

# **USING “IN-VESSEL” SYSTEMS TO COMPOST FOOD RESIDUALS**

## **On-Site Composting Takes Root in King County**

This report summarizes the activities and results of King County’s Solid Waste Division pilot program to assess the feasibility of on-site, in-vessel food waste composting at businesses and schools. The program has assisted a total of nine schools and seven businesses in acquiring relatively small-scale in-vessel (fully enclosed) composting systems. The pilot program assisted a broad spectrum of schools: elementary to college level, public and private, and outdoor education facilities. The program also assisted restaurants, grocery stores, bakeries, a resort and an office building. The Solid Waste Division has maintained a webpage dedicated to the program so that others may learn from the successes and failures experienced by the program participants

The Solid Waste Division’s program, partially funded by a grant from the Washington State Department of Ecology in 2003, utilized several small scale composting systems: the Earth Tub (manufactured by Green Mountain Technologies), the BioStack/Advanced BioSystem (manufactured by BioSystem Solutions), two models of Worm WigWam (manufactured by Sustainable Agricultural Technologies, Inc.), and a plywood box system sold by Seattle Tilth. This report summarizes the pilot program as well as pros and cons of using these systems, based on the experiences of the pilot program partners.

### **Program Promotion**

Several promotional strategies were used. The most effective proved to be a targeted promotional campaign. Creative ads promoting the pilot program and asking the question “Got Food Waste?” were run in local business journals. A brochure describing the advantages of on-site composting and an overview of the available assistance for pilot participants was mailed to targeted businesses within King County, such as restaurants, caterers, assisted living communities, food processors, wineries, grocery stores, food banks, colleges, resorts, hotels and large corporations. Finally, a press release was issued regarding the program, and articles appeared in a number of local papers.

Over 60 businesses contacted the Solid Waste Division asking for additional information. Interested businesses received a site visit from county staff to assess the location and food waste of the business, explain the details of the program and answer any questions. These site visits also allowed the Solid Waste Division an excellent opportunity to provide general education on other waste reduction and recycling issues, along with other food waste management options (donation to food banks, rendering, etc.).

The criteria for participation in the pilot program included having a dedicated person who would be in charge of the system, sufficient staffing, space to locate a system, low meat content of food scraps, and management support. Seven businesses signed partnership agreements to take part in the pilot program. The others either opted not to participate or did not fit the criteria for participation.

After initial start-up of the business composting systems an additional promotional effort to recruit schools was implemented. The school promotion was conducted via word of mouth and by direct contact with teachers who were known to have worm bins in their classrooms or who had invited a Solid Waste Division speaker to talk to students about composting. Over time, nine schools ended up joining the program.

### **Why On-Site Composting?**

When meeting with businesses and schools about on-site, in-vessel composting, they all wanted to learn about the advantages of doing on-site composting. In explaining the benefits, county staff often began with the information that, on average, a 55-gallon container of food waste weighs about 400 pounds. For businesses and schools that utilize a compacter and pay for garbage disposal by weight this quickly impressed upon them the

potential cost savings which could be obtained by no longer adding food waste to their compacter, especially when it meant that they could then go longer between compacter pulls. We also discussed the fact that in-vessel systems often have fewer odor issues than leaky dumpsters, lower sewer maintenance costs, and produce a mulch or soil amendment for their landscaping needs.

Food composting also provides additional environmental benefits by transforming a former waste product into a beneficial resource that improves soil quality and surface water quality. Because food waste makes up 14.6 percent of the solid waste stream in King County, utilizing this resource can also effectively reduce the overall amount of material being landfilled.

### **Pilot Program and Transition**

The Solid Waste Division covered significant portions of the purchase price of the composting systems. Participants were limited to assistance with the purchase of only one system. Additional technical assistance included selecting the best type of system based on site-specific characteristics, system start-up, training staff to operate the system, and providing instructional signs.

In return for the Solid Waste Division's financial and technical assistance, program participants were required to compile and report three years of data on the daily use of their system including documentation of food waste diversion rates, compost generation rates, and comments/issues that arose as the system was being used (odors, staffing problems, etc.). Data sheets were provided and returned to the Solid Waste Division on a regular basis. Finally, the participants agreed to allow photographs and video of the systems for purposes of documenting and promoting the pilot program.

After the initial 3-year contract period two of the participating schools and three of the business participants chose to no longer compost on-site. Composting systems which were no longer wanted were matched up with, and provided to, schools which had expressed interest. King County is continuing to collect data from schools on a voluntary basis in exchange for continued technical support which includes monthly "Compost Hints" via e-mail and limited phone or e-mail troubleshooting, advice. Occasional site visits may be possible if the participants get themselves into trouble.

### **Composting Systems Used**

The pilot program used 3 brands of composting systems, the Earth Tub (<http://compostingtechnology.com/products/compost-systems/earth-tub>), the BioStack, and the Worm WigWam (<http://wormwigwam.com/>).

The Earth Tub (made by Green Mountain Technologies) was designed specifically to compost food wastes on-site and was reported by the manufacturer to process up to 150 pounds of food waste per day. A wide range of food waste such as vegetable and fruit preparation waste, coffee grounds and tea bags, plate scrapings, napkins, breads and pastas, can be processed in Earth Tubs. Earth Tubs were installed at three schools and two businesses as a part of the pilot program: Crestwood Elementary School in Renton, Waskowitz Outdoor Education Center in North Bend, Pacific Crest Farm (school owned farm) on Vashon Island, Bernie and Boys Market in White Center, and Willows Lodge in Woodinville.

The BioStack vermicompost system (made by Biosystem Solutions) is a two drawer system where worms do most of the work of processing the food waste into compost. It was reported by the manufacturer to process 20 pounds of food waste per day including vegetable and fruit food preparation and plate scrapings, coffee grounds and tea bags. Shredded office paper, newspaper or leaves were used as a bedding material for the worms. Six BioStacks were installed at the following original locations: Lake Washington Technical College in Kirkland, Briarwood Elementary School in Renton, My Favorite Caterer in Bothell, Aegis of Shoreline in Shoreline, Wild

Mountain Café in Seattle, and King Street Center in Seattle. Two additional schools, later adopted BioStack systems from exiting participants: Cascade Elementary in Renton, and King’s School in Shoreline.

Worm Wigwams (made by Sustainable Agricultural Technologies, Inc.) are manufactured in several sizes. The home sized system in place at The Evergreen School in Shoreline is a cylinder 3-feet high and 3-feet in diameter that may be able to process 7 to 9 pounds of foodwaste per day optimally. The Worm WigWam model 5-6 is much larger, approximately the size of a 4-yard dumpster, and is designed to handle 75 to 150 pounds of organic waste per day. This system was placed at Camp Sealth on Vashon Island and has been used quite successfully.

**Results**

Key to the evaluation of the pilot program has been gathering and analyzing data to indicate the success of the individual in-vessel systems. To ensure thorough data collection, King County worked closely with all of the program participants to properly record necessary information. This data was synthesized to reveal the information presented in Table 1.

**Table 1  
Average Diversion Rates**

<b>Location</b>	<b>System</b>	<b>Average Food Scraps Diverted</b>
<b>Schools</b>		
Briarwood Elementary	BioStack	5 lbs/month
Camp Sealth	Worm Wigwam 5-6	147 lbs/month
Cascade Elementary	BioStack	20 lbs/month
Crestwood Elementary	EarthTub	132 lbs/month
The Evergreen School	Worm WigWam	21 lbs/month
King’s School	Biostack	25 lbs/month
Lake Washington Technical College	BioStack	7 lbs/month
Pacific Crest Farm	EarthTub	45 lbs/month
Waskowitz Outdoor Education Ctr	EarthTub	203 lbs/month
<b>Businesses</b>		
Aegis of Shoreline	BioStack	3 lb/month
Bernie & Boys Market	Earth Tub	675 lb/month
King Street Center	BioStack	53 lb/month
My Favorite Caterer	BioStack	21 lb/month
Schuller’s Bakery	Plywood Bin	18 lb/month
Wild Mountain Café	BioStack	83 lb/month
Willows Lodge	Earth Tub	1050 lb/month

In addition to getting an idea of the amount of food scraps that could be diverted and the amount of compost that could be generated from various models within a school or business, the pilot program sought information on the kinds of technical issues that could arise with in-vessel composting systems. Some of these issues were specific to the systems used while others were specific to schools due to their seasonal operations. Other issues were common to nearly all program participants regardless of the system they used.

## **BioStack Evaluation**

Users of the BioStack system were generally very happy with the appearance of the BioStack, its small footprint, security (lockable cover), apparent ease of use and the flow-through vermicomposting technology. Some concerns were expressed over the amount of leachate that accumulated in the compost collection drawers. That seemed to be the result of a number of different issues: the system is all plastic with very little ventilation (we did not purchase the optional climate control attachment), users may not have put in enough bedding material, and/or they may have simply exceeded the daily capacity of the system. The leachate would not be an issue except that it collected in the compost collection drawer where it mixes with compost that has fallen down, creating a mucky slurry that can go anaerobic if not quickly disposed of. The compost collection drawer also had no leachate release or spigot which means that the whole drawer must be removed from the system and dumped out.

The Solid Waste Division program manager, with input from the pilot participants, partially solved this problem by placing a collapsible window screen or a raised piece of stiff hardware cloth in the bottom of each drawer to keep the finished compost separated from the leachate so that the leachate can be sucked out of the bottom of the drawer using a turkey baster-- a rather crude yet successful solution.

User discontent issues included flies (controlled by placing solid sheets of newspaper over the top of the bedding in each drawer), bad odors (went away when leachate was dumped more often), and leachate dripping occasionally from the drawers when they are pulled out (reduced when leachate was emptied regularly and not an issue when system is placed outside on soil). With age, additional problems have arisen with the Biostack harvest mechanism. These include rusted and stuck harvest mechanisms, handles on the harvest mechanisms breaking off, and generally more effort required or inability to pull the castings shelf out.

## **Earth Tub Evaluation**

All five of the originally installed EarthTubs are still in use. Users of this system have generally become quite attached to their EarthTubs and have been impressed with the amount of food waste that can be added to their system, the appearance of the system, and the fact that the biofilter works well for keeping odors down. The biggest problem schools dealt with on the Earth Tubs has been the need to get a school district electrician to come to their site and connect the system. Businesses generally did not have that level of bureaucracy to deal with.

Operational hurdles discovered with the Earth Tubs stemmed from the need to make sure basic composting concepts were understood. Numerous educational techniques were employed including monthly e-mailed "Compost Hints" discussing these concepts, technical assistance site visits and instruction, and 3 yearly half-day Earth Tub Summits. The EarthTub Summits have been quite popular and drew other EarthTub operators, entities investigating their own use of EarthTubs, and interested educators, students, and solid waste professionals from 4 counties, as well as the King County pilot program participants. A large part of each EarthTub Summit has been the communication and networking opportunities provided by bringing EarthTub operators together to ask questions and learn from innovations that each operator makes. The summits have all been held at participants' facilities so they were able to show off their system and talk about their site specific issues while attendees got to see real life applications.

Specific educational concepts important with the EarthTub included: the importance of bulking material, on-going challenge of finding low cost or free bulking material, the importance of consistent moisture, and the continuing battle to get temperatures high enough. The creativity expressed in the different types of bulking material has been a source of entertainment for participants and have included: straw, corn stalks, large bread bags, a coat hanger (accidentally), and Krispy Crème donuts. The stringy materials such as straw, corn stalks, etc. presented problems by wrapping around the auger. The day-old Krispy Crème's added a great deal of

energy, but their source was lost. A solution to the temperature issue for one school was found by adding a couple of loads of green grass clippings to the EarthTub after school let out for the summer. This high nitrogen material kicked the temperature up and allowed the remaining foodwaste to degrade and have time to cure before being emptied when school started the following year.

Finally, a manufacturing defect resulted in the lid of several of the units becoming de-railed, making the lid difficult to turn. The manufacturer replaced the rollers on these bins and has implemented a design change to correct the problem in later models.

All five Earth Tubs users are generally happy with their systems. One system is temporarily disconnected due to extensive remodeling of the facility, and another is under-used because the planned expansion of the school program has not occurred within the expected time frame. Yet the users continue to express enthusiasm about their EarthTubs and their potential for the future.

### **Worm WigWam Evaluation**

Worm Wigwam is the name for a series of systems manufactured in Oregon by Sustainable Agricultural Technologies Inc. Several sizes and options are available. The two models used for the On-Site Food Waste Composting pilot program are the 'Home' system in use at Evergreen School and the industrial model "5-6" in use at Camp Sealth.

The 'Home' system at The Evergreen School is neat and easy to access. However, it has been difficult for the teacher to operate correctly for incompletely understood reasons. Worms have repeatedly 'disappeared' and needed to be replaced. This may be due to mismanagement compounded by the system design of the base being raised up off the ground. This gap (in common with most commercial systems) allows worms to crawl out when conditions in the system are not ideal but they later they can not to crawl back in. The harvest crank handle was removed or fell off during re-loading one year and was not re-attached. Sustainable Agricultural Technologies Inc. has a very impressive customer service presence. Calls to the manufacturer have been answered immediately by a very helpful technician who has offered to walk the operators through repair, operation, etc. in real time via phone.

The larger "5-6" model has worked quite well for Camp Sealth, but like any vermicompost system has required learning the 'knack' of relating to the worms' needs. The specific issues experienced by this system include:

- The vermicompost tended to pack down too densely if it was not harvested frequently
- Considerable leachate can collect in the tray at the base of the unit and needs to be drained off in a less than convenient manner
- Temperature is always a challenge in an outdoor vermicompost setting. Monitoring, along with heated insulation pads in very cold weather, or attention to feeding and feedstock mix during very hot weather, have been used to mitigate this challenge
- Odor and flies can be a problem (as in any compost system). Covering the surface with cardboard or newspaper helped control these issues

## **Recommendations Summary**

Based on the data and feedback received through the On-Site In-Vessel Food Waste Composting Program the general recommendations for businesses and schools in King County are as follows:

Schools of all sizes should consider on-site in-vessel composting systems as a part of their food waste management strategies. The payback time on investment appears to be somewhat less than 7 years and the systems serve as wonderful educational tools for teachers at the schools - allowing students to learn by doing and to establish habits of mindful waste management. Any school considering an in-vessel system should make sure that their maintenance/ janitorial staff are included in the planning and are on-board with the program to ensure success of the program. If a powered system such as an EarthTub is utilized, early planning and requests through the school district for electrician support is important. Training the teachers in composting basics is important and ideally would be provided prior to beginning operation of a system.

Businesses located in areas which have access to food waste collection programs or that will have access to food waste collection programs in the next 3-4 years will not find on-site composting to be to their advantage and should be dissuaded from engaging in on-site composting unless they are truly devoted to the idea for ideological or PR reasons. The average pay-back period for on-site in-vessel composting has been estimated to be about 7 years and that is when the system is scaled appropriately to meet the majority of the businesses food waste production. Many of the businesses in the pilot program did not have the capacity to significantly impact their waste flow to reduce dumpster sizes and/or reduce pick-up schedules so that disposal costs were avoided.

Businesses located in areas where food waste collection programs will not be developed for a few years are encouraged to consider on-site in-vessel composting to meet a portion of their disposal needs. The system should be large enough in size that hauling costs can be reduced. Businesses must also understand the staffing commitments which are required.

## **Other Lessons Learned**

The pilot has shown that correct use of in-vessel composting equipment can avoid most of the perceived drawbacks of food waste composting. Each system has shown to have its own limitations and operating requirements, and thus it is critical that the users of the systems get the initial hands-on assistance necessary for them to effectively use their system. Teachers and business employees alike are challenged in that they generally have more than full time occupation with the everyday parts of their work and they may have little patience for the on-going attention that is needed to properly operate and maintain an on-site composting system. On-going technical assistance and troubleshooting can provide the comfort level needed for a teacher to take on the long-term management task of operating a composting system.

Additional value provided by this pilot program can be determined by the notoriety of the program given the fact that with little more than word of mouth, schools continue to ask to be included in the program. Solid waste representatives of out-of-King County school districts and governmental entities continue to contact King County and look to them for guidance in starting their own in-School composting programs.

Additional information on this program is available by contacting the program manager, Kinley Deller, at 206-477-5272 or [kinley.deller@kingcounty.gov](mailto:kinley.deller@kingcounty.gov). Information on the program can also be found on-line at <http://your.kingcounty.gov/solidwaste/garbage-recycling/onsite.asp>.