Compost Wizard

Computer technology makes windrow operation planning easier

Jason Governo

Waste management planners and engineers are often faced with the question of how much land, equipment, labor and investments are required for composting operations.

The numerous factors that impact this type of design make it tedious to formulate these assessments quickly. To address this situation, engineers at the University of Georgia have developed a user-friendly, spreadsheet-based computer program called the Compost Wizard©. This program helps waste managers, engineers and composters design windrow-composting operations.

Commercial-scale composting is a complex operation and a well-designed process is conducted in seven steps:

- feedstock recovery,
- feedstock preparation,
- composting,
- stabilization,
- curing,
- refining and
- storing.

The Compost Wizard takes these steps into account for designing the composting area, runoff collection pond and land treatment system for a windrow compost facility. The program uses critical user inputs such as amount of feedstocks, types of equipment, number of workers and facility location to develop preliminary composting process designs. Each variable has interrelated economic ties that the program uses to estimate the required startup capital and facility operational costs.

Using this tool, users can quickly vary inputs and generate design scenarios to address site-specific needs and conditions.

An owner's manual accompanies the program and provides examples to be used throughout the design process. This allows users less knowledgeable with the compost process to quickly and easily use the Compost Wizard.

The design process

The design process for a turned windrow composting facility involves: process design, sizing of the composting area, runoff collection pond, land treatment design for runoff, and capital and operating cost estimation. The Compost Wizard is written in design modules in spreadsheet form within Microsoft Excel® software. The design modules use inputs and previously calculated outputs for calculations.

Composting process design

Composting is a biological process for stabilizing organic waste materials and converting them into value-added products to be used in landscaping or agriculture. Compost Wizard requires the user to input available feedstock quantities, feedstock properties and target process conditions based on a continuous or batch operation scenario. The total daily throughput of a facility is calculated and the Compost Wizard user's manual provides tables that contain properties of commonly used feedstocks.

The compost pad is composed of a windrow area where the active composting process and turning occurs, a curing area where final product stabilization occurs and a

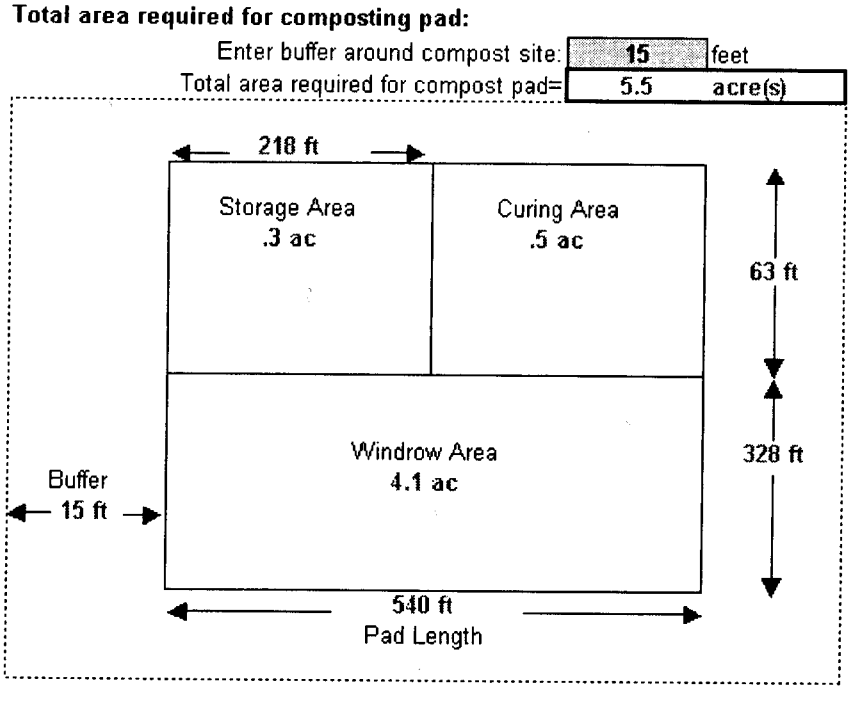

Figure 1. This example is a graphical layout that Compost Wizard presents for sizing a compost pad. Ensuring that the rows are properly sized and spaced helps facilitate degradation and product handling efficiency.

storage area for the marketable product. Within the windrow area, incoming material or feedstocks are mixed proportionally and placed in long triangular piles where they undergo controlled biological decomposition. The Compost Wizard accepts input on these windrows' height, width and length, process duration time and estimated volumetric material shrinkage. Using this information, the windrow volume, number of windrows, acres required and a graphical site layout are presented (see Figure 1).

At the end of the composting period, the material moves into the curing area where the compost is cured as specified by the user. Managers may choose not to physically move the material from one region of the pad to another. However, that material occupies space that cannot be used for other operations. The curing pad area size is based on the curing period and size of curing windrows. After curing, the windrows can be left in place or moved to another location for storage. A buffer zone around the compost pad is added for odor control. The more rural an area, the less buffer required.

Besides the engineering design of a composting facility, many non-engineering obstacles must be addressed before starting an operation.

Design criteria

In many states, depending on the type of feedstocks processed, regulations require surface runoff collection and treatment. For example, in Georgia, biosolids composting requires a retention pond with a capacity greater than the expected runoff from a 24-hour, 25-year rainfall event.

The Compost Wizard design criteria for sizing a retention pond is based on the highest monthly rainfall from a 30-year historical weather data set. Users select the geographical region of a state and the program references data for that region. To ensure a conservative design, runoff volume is calculated based on all water falling on the compost pad area being captured in the pond. The retention pond is then sized to collect this runoff amount with the user specifying the side slope angle, depth and pond surface length.

Various states require captured runoff water to be treated, which is often accomplished using land treatment systems. Land treatment systems apply captured runoff water to a designated area using agronomic application rates.

Land treatment design is dependent on site-specific, 30-year weather data for a location. The treatment acreage required is based on the hydraulic budget of soil or the nitrogen balance of the cover crop that consumes applied nutrients. The larger of the hydraulic budget and nitrogen balance areas is used to determine the required land area for treatment.

Capital and operating costs

The total cost of composting is the aggregate sum of the number of unit operations, type of equipment, number of employees and throughput of the operation. It can be difficult to correlate these factors collectively to determine the amount of startup capital needed to begin operation.

Compost Wizard allows the user to input wages for skilled and unskilled labor, equipment size, number of windrow turns per cycle and fuel, land, construction and insurance costs. The program also produces a cash flow statement using adjustable inputs for tipping fees, bulk product sales, interest rates and loan life.

Compost Wizard balances capital expenses, operational costs and revenue generation to produce a bottom line cost per ton dollar figure. This amount can be compared to other waste management options to determine if composting is economically feasible.

Compost as a business

Besides the engineering design of a composting facility, many non-engineering obstacles must be addressed before starting an operation. These obstacles include public perception, permitting, logistics, economic support, potential markets, marketing ability and land, feedstock, and skilled labor availability. Helping the user consider these factors is one of the program's goals.

Availability

To make the program available to a larger audience, 18 states with composting interests have been selected for distribution. They are: Arizona, California, Delaware, Florida, Georgia, Indiana, Iowa, Louisiana, Michigan, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Texas, Virginia and Washington. These states have been chosen based on their current composting infrastructure.

Calculations and requirements for the states are based on Georgia's current design requirements.

The new program will be available for purchase in fall 2001. **R**

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