

COMMERCIAL FOOD WASTE COMPOSTING RESEARCH REPORT 1999 - 2000

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Program Goals

Facilitate the diversion of food wastes from the landfill by:

- Providing technical support to program participants for the operation of six in-vessel composters purchased through the SCWMA pilot program of 1998-1999
- Providing an unbiased evaluation of the in-vessel composters
- Providing source separation training and monitoring of food waste separation for participating food businesses
- Providing information to food businesses interested in using an in-vessel composter for food waste composting

Background

Food Waste & In-Vessel Composter

Based upon a waste characterization study conducted in May, 1996, 42.8% of the Sonoma County commercial waste stream is compostable and includes 13.7% (19,600 tons) commercial food spoils. This portion of the waste stream has traditionally been difficult to reduce because of the inherent difficulty in handling and composting food waste, but represents a significant portion of the waste stream.

An increasing number of communities nationwide are considering composting as an essential part of a comprehensive waste management strategy. The fastest growing composting projects include commercial and institutional "organics." Surveys in 1997 and 1998 by BioCycle magazine indicated a dramatic increase in composting projects accepting commercial and institutional food waste. In 1997 there were 220 projects nationwide, which rose to 250 in 1998. This project was included as one of the projects in a list of pilot programs in BioCycle, August, 1998.

We tested an in-vessel composter machine from Green Mountain Technologies in 1997 – 98 at a major outdoor event (4-H Chicken-Que), a restaurant (Mistral), a cafeteria (SRJC), and an institution kitchen (Sonoma Honor Farm). It was the most practical machine on the market with

some track record, affordable price, compact size, and availability for demonstrations. The machine was an early "demo" model with some problems, primarily the warped lid that led to rainwater intrusion and the auger hitting the bottom screen. Subsequent models have corrected most of the problems.

Green Mountain Technologies' Comp-Tainer/Earth Tub has a retail cost of approximately \$6,500. The machine is a cone shaped cylinder with a diameter of 89 inches and is 48 inches high. It weighs 300 lbs. and is constructed of plastic and foam insulation. Its capacity is 3.5 yards³ and can be filled with 100 to 200 pounds per day of organic materials.

The machine has a motorized auger mounted to a rotating lid that is turned by pushing the lid around in a circle. The auger mixes the lower materials with the upper materials and is set in place on a sliding metal sleeve within the lid that allows it to be moved toward the center, middle, or edge of the circular tub. The lid is usually rotated three times, once for each of the three positions of the auger. The unit has two clean-out ports, on opposite sides, for access to remove the finished compost.

Rebate Program

A 1998 survey of seventeen businesses interested in composting their food wastes indicated that an incentive of \$1,000 to \$3,000 was necessary to get most of them to purchase an in-vessel composter. Together with the Sonoma County Waste Management Agency, we then established a rebate program offering \$2,000 to the first ten businesses to take part in the program. If different types of machines were purchased and operated, it would give the program a chance to evaluate the performance of those machines rather than try to test one machine each year over a period of years.

Linda Peterson, James Johnson, and Paul Vossen contacted hundreds of restaurants, grocery stores, and individual food businesses and invited them to participate in the rebate program and purchase an in-vessel composter. SCWMA offered a \$2,000 price reduction and Green Mountain Technologies offered an additional \$1,000 discount if we could jointly order and purchase 10 machines at once. They ultimately provided the discount for six machines purchased with the hope that the operational machines in the area might attract additional business for them.

The concept of composting food waste on-site with a small containerized mixing machine such as this has merit and was well received by several food businesses in the county. At a cost of approximately \$6,500, the composter could conceptually pay for itself in lower trash hauling fees in about three years. Some food businesses expressed a genuine interest in purchasing some type of composting machine and operating it near their trash bins, but most felt that the initial cost was prohibitive.

Contract Extension

University of California technicians promoted the rebate program and monitored the purchase and set up of four of the machines in 1999, which became operational in May, two months

before funding ended. An extension was granted to fund the program for an additional six months in order to monitor the progress of the in-vessel composters and to assist in the initial operation of two machines at the Sonoma Development Center.

Last year we received \$2,008 to visit operational in-vessel composters and to help other participants set up their machines. We worked with four sites and six in-vessel composters for six months from June 30 to December 31, 1999. This program was conducted by a part-time assistant (10%), Linda Peterson, in cooperation with Horticulture Advisor, Paul Vossen, and James Johnson, UCCE-Sonoma County field assistant.

Summary of Objectives Achieved

Six Green Mountain Technologies “Earth Tubs” were purchased, delivered, and made operational as part of the rebate program. Two machines are located at Food For Thought in Santa Rosa, two at the Sonoma Developmental Center in Glen Ellen, one is at the Food For Thought store in Sebastopol, and one is located at the Vineyards Inn in Kenwood. Food For Thought was purchased by Whole Foods this spring so the store names have changed.

Waste audits that were conducted at all of the sites indicated that food waste and other compostable materials averaged 66% of the total waste generated by these operations. Research was conducted to determine the volume of material composted, temperatures reached in the process of composting, needs for source separation, electrical hook-up, and labor needed to operate the in-vessel composters.

The actual composting process of adding bulking agent and food scraps periodically was not complicated and the mixtures began composting within two weeks and heated up to rapidly decompose reasonable quantities of organic materials. The time requirement in separating out compostable materials was not an excessive burden for the participating businesses nor was the time required to periodically turn the mixture.

Greater care needed to be taken in properly locating the in-vessel composters, separating out contaminants, monitoring compost temperatures, maintaining ideal moisture conditions of the mixture which varied by weather conditions, bulking agents used, and moisture content and consistency of the food waste added. Clean out of finished compost was easily achieved by hand with a scoop shovel through the two ports located on either side. Some mechanical problems were experienced with the composting tubs, primarily with the biofilter fan.

Food For Thought – Whole Foods

There are two machines located at the store in Santa Rosa and one in Sebastopol. Ernie Shelton, one of the owners, was the main instigator behind the purchase and use of the in-vessel composters to maintain the store’s conformity to earth friendly technologies. He





In-vessel composters at the rear of the Santa Rosa Food For Thought/Whole Foods store. Note the hard wired electrical hook-up.

had the three tubs operational starting in May of '99. Food For Thought won the California Integrated Waste Management Board (CIWMB) Waste Reduction Awards Program (WRAP) award in 1999 due in part to the use of the earth tubs for composting food waste. Publicity for that award appeared in a Press Democrat (10-17-99) article featuring the Food For Thought in-vessel composter and worm bins (vermicomposting) at Cricklewood Restaurant.

In that article, Joe Rogoff, general manager of Food For Thought, is quoted as saying that they have cut 40% off their disposal bill and save about \$10,000 per year (See Appendix G). Our estimates are close to that since they have eliminated one dumpster at each store diverting about five tons in Santa Rosa and four tons in Sebastopol over a six-month period. Our waste audit indicated that the Food For Thought Store in Santa Rosa was producing 176 tons per year of compostable food waste materials. The Sebastopol store was producing 105 tons per year.

Problems at the Santa Rosa store have kept the tonnage diversion lower than expected with two composters, because one of the in-vessel machines needed a replacement fan for the bio-filter which took over two months to replace. Another problem they experienced was the lack of staff to unload the tubs. While the machines were not operating the food waste was taken by a hog farmer for feed. About 30 cubic yards of compost were produced at the Santa Rosa store in ten months from two machines. The compost was being used at Ernie Shelton's orchard.



Carmelo Avila and Linda Peterson in front of the Sebastopol Food For Thought/Whole Foods in-vessel composter that has been operational since May of 1999.

The Sebastopol machine was adding both produce waste and deli waste to the composter using five-gallon buckets to collect it inside the store and deliver it to the composter. About 10 cubic yards of compost was produced every six months and was being used on Jim Shelton's property in Sebastopol.

After the sale of Food For Thought to Whole Foods, the new management has tried to maintain use of the earth tubs but other problems arose at the Santa Rosa site. According to Lynn Silva, store manager at the Santa Rosa store, they are not using the tubs right now, because the property owner will not allow the store to make needed improvements to the platform area at the back of the store. Whole Foods is currently negotiating with the landowner to bring the composters back into operation

The composter tubs needed to be elevated slightly to facilitate the removal of leachate and finished compost from the composters and condensate liquid from the biofilters. They also required some protection from delivery trucks that park adjacent to the tubs and have in the past broken the plastic piping leading from the composter to the biofilter.



In-vessel composters at Food For Thought/Whole Foods. Note proximity of the machines to the delivery area. This is where vehicle traffic broke the tube connecting the composter to the biofilter.



Broken tubing between the composter and biofilter that had been hit with vehicle traffic.

They have not used tubs since March of 2000. Prior to that the in-vessel composting process was working fine and creating good usable compost. The Earth Tub is still operational at the Sebastopol Whole Foods store. Contacts at Whole Foods were Carmelo Avila and Bruce Buell, Receivers, and Lynn Silva, Store Team Leader.

Conclusions from the Food For Thought/Whole Foods experience were:

- The In-vessel composters make great compost when operated properly and the staff appreciates the concept of environmental stewardship that they create
- The property owner of the Whole Foods Store in Santa Rosa has a negative view of operating in-vessel composters at that site
- The in-vessel composters require a systems approach, right from the beginning, that starts with an appropriate physical site, management of the raw product, commitment of labor to operate and oversee the composting process, and disposal of the finished compost
- The physical site should include protection from vehicles, an elevated platform to facilitate removal of compost and drainage liquids, hard electrical wiring to avoid vandalism and safety hazards, proximity to the raw product source, and a dry area for storage of bulking agents
- The raw product must be clean of non-compostable materials. This requires training of staff to separate materials and several months to develop a habit of separation

- Labor is necessary to turn the compost daily (6 times/week) and to maintain the proper moisture content of the compost by adding dry bulking agents (wood chips and sawdust) if it is too wet or by adding water if it is too dry. Labor is also needed to acquire the proper bulking agents and to remove and transport the finished compost
- Operation of an In-vessel composter (add materials and turn auger) requires about 20 minutes per day (3 hours per week). Two machines require double that amount of time
- Whole Foods is now donating the finished compost to organic community gardens near each store. The garden volunteers are eager to remove and transport the finished compost to the garden. Whole Foods will use the donation as positive community publicity. This eliminates the labor requirement to remove the finished compost. It takes about 1 hour for two people to unload the finished compost from the machine
- Addition of about 60 gallons of waste produce and deli waste per day works very well. Under normal operation there is no perceivable negative odor whatsoever
- The addition of 60 gallons of spoiled oranges plus the normal 60 gallons of daily waste created an anaerobic odor that required the addition of more bulking agent, more frequent turning, and about one week for the odor to dissipate
- There have never been any complaints from neighbor residences or businesses
- The use of the in-vessel composters has saved dumpster charges at both stores
- There have been frequent problems with the biofilter fans
- Prior to operation the in-vessel composters are filled about 1/3 full with 1.5 yards of wood chips and 1/2 yard of sawdust. This material is an additional expense
- If the process is neglected the compost can quickly turn anaerobic and create an odor problem.
- Overall the composters have been a positive experience and they would recommend their use to other businesses. Their new stores will be including in-vessel composters into the design of the physical structure and handling area at the rear of the stores

Vineyards Inn Restaurant

Steve Rose at Vineyards Inn put his machine on a concrete pad on his property about ½ mile from the restaurant. This machine has been operational since May 31,1999. Our waste audit determined that the restaurant was generating about 20 tons per year of compostable food waste materials and so far has managed to divert approximately 12 tons of waste over a sixteen-month period, about half of what they are generating. They cut the restaurant's garbage pickup from a 6 yd³ dumpster to a 2 yd³ dumpster picked up every week saving \$148/month.



Steve Rose turning the compost in the in-vessel composter located next to his barn about 1/2 mile from the Vineyards Inn restaurant.

Steve has experienced some problems with the earth tub system including having to modify the placement of the tub to prevent leachate from draining down into the fan causing it to burn out. He has also experimented with various types of bulking agents such as decorative bark, wood shavings, grape pomace, and wood chip mulch. The finer, dry, and absorbent mulch worked the best because they were adding excessively wet materials. Some of the other materials did not absorb the excess moisture well enough.

An on-site property manager operates the system.

Many recommendations have been made over time on best management practices, most have been implemented. Initially the compost that they were removing from the earth tubs was not completely finished. It contained many food and mulch particles that had not been sufficiently broken down, and was still hot. At one point, when the tub was about 3/4 full, it was emptied into a large plywood box serving as a worm bin, but the compost was still too hot for the worms.

They were not checking temperatures often enough, but recently have begun to monitor temperatures daily to determine how the compost is progressing in order to allow it to completely finish. One of the aspects of more careful monitoring was noting that during rainy weather the temperature of the compost decreased. This is believed to be caused by the higher humidity and a reduced effectiveness of the bio filter fan to remove excess moisture from the composter. More dry bulking agents needed to be added during wet periods.

They were adding about 60 lbs. per day of food waste with some contamination of bones, plastic wrap, rubber gloves, rubber bands, plastic straws, and silverware. The amount of contaminants has significantly decreased over time, but continues to be an ongoing problem due to constant turnover of restaurant staff that requires training. The finished compost is used to supplement purchased compost that is applied to the owner's vineyards, which are certified organic.

This is what we learned from the Vineyard's Inn experience:

- A committed operator is necessary to manage an in-vessel composter
- Reduction of contamination of compost with plastics and other noncompostable materials requires a constant educational effort for restaurant staff
- Weather needs to be taken into account when operating an in-vessel composter. Humid, cool weather requires the addition of more dry bulking agents to absorb excess moisture
- It takes about fifteen minutes to turn the compost in the machine every day. More time is needed for collecting and delivering food wastes from the restaurant to the composter and dealing with the acquisition and addition of bulking agents. It takes about two hours for one person to unload the composter

- Large sized bulking agent chips do not work as well as smaller particle sized materials, because of their difference in capacity to absorb moisture
- Three fan motors have had to be replaced in the 1.5 years of operation. It is believed that they stop working because they get wet either from excess leachate or wetness from the high humidity (vapor) of the air that the fan is moving from the composter to the biofilter. The manufacturer has replaced the fans relatively quickly
- Initially the composter is filled about 1/4 full with green waste wood chips (from Sonoma Compost). Food waste materials are added every day (60-80 lbs., which varies depending on volume of business and contamination) plus more bulking agents if the compost gets too wet. It takes about one month to fill the composter. When full, no more food materials are added, the compost is turned every day for three days, then emptied, hosed out, and refilled with a new batch of wood chips
- The owner, Steve Rose, recommends the in-vessel composter to other similar businesses as a method of reducing input of food waste into the landfill and saving money on dumpster costs. He is saving \$1,776/year in reduced dumpster charges by composting his food waste

Sonoma Development Center

The Sonoma Development Center purchased two earth tubs and had a difficult time getting them operational because of other priorities, insufficient manpower, and they could not decide where to place them. They ultimately placed them right outside the door to the main kitchen, a location that we had advised against.

After placement, they began loading the machines with pureed wet food scraps without having adequate absorbing bulking agents in the mix. The leachate drain lines plugged up and the compost became anaerobic and smelly. For about 3 months, they had an odor problem. Linda Peterson worked with John Bachelder, the head groundskeeper who was committed to making the composters work, to alter the drainage system, add more bulking agents to absorb the excess moisture, and clean out the drain on a regular basis. The odor problems were then solved and good compost was produced.



The kitchen dock at the Sonoma Development Center. The in-vessel composters were located in the walkway on the upper level of the dock next to the door

Once the kitchen staff had experienced the odor, however, they became very strongly allied against the in-vessel composters, especially since they were located so close to the kitchen door. The kitchen staff's complaints about odors were such that the tubs were removed. They have not been operational for several months and will not be used again at the center. The composter tubs will be moved to other state operated facilities for trial under circumstances more likely to succeed.

The people involved with the project at the Sonoma Development Center were: Dan Davis - chief of plant operations, Jinger Rood - Asst. Director of Dietetics, Paula Prideaux - head of Nutrition Services, Kathleen Wagner – Administrative Services Director, and the plumbers, electricians, kitchen staff and John Bachelder, the groundskeeper. The original impetus to install the composters at the center came from Jesse Adams from Project Recycle at the California Integrated Waste Management Board.

Lessons learned from the Sonoma Development Center experience were:

- Some center staff and administrators were willing to try the concept but did not have the required acceptance by the kitchen staff of the in-vessel composting concept prior to installation of the machines. The original idea was to have the kitchen staff manage the composting process
- The center is currently understaffed and really needed to either hire or reassign someone to manage the composters from the beginning. The labor to try and make the composters work ultimately came from the grounds maintenance crew which took them away from other scheduled duties
- The location of the machines was too close to the kitchen. When anaerobic odors developed they entered the kitchen and bothered the staff. Unfortunately, there was no good location that was easy to establish for the composters
- The food waste at the Development Center is mostly highly processed, wet, pureed food for patients that cannot eat regular meals. This waste product is unique and offered unique problems in the composting process due to lack of aeration. It was difficult to deal with and required greater additions of bulking agents. It also created a compaction problem against the floor grate, which in turn affected the ventilation
- About 150 lbs. of food waste were added daily to the in-vessel composters that were 1/2 full of bulking agents. The bulking agents used were dry wood chips, sawdust, oak leaves, and hydrated lime
- In the opinion of the grounds maintenance staff, the drainage line for the biofilter, which accumulated condensate from the humid air inside the composter and leachate directly from the compost was not large enough to accommodate the flow of liquids. It easily became plugged up, which then stopped the biofilter fan. This was a frequent problem. After the drain line was cleared, any odor problems disappeared within a short time, however, the line required frequent dismantling for cleaning and was a very unpleasant duty
- There seemed to be a direct correlation between the success of the composting process and the humidity of the air. Once the correct amount of bulking agent was used to produce the ideal compost moisture content, it was difficult to maintain under changing weather conditions. In the dry (low humidity) summer months the dry air helped reduce the moisture content of the compost. In the wet (high humidity) winter months it was much more difficult to keep the compost at the proper moisture content. It was almost always too wet

- The design of the auger and rotating top worked well for mixing the compost. When the correct balance of bulking agents to food waste was used and the weather was dry (low air humidity) a good compost was made in about 30 days
- According to center administrators, the amount of compost and value of the compost plus the savings in trash hauling or potentially reduced sewer charges (for BOD and TDS from garbage disposal of food wastes into the sewer system) were not enough to offset the cost of labor to operate the in-vessel composters.

Sharing Information

The coordinators and participants in this program shared information with other in-vessel compost bin operators around the country (Oregon, Washington, Hawaii, Florida, Kentucky, & Wisconsin) and with others around the world (Belize, Japan, Switzerland, and England) interested in food waste composting with an in-vessel system. Many contacts were also made with interested food waste composters in other areas of California (Santa Cruz, Berkeley, Bolinas, Napa, San Jose, Livermore, and Irvine).

Jennifer Ketring and Theresa Eade from the Alameda County Waste Management Authority came to visit tub sites and worm sites in July 2000. They were interested in purchasing two tubs for one of the county school districts. Karin Grobe, an independent consultant, who does a lot of food waste composting (mostly with worms) in Santa Cruz County, also contacted us this summer. They were buying a couple of tubs and she wanted information from us. We have become a resource for businesses, consultants, and public agencies around the country that are interested in using in-vessel composters.

Worm Boxes

The Green Mountain Technology Earth Tubers were the only in-vessel composters that we had the opportunity to work with. We did, however, observe an alternative food waste disposal technology that uses worms to compost food waste at a couple of sites. We believe this low input technology shows some potential and should be investigated further.

We have observed the operations of two small-scale worm composting facilities for composting food waste at Cricklewood Restaurant and Park Avenue Catering. Michael O'Brien, owner of Cricklewood restaurant in Larkfield, started a vermicomposting project in 1998 with a very simple and inexpensive system located on the restaurant property. Just beyond where the patrons eat on the patio dining area are four 4' X 8' plywood bins. They sit under a couple of old olive trees against the fence hidden by the landscaping. He is putting all of his kitchen prep waste (200 lbs. per week) into two of the bins while the other two are at various stages within a rotation. Prior to adding new material, they use a pitchfork to mix in previously added food scraps. The worm bins produce no odor and seem to be a very successful "low tech" and appropriate solution to part of the waste handling problem at their site. They use the worm castings on the property landscaping.

Bruce Reizenmann, owner of Park Avenue Catering, is also using worm bins to digest the food waste from the catering business. He is very enthusiastic about the potential for using worms because of the low cost to establish bins, the simplicity in maintenance, and ecological benefits as an alternative to disposal in the landfill.

Conclusions & Recommendations

The Earth Tub in-vessel composter system must be managed properly in order to produce a consistently good product with no odors or contaminants. If it is not, problems will arise and results will be unsatisfactory. We feel that it takes three to six months of experience working through several cycles of the composter, from starting to add food waste to finished compost, in order to have the whole process working successfully. The in-vessel composting system involves management of the food waste, bulking agents, machine operation, and disposal of the finished compost.

- The location of the in-vessel composter must be selected carefully so that it is easy to load and unload, safe from vehicle traffic, close to a drain for leachate and biofilter condensate disposal, and far enough away from people who may become exposed to odors
- It should be hard wired electrically to avoid vandalism and safety problems
- The bulking agents should be appropriate for the type of food waste added. In most cases a mixture of small wood chips and sawdust-like materials are needed to absorb excess food waste moisture. The compost should be checked periodically for temperature and maintained at an ideal moisture content, which also seems to be influenced by the weather
- The composter should be checked often (daily - if possible) for proper operation of the biofilter fan, moisture content, and to turn the compost
- Management of the composter should take into account the weather, type of food waste added, and type of organic solids used as bulking agents
- Constant attention needs to be paid to the separation of contaminants at the source so they do not get into the compost initially
- The finished compost should be allowed to completely finish for a few days without the addition of more raw food waste prior to unloading. Having a location to use the compost or other home for the compost is also important
- Someone at each in-vessel composter site should take responsibility for the operation of the whole system (food waste, bulking agents, machine operation, and compost disposal) and learn the intricacies of the system operation based on the specific characteristics of that site

- Green Mountain Technologies needs to continually improve upon the design of the in-vessel composter, itself especially the biofilter fan and drainage system. They would also be well advised to provide sufficient education to machine operators regarding the maintenance of proper moisture content of the working compost

Summary of Project Failures

The Sonoma Development Center in-vessel composter trial was a failure because there was no appropriate location for the machine. The type of food waste generated at the facility, primarily pureed foods posed a particular and difficult challenge to the maintenance of adequate aeration in the compost. There was also an inadequate labor supply designated for the needs of the whole system operation. Hopefully, the lessons learned from that experience would prohibit similar failures in the future. Not all locations are right for this type of machine.

Ultimately, the failure of the in-vessel composting system for aiding in the reduction of food waste disposal into the landfill can be noted by the small number of machines in operation in Sonoma County. Even with the SCWMA rebate of \$2,000 and Green Mountain Technology's additional discount of \$1,000 we could not convince ten businesses to try the machines. It seems that the complexity of dealing with the in-vessel food waste composting system is too complex and costly for most food businesses. Only those who are very committed to the concept and willing to devote the time, energy, space, and costs to properly manage the system will be successful. Obviously, the potential cost savings of reducing landfill disposal (dumpster costs) was not sufficient to create much interest.



Inside an in-vessel composter showing food waste mixed with paper products and bulking agents undergoing active composting.

Tonnage Diversion

This pilot project was a research effort to see how well the Earth Tub in-vessel composters would work and if the businesses could easily separate trash and other compostables from the food waste. The businesses that successfully operated the in-vessel composters had a significant cost saving due to reduced garbage pick-up fees.

The estimated quantity of food waste diverted from the landfill by an operational in-vessel composter is approximately 20 - 21 yd³ or 8.5 - 9.0 tons per year.

Santa Rosa - Food For Thought/Whole Foods

- Two tubs were operated from May, 1999 to March, 2000 (10 months)
- Diverted 1.3 tons of food waste per month while in operation
- 30 yd³ of food waste were composted in ten months = 12.72 tons/10 months

Sebastopol - Food For Thought/Whole Foods

- One tub has been operational since May, 1999
- Diverted 20 yd³ per year = 8.5 tons per year of food waste

Vineyard's Inn Restaurant

- Diverted 21.2 yd³ per year = 9 tons per year

Sonoma Development Center

- Two tubs operated for three months September to December 1999
- Diverted 4.5 yd³ in three months = 1.9 tons

Weight and volume calculations for compost are based on 50% moisture (848 lbs./yd³).

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