

MEDIUM-TO-LAGE-SCALE VERMICOMPOSTING SYSTEMS

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Institution and business managers are looking for new ways to divert waste from their disposal systems. Food waste and other organic materials are of particular concern because they can be as much as 90 percent of a facility's total waste stream. However, businesses and institutions often do not have enough space to compost their organic materials on-site or there are no composting operations within a reasonable distance. Therefore, many facilities managers are investigating the possibility of vermicomposting their organics.

This presentation will provide an overview of the types of vermicomposting systems used at 13 institutions and businesses located throughout the United States and Canada. Slides will depict a variety of systems that were either commercially produced or designed and built on-site. The following types of facilities will be highlighted:

- * Elementary school in Pennsylvania
- * Air force base in Nova Scotia
- * Hospital in New York
- * 28-story downtown office building in Ontario
- * Processor of grocery chain food scraps and municipal organic materials in Oregon
- * Correctional facilities in North and South Carolina, California, and Florida
- * Athletic arena in Washington
- * College in Washington
- * Federal building in North Carolina

Four correctional facilities in the Carolinas--Caledonia, Brown Creek, and Sampson in North Carolina, and Broad River in South Carolina--are expanding projects with on-site composting and vermicomposting of organic residuals as they examine ways to reduce the amount of garbage they send to landfills. Several other North Carolina prisons are considering adopting these methods of waste reduction in the future in response to Governor Jim Hunt's call upon state agency managers to

implement more environmentally-sustainable practices. The governor has asked state agencies to “look for ways to reduce the use of natural resources, eliminate waste and limit environmental impact, and serve as models of environmental stewardship.” Furthermore, state officials are

considering expanding executive policy to specifically address food waste recycling by requiring state agencies that operate food service establishments, such as snack bars, cafeterias, dining halls, etc., to implement programs to recover and recycle edible and inedible food when feasible and practicable. Reducing waste will also save taxpayers money; during FY 1997-98, 83 correctional facilities statewide disposed of a total of 31,710 tons of solid waste at a cost of \$791,205.00 (average disposal fee of \$24.98 per ton).

CALEDONIA CORRECTIONAL INSTITUTION

In 1995, Caledonia Correctional Institution in Halifax County was the first prison in North Carolina to implement on-site composting. Located on 7,600 acres near the Virginia border, Caledonia has always diverted kitchen scraps from their waste disposal system, initially by giving them to a nearby hog farmer who collected them two or three times a week. When hog prices plummeted in 1997, the hog farmer severely cut back on food scrap collection, and prison managers scrambled to find another method for keeping the materials out of the landfill. They obtained a one-year pilot permit from the state which allowed them to implement windrow composting. In the meantime, Caledonia began the lengthy process of applying for a permanent facility composting permit while designing and constructing a bin system. As soon as the permit was approved in May 1998, they began composting in aerated bins.

The \$40,000 forced-air static composting system was designed by the prison’s maintenance supervisor and carpenter. The system consists of 12 bins, divided into two rows of six, and each bin is 7 feet long by 7 feet wide by 5 feet tall. The front of each bin has six 2 by 8’s that can be removed two at a time by a person on each end. The capacity of each bin is 36, 30-gallon barrels, or over 9,700 pounds of food scraps. The floor of each bin has 16 BioPlates for aeration and leachate. The BioPlates, constructed of fiberglass and concrete at a cost of \$89 apiece, are strong enough to withstand the weight of a skid loader. The top of each BioPlate is flat with cones underneath that rest on a concrete pad, thus raising the plate several inches off the floor so leachate and air can move through the numerous holes in the plate. A 980 cubic feet-per-minute fan for each bin is operated on a timer to aerate the pile by forcing air through the center of the system and up through the BioPlates in the floor. When aeration is needed, usually for moisture reduction, the blowers run for 10 minutes every hour on the hour. Moisture is usually added at a rate of 25 gallons at a time by placing a portable irrigation sprayer on top of the compost pile that uses a 3 gallon-per-minute electronic water meter. They presently use the “dig and squeeze” method of moisture testing, but plan to obtain an electronic moisture reader. An overhead irrigation system was considered but rejected due to the prohibitive cost of purchasing an electric water meter for each bin (\$113 for each meter) to meet the requirement of keeping daily records for their permit. Leachate runs to a trough between the two rows of bins and into a 1,500-gallon septic tank.

The collected leachate is handled by three alternative methods: either added to bins to increase moisture levels or land-applied as allowed by their permit or processed at their wastewater treatment plant.

Caledonia is composting food scraps, paper products from the kitchen, 100% cotton t-shirts, and bones. T-shirts are only occasionally added to the bins. About 12 barrels (30-gallons each) a day are generated of food preparation waste, leftovers, and scrapings from inmates' plates. When all of the bins are operating, they plan to compost cannery waste plus kitchen scraps from two smaller correctional facilities next door. Because the maximum security inmates housed at Caledonia are ineligible to work at the composting facility, a team of three inmates from the minimum-security facility next door use a front-end loader attached to a tractor to fill and empty the bins. Wood chips, obtained at no cost from a nearby paper company, are used as a bulking agent. They initially tried using wheat straw and poultry litter separately as bulking agents, but both compacted so much that the forced-air system didn't work and inmates had to hand-turn the piles. Inmates apply a 4-inch layer of wood chips (two Bobcat scoops or 420 pounds) on the bottom of the bin, then add 4- to 8-inches of food scraps (12 drums; 190 pounds), then 10 pounds (5 scoops) of 46 percent nitrogen urea from a fertilizer company (to increase pile temperature). This procedure is repeated three more times until the bin is almost full and then capped with a 4-inch layer of wood chips. The materials remain in these layers during the next two weeks; no agitation or mixing takes place since the bins are aerated with forced air. From May 1998 through March 1999, Caledonia composted 131 tons of organic materials.

Organic materials are composted for about two weeks, and then the bins are emptied into windrows for at least two months of curing. So far, Caledonia has been using most of the compost as a bulking agent in the bins because the wood chips and compost can be reused three times for this use. Eventually the compost will be screened and used to grow day lilies or spread on fields for crops.

One prison official and three inmates maintain the composting operation. They spend about an hour a day checking the bins, and twenty minutes taking temperature readings of the five bins currently in use. It takes two to four hours to empty and refill the bins and mow grass around the site when needed. A separate crew consisting of a corrections officer and two inmates delivers about 40 barrels of food scraps once a week to the composting site. Approximately 8 to 12 barrels of kitchen scraps are generated daily and stored in a fenced area near the kitchen. The crew spends about an hour per week hauling the barrels of food scraps over to the composting site.

Caledonia is still trying to get the kinks out of their composting system. The biggest challenge occurred the first winter when bin temperatures would not rise enough to meet their permit requirements. This problem was attributed to the BioPlates lying on a concrete pad that did not allow the bins to hold heat. The bin contents were emptied into windrows during the coldest months of winter. A couple of other "lessons learned" are also associated with the BioPlates. To dump the organic materials into each bin, they were driving a skid loader right onto the BioPlates. They didn't

realize until several months later that the Bobcat tires were pushing the organic materials into the holes of the plates and plugging them up. Now they use a front-end loader attached to a tractor so that the tires only roll onto the first three inches of the plates. Another problem was that a lot of grease was being added to the bins, and the spaces between the concrete pad and the BioPlate cones were getting clogged with grease and impeding the flow of air and

leachate through the holes.

The bin system would also be improved by adding more overhang to the roof and curtains on the sides of the bins to keep out rain. They also could use asphalt around the bins to prevent the skid loader from getting hung up where the gravel doesn't come up to the sides of the bins.

Thus far, Caledonia has no cost savings associated with their composting operation. There are no disposal savings because food scraps were never sent to a landfill or wastewater treatment facility. And since they haven't used the compost yet, Caledonia has no documented savings on its use as a fertilizer or soil amendment.

BROWN CREEK CORRECTIONAL INSTITUTION

Near the South Carolina border in Anson County (NC), Brown Creek Correctional Institution (BCCI) implemented a comprehensive waste reduction program that includes composting and vermicomposting. BCCI reduced their solid waste disposal by 67 percent, from 333 tons (28 tons per month average) in 1996-97 to 73 tons (9 tons per month) in 1998-99, saving the state more than \$4,000 in disposal fees. During 1997-98, BCCI recycled 62 tons (reaping revenues over \$5,000), composted 43 tons, and recovered 8,488 articles of clothing (worth \$17,848) by hand sorting all of their garbage.

In August of 1997, BCCI began their experimental vermicomposting project. First, they built a 24-inch by 48-inch wooden box and added five pounds of redworms and food waste to the shredded paper bedding. A few months later, two additional worm bins measuring 24-inches by 28-inches were set up after converting them from a used wooden shipping crate. Worms were taken from the original worm bin to stock the new bins. All three bins are located inside a greenhouse used for a therapeutic planting program for chronically-mentally ill inmates who mix the worm castings with soil to grow vegetables and flowers. Built of salvaged steel bridge beams, the 20 foot by 24 foot worm bin is divided into three sections by recovered concrete blocks. They stocked small sections of this vermicomposting unit with worms harvested from the greenhouse bins. Since the project began, they have not purchased additional worms; they continue to expand their vermicomposting program with worms raised in the original greenhouse box.

The vermicomposting project is staffed by one correctional officer and one inmate who spend approximately 15 to 30 minutes each week checking on the worm bins, and 30 to 45 minutes twice per

month adding food residuals to the bins. They discovered that lettuce leaves and other food scraps that decompose rapidly are more suitable for the worms than whole potatoes or broccoli stalks, so only certain organic residuals from the waste stream are fed to the worms. Plate scrapings, which could have grease or meat mixed in, are not added to the worm bins. The following types and amounts of food are added to worm bins per feeding: 60 to 80 pounds of lettuce, 5 to 10 pounds of coffee grounds, 3 to 7 pounds of paper and paper egg crates, and 10 to 15 pounds of banana peels. Through April 1999, the total amount of food added to the worm bins was 915 pounds of paper, 640 pounds of lettuce, 170 pounds of coffee, and 200 pounds of banana peels.

BCCI's first composting bin was fairly small, constructed of wire and concrete. They soon realized that a larger system was needed to compost pre- and post-consumer food scraps, dryer lint, and hair clippings from their barber shop. So, inmates constructed a three-compartment composting bin from wood and wire measuring 4 feet by 12 feet by 5 feet high. The bin system worked fine, so Superintendent Rick Jackson planned to have more bins built, until he heard about Organic Wastes Recycling Grants available from the state Division of Pollution Prevention and Environmental Assistance. Jackson applied for and was awarded a grant for a demonstration project of food waste source-separation and in-vessel composting. In early June 1999, BCCI set up a Greendrum In-Vessel Composter, distributed by RKB Enterprises of Norfolk, Virginia. The \$39,000 rotary-drum composter, measuring 6 feet in diameter and 16 feet long, has a 900 pound per day capacity. The unit takes one part food to two or three parts amendment for bulking and moisture reduction. Organic wastes are loaded at one end, passed through a grinder, and moved through the drum by gravity (it's on a two-degree angle). Retention time inside the chamber is one week, followed by one month of curing. Jackson also purchased an identical composter so the two units can handle the 1,400 pounds per day of food scraps generated at BCCI and 400 pounds of food scraps produced daily at a smaller prison next door.

BROAD RIVER CORRECTIONAL INSTITUTION

In 1990, a composting system was implemented at the Broad River Correctional Institution (BRCI) in Columbia, South Carolina to divert food waste from disposal and build up soil for their vegetable garden and flower beds. Kitchen scraps generated from preparing meals for 1,000 inmates ranges from 1,000 to 3,000 pounds per week, depending on menus. Food scraps are mixed with yard waste and pine straw in windrows for composting. Cow manure is added periodically to increase the pile temperature. Two inmates are in charge of hauling the materials, grinding them and aerating the pile using a rototiller and pitchforks. Plans call for expanding the program to plate scrapings and they anticipate having six 100-foot windrows to compost most of the organics.

Although prison officials were satisfied with the windrow composting system, when they were approached by a state official interested in setting up a vermicomposting demonstration project, she readily agreed to try it. Beginning in June 1998, BRCI started vermicomposting about 10 percent of

their food scraps. Every two to three weeks, about 800 to 1,000 pounds of kitchen scraps that have been shredded and allowed to cool in a pile for a few days are added in 4 to 6-inch layers to worm bins. Mostly leafy food scraps are added to the bins because the worms are able to process them faster. The vermicomposting bins were manufactured and installed by Vermitechnology Unlimited at a cost of \$2,000, which included 120 pounds of worms (90 pounds of worms were added to this system, and 30 pounds of worms were used for another project). The Insulated Ground Vermicomposting System is constructed of wood and insulated panels, measuring 34 feet long by 7 feet wide by 18 inches high with a center divider for ease of feeding and harvesting. It has a capacity of 100 to 150 pounds of food waste per day. A screen is installed beneath the unit to keep out moles and other pests. Inmates added a greenhouse mesh suspended by metal poles for shading, at a cost of \$120.

So far, the worm bins have only been harvested once. From May to September 1998, thirteen 55-gallon barrels of worm castings were produced and harvested. The state was interested in seeing how the vermicompost would sell at retail outlets, so they developed labels to stick on paper bags containing 5 pounds of castings in plastic bags, to be sold for \$7.50 per bag. The bags are being offered for sale at an herb farm, a flower shop, and a nursery, however they have not been selling well. The prison is splitting sales of the vermicompost with the retail outlets.

Table 1. Summary of systems used at three prisons and tonnages diverted

Prison Name	Type of Composting System	Tonnage Diverted/Month
Caledonia	Forced-air static bins	13
Brown Creek	Greendrum Rotary-Drum Composter	19
Brown Creek	Hand-made vermicomposting bins	2
Broad River	Vermitechnology Unlimited	4