostable waste a day, which needs to be transported to an off-site location. (AMS Waste Audit, 2010) By having an on-site composting unit, it is beneficial in several ways. The roof-top provides a location that is isolated, so ventilation and odour will not be an issue, also there will be ample sunlight for the solar panel. The endproduct of the composted soil can be used for a rooftop garden, surrounding gardens, or landscaping.

3.1 Triple-Bottom Line Assessment

A triple-bottom-line assessment was conducted on the Eco-Verm On-Site Organic Digester for composting organic waste at the new UBC SUB.

3.1.2 Social

Having an on-site composting unit at the new SUB has several social benefits. By supporting positive sustainable behaviour changes, there are increases in awareness and education. This can be accomplished by encouraging students, faculty, and staff to compost organic material within the SUB, encouraging the use of compostable materials. Organic foods can be cheaply grown on the roof top and used at the SUB. This decreases the amount of garbage waste being thrown away. (SUB Vision Principle Objectives)

The roof-top garden can provide a liveable and productive roof. This can be done by demonstrating a food growing to eating cycle, where food waste is composted to provide fertilizer for local organic foods to be grown and consumed within the SUB. (SUB Vision Principle Objectives)

3.1.2 Economical

The Eco-Verm On-Site Organic Digester can accommodate up to 50kg of waste per day, and also has a solar powered control system for temperature control. This supports economic viability during the academic and non-academic year by producing soil for local use, instead of selling organic waste and buying back the composted soil from UBC Waste Management. The solar powered temperature control for the composting unit makes it self-sustaining, no other source of energy is required. (Vermiculture Canada)

The total cost for the machine is approximately \$15,000. The unit requires low maintenance. The costs required to startup this machine would be the cost of the Red Wiggler worms. Red Wiggler worms cost about \$20 per pound (1000 worms). The SUB creates 88lb (40 kg) of waste daily. Because Red Wiggler worms can eat half their weight, therefore we require 176lb of worms which cost \$3,520 before taxes and shipping. (Pocock, J., 2008)

3.1.3 Environmental

There are several environmental benefits to adding the composting unit on top of the new SUB. We help to minimize the amount of waste being transported to UBC Waste Management, reducing the carbon-footprint of the new SUB. From the composted fertilizer we are able to produce, we can support the local building economy by using it for a roof-top garden, as well as landscaping and plants around the SUB. (SUB Vision Principle Objectives)

3.2 Design of Composting Unit

The Eco-Verm (Tat-G) has a unique design, which feeds waste into the unit via a hand-cranked lid. The double triangular design (see Figure 3 below) optimizes the processing capacity, allowing for seven large trays to collect the castings. The Worm castings can be used

for plant food, and are high in nutrients and essential soil microbes. Moisture is cycled via a filter and collection tray, and can be pumped out for direct use on the roof-top garden.



Figure 3: Eco-Verm Onsite Organic Digester
 Source: Vermiculture <www.vermica.com>

The composting unit kit can be assembled on-site and can be ordered in Vancouver. The unit itself is small in size, requiring a 2.6m x 1.6m area for the base (see Table 3 below). The components are not welded, and are galvanized for durability. For servicing, the outer sides are removable, allowing access into the mesh panels. (Vermiculture Canada)

Footprint: 2.6m x 1.6m (8.5 ft x 5.25 ft)	Height: 1.8m (6 ft)
Solar panel: 5 watt	Battery: 7.0 amp hr
Pump: Rule submersible 360 gal/hr	Timer: 12v on-board computer
Trays: 7 x 36 liters	Shredder (optional)
Processing capacity: Up to 350kg (770 lb)/week on mixed food/cardboard blends. Higher on Manures.	

Table 3: Specification Chart
 Source: Vermiculture <www.vermica.com>

3.3 Enriching with Urine

Composted organic material is rich in nutrients, but some nutrients are more abundant than others. In order to create a more balanced and rich fertilizer or soil from composting, an addition of phosphorus is required. The addition of human urine excrements can accommodate for the lack of phosphorus, creating a more balanced compost mixture. The increase in phosphorus

also supplies nutrients to micro-organisms to decompose the waste at a faster rate, and also increase the multiplication rate. Experiments and studies have been conducted to prove that urine added to compost will increase its nutrient content. This makes the composted material richer, and therefore has an improved market value for sale. (Mang, Jurga, Zhe, 2007)

3.3.1 System Incorporation

Urine is often diluted with water through the flush of urinals, resulting in a waste of the nutrients. By utilizing a flushless urinal such as Falcon Waterfree Technologies, which have already been implemented in UBC Buildings, we are able to harvest the urine without dilution being an issue. The cost of the waterfree urinals are on par with the cost of traditional flush urinals. This technology of urinals also minimizes the water use in the SUB, each urinal will conserve approximately 150,000 litres of water per year. The only cost to maintain these urinals are cartridges which need to be changed three to four times a year, for \$35 per cartridge. (Falcon Waterfree Technologies)

This system will allow the urine to be directed to a small storage facility on the roof-top of the SUB. Small amounts of urine will be added to the organic material, while the excess will be drained to the main sewer line of the SUB.

4.0 CONCLUSION

After analyzing various methods of composting at the UBC SUB, this report recommends composting at the new SUB is the most appropriate method of organic waste disposal. It is recommended to compost on the roof-top of the new SUB using an Eco-Verm Onsite Organic Digester with the incorporation of urine to enrich the soil.

The most cost efficient method of composting is discovered to be vermi-composting in bins. However, it is difficult to control the suitable environment for the worms on a large-scale basis. Therefore, this method is not recommended for the amount of waste produced at the new SUB.

Traditionally, the waste produced in the SUB is sent to UBC Waste Management, which is not a sustainable method due to several reasons. This does not meet a requirement of having net-zero waste at the new SUB. Also, the transportation of waste to UBC Waste Management located in the South Campus requires the cost of fuel, and ultimately increases the carbon footprint. Composting via UBC Waste Management is not suitable for the goals of the new SUB.

The organic digester is recommended on the roof-top to provide ample sunlight to the solar panels, as well as preventing issues with ventilation and odour. The endproduct of the composted soil can be used for a rooftop and surrounding gardens, or landscaping. The implementation of an onsite organic digester can increase awareness on the amount of waste produced, and help to decrease the amount of food waste thrown away. Economically, the organic digester is self-sustaining, having a low initial and maintenance cost. The addition of urine to the compost will help to balance nutrients found in the endproduct of the soil. This also decreases the amount of water used at the new SUB, by using flushless urinals in the washrooms for urine harvesting. After a triple-bottom line assessment, composting via organic digester is comparably more appropriate than the other methods mentioned above.

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