

MANAGING FEEDSTOCK RATIOS

UNIVERSITY TESTS IN-VESSEL COMPOSTING OF FOOD RESIDUALS

ALMOST 25 million tons of food residuals were landfilled in the United States in 1999, nearly double the amount of just ten years ago, according to the U.S. EPA. The agency recently declared food residuals to be the leading methane source (by unit volume) coming from MSW landfills, which are the top producers of methane in the U.S. In Georgia, rising volumes of food and other organic residuals are increasing demands on landfills. To address this, the University of Georgia's (UGA) Engineering Outreach Program of the Department of Biological and Agricultural Engineering and the Pollution Prevention Assistance Division of the Georgia Department of Natural Resources have teamed up to research, educate and implement strategies in waste reduction, by-product recovery and pollution prevention.

A pilot study was initiated in the fall of 1999 to recycle institutional food residuals at the Bioconversion Research and Education Center on the UGA campus. The objectives were to: Determine whether an agitated aerated composting system could be used to recycle all the university's food residuals; Evaluate the speed and function of the system; Assess the impact of three mixing ratios on the composting process; Determine the amount of leachate produced per unit weight of food residuals; Evaluate odor levels based on ammonia and hydrogen sulfide concentrations; Meet EPA Part 503 temperature requirements to eliminate plant and human pathogens; and Determine air flow rates based on the amount of food residuals in the container composting system.

PROCESSING CAFETERIA RESIDUALS INTO COMPOST

The study involved all four of the university's cafeterias, which together serve 19,000 meals/day. Feedstocks included one week's worth of preconsumer and postconsumer food residuals and soiled paper, and ground yard trimmings added for carbon, moisture reduction and bulking. Food residuals were pulped at the cafeteria to reduce moisture content ten to 20 percent, resulting in an average of 71 percent moisture.

The materials were loaded into six Earth

Staff at University of Georgia examine feedstock ratios, odor levels, leachate, air flow rates and product quality as part of regional technical assistance program.

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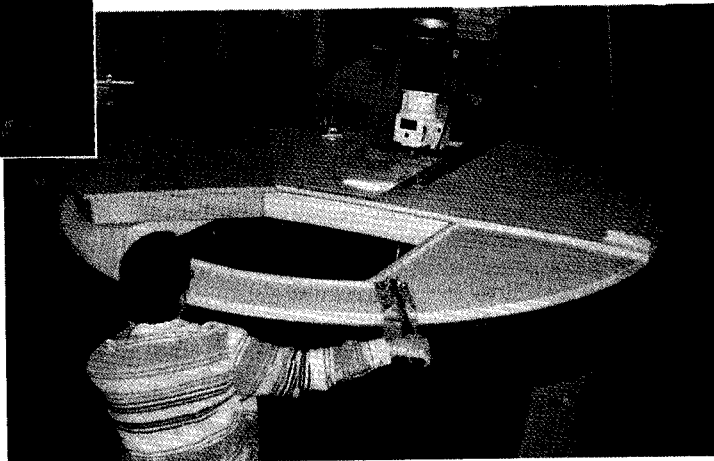
Compostables from University of Georgia cafeterias are tipped (inset) prior to loading in one of six 3.5-cubic yard in-vessel containers (right).

Tub in-vessel containers (manufactured by Green Mountain Technologies) that hold 3.5 cubic yards of material. A 2 HP vertically mounted, manually rotated auger mixed feedstocks as they were loaded through a hatch on the lid. Each container had an aeration system with a 10-watt blower to pull air through the compost from the top, then through a perforated floor chamber for release. The blowers were run continually at maximum power unless the compost seemed to dry too quickly, at which point they were turned off until moisture and temperature levels returned to optimum levels. The floor chamber collected leachate and discharged it through the blower aperture.

The containers were kept inside a building and measured for temperature every five minutes. Air velocity and air flow rates were measured from the center of the PVC pipe attached to the blower using a hot-wire anemometer. Following this, each pile was turned using the motorized auger. When moisture content fell below 40 percent, water was added during turning to bring the level up to 60 percent. Stable compost was achieved for all three mixture ratios after 73 days. Compost was then screened to remove contaminants.

RATIOS AND COMPOST QUALITY

Initially, three recipes were selected for investigation. These included volumetric mixing ratios of 1:1 (food residuals:yard trimmings), 2:1 and 1:2. The mixture ratios proved



PROFESSIONAL SERVICES

beneficial for varying situations. A 2:1 ratio of food residuals and paper to yard trimmings was optimum for waste reduction purposes, but ammonia and leachate problems were a concern. At times, high ammonia levels made working conditions uncomfortable, particularly with the 2:1 mixture. Ammonia concentrations peaked at 560 ppm, but decreased dramatically after the first month. There were no detectable levels of hydrogen sulfide. Leachate production ranged between one liter per 14 kg of food residuals to one liter per 27 kg. Most leachate was produced in the first week; all of it was generated in the first two weeks. A 1:2 mixture of food residuals to yard trimmings may be suitable if there is an abundance of yard trimmings and space; however, moisture contents must be monitored closely as this mixture tends to dry out quickly. As expected, this formula produced less leachate, ammonia and observable odor.

All treatments attained EPA standards of 55°C (131°F) for 72 hours. Temperatures fluctuated rapidly as moisture contents fell below 35 percent and when forced aeration was terminated. All three mixtures contained less than 1.5 percent (dry weight) total human-made inerts, meeting U.S. Composting Council recommendations for quality compost. The quarter-inch screened compost ranged from 0.4 to 0.6 percent contaminants and inerts. Generally, the more food residuals in the initial mixture, the higher the nutrient content in the finished compost. Soluble salt content positively correlated with the amount of food residuals, probably due to the high salt content of cafeteria foods.

Air flow rates decreased dramatically in the first two weeks — probably due to reduction in pore space from the initial breakdown of the feedstocks — and leveled off for the remainder of the study. Oxygen levels fluctuated between ambient (20.6 percent) and 18 percent throughout the trial. All treatments compacted at nearly the same rate. Weight reductions ranged from 75 to 80 percent (wet basis) and volume reductions ranged from 55 to 61 percent (wet basis).

AERATION AND PRODUCT QUALITY

More frequent turning may reduce the observable odor and amount of ammonia leaving the composting system, leading to a higher nitrogen content of the finished compost and less air pollution from volatilized nitrogen. Leachate recycling could reduce water amendments to each treatment. A variable speed aeration system may help to reduce drying of treatments and subsequent need for water additions. In conjunction, variable speed

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aeration may lead to less fluctuation of temperatures and thus a shorter period of time from start to stabilization. Based on a post-study sieve test, reducing the screen size from a quarter-inch to one-fifth-inch could lead to significantly lower final inerts analysis, in addition to an aesthetically superior finished compost.

FUTURE DIRECTION

A recent study at a Midwestern university found that the total cost in disposal fees for service waste at one cafeteria, including water, energy and sewer (but not tipping fees), was \$3,582/year. Based on 357 tons of food residuals at \$35/ton, annual tipping fee for UGA through composting would be \$12,500. This is in addition to savings from reduced expenditures in off-site hauling, compost and fertilizer purchasing, and water, energy and sewer fees. However, UGA would need 58 3.5-cubic yard containers to compost all of its food residuals on a continual basis. Since this would be cost and spatially prohibitive, other systems are being investigated.

Finished compost from the pilot study was land applied in roadside demonstration plots utilizing surface application and soil incorporation techniques at the Bioconversion Research and Education Center. Study results are being used to incorporate food residuals into the university's composting program, which processes yard trimmings and animal bedding in windrows.

UGA is developing a comprehensive food residuals compost program that will include demonstrations for industrial, commercial, institutional and residential waste generators. It is providing technical assistance to Organic Diversion Recycling and Creative Earth of Athens, Georgia in composting food residuals from nearly 40 restaurants, grocery stores, coffee shops, food processors, and local food banks. The university is providing outreach to area schools to develop a compost science curriculum and on-site composting of cafeteria food scraps. A demonstration and education site in Atlanta that incorporates community and industrial food residuals composting on an urban farm is almost complete. UGA has recently begun providing technical assistance to Emory University to begin composting campus cafeteria food residuals. ■

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