After 40 years of successfully composting biosolids, Merrimack plans for the future

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ABSTRACT: Since the 1970s the town of Merrimack, New Hampshire, has been successfully managing the biosolids generated at the wastewater treatment facility through composting. The original aerated static pile system was replaced in 1994 with an enclosed agitated bed facility. After extensive evaluation of alternatives, including both landfill disposal and privatization of the composting operation, the town recently completed a major upgrade to the composting facility. The town’s investment in the continued operation of the composting facility was due in part to the compost marketing partnership with a third-party compost blender and marketer.

KEYWORDS: Biosolids, composting, compost, aerated static pile, agitated bed facility

INTRODUCTION
Biosolids management is a significant cost for wastewater treatment plants in New England. Whereas many municipalities transport and dispose of biosolids in regional landfills or incinerators, the town of Merrimack, New Hampshire, has composted its wastewater residuals into biosolids for more than 40 years as a commitment to biosolids beneficial use. Merrimack has a population of about 36,000, occupies an area of 32.6 square miles (84.4 square kilometers), and is located along the Merrimack River in southern New Hampshire. The town was selected as one of the top 25 places to live in the United States in 2013 by Money Magazine. At nearly 800 people per square mile (310 people per square kilometer) as one of the top 25 places to live in the United States in 2013, Merrimack is predominantly an urban-suburban community with a median household income of about $76,000 per year. This article describes the development of the composting program, changes to the composting technology, various studies and reviews over the years, and the commitment to continue with composting as the preferred option for managing biosolids. Over the years the town has developed a compost marketing program, which is also discussed below.

FACILITY DESCRIPTION
The Merrimack Wastewater Treatment Facility (WWTF) started operation in 1970 and underwent significant upgrades in 2007 and in 2013. The WWTF can treat 5.0 million gallons per day (mgd) (18.9 million liters per day [mL/d]) with an average flow of 1.8 mgd (6.8 mL/d). The Anheuser-Busch brewery generates about 35 percent of the flow and 76 percent of the total suspended solids (TSS) entering the plant. The liquid treatment process train includes an aerated sludge system with an anaerobic zone for enhanced biological phosphorous removal. A screw press produces a dewatered cake from a combination of primary and secondary solids, which are composted to meet Environmental Protection Agency Class A standards. The facility has received a number of awards, including ones for operations and maintenance, biosolids, and industrial pretreatment.

SOLIDS MANAGEMENT
The WWTF started composting in the 1970s with an aerated static pile (ASP) operation and upgraded to the in-vessel gated bed facility that began operations in 1974.

When the WWTF began operation, sludge was dewatered with vacuum filters and hauled to a lined lagoon next to the town’s landfill off Lawrence Road in Merrimack. The New Hampshire Department of Environmental Services (NHDES) required the town to close the lagoon and remove the accumulated sludge. The town used the ASP composting approach to stabilize the sludge and operated the ASP at the lagoon site from 1979 to 1981. With the ASP operation being evaluated as successful, composting operations were permanently relocated to the grounds of the WWTF after 1981.

At present, the Merrimack compost facility handles about 356,000 wet tons per year (WTPY; 800,000 wet tonnes/year) of dewatered biosolids at approximately 20 percent dry solids. About 3,600 WTPY (3,000 wet tonnes/year; 37 percent) are received from other treatment facilities in southern New Hampshire and northeastern Massachusetts.

AERATED STATIC PILE COMPOSTING
A pilot was initiated in 1976 using the ASP method pioneered by the United States Department of Agriculture (Beltsville, Maryland) and operated by Epstein et al. (1976). This approach consisted of mixing the dewatered sludge with wood chips (bulking agent) and placing the mixture of chips and sludge over perforated piping. Aeration blowers connected to the end of the pipe pulled air down through the mix. The odorous air was exhausted from the pile through a small scrubber, and as there was no treatment at the end of the pipe, the exhaust was released to the atmosphere.

The enclosed agitated bed facility offered a number of advantages over the ASP/III system: it captured and treated odors using biofiltration, it agitated bed composting used automated temperature monitoring to control operation of the aeration blowers, and it operated in a positive, controlling compost temperatures more precisely. Dryer compost was generated in a short period of time.

Operational facilities demonstrated the system’s ability to generate a consistent quality dry product that was marketable. Production of a consistent, marketable product was of importance to the town, which had historically struggled to distribute compost.

FACILITY DESIGN AND LAYOUT
The agitated bed composting system is modular with parallel, elongated bays. The compost mix is loaded into the front end of each bay and moved
down the bay with an automated agitator traveling on rails mounted on the bay walls. Figure 1 shows the arrangement of the agitators and bays. The Merrimack facility was constructed with 15 bays and three agitators. Each bay can receive about 1.4 cubic yards (yd³) (1.1 cubic meters (m³)) or “charge” of new compost mix following the agitation process. A charge contains approximately 6 yd³ (4.6 m³) ~ 4 tons (3.6 tonnes) of biosolids and 8 yd³ (6.1 m³) ~ 2 tons (1.8 tonnes) of wood shavings. Each bay is designed to be agitated five times per week (once each working day). After about a 21-day retention, the compost is discharged from the bays and transferred using a front-end loader to uncovered outdoor curing. Approximately 7 yd³ (5.5 m³) of compost are discharged from each bay with each agitation. Compost removed from the enclosed facility is cured outdoors in open windows for a minimum of 30 days. Paved areas previously used for the ASP operations now provide a location to cure, screen, and store compost. A wooden pole building also constructed for the original ASP facility store the bulking agent.

Temperature sensors (thermocouples) in the bay walls automatically monitor compost temperatures. The temperature data controls the aerator blowers that provide oxygen and cooling. The aerating system follows design principles from various research studies, including Kuter et al. (1986) and MacGregor et al. (1998), that demonstrate the importance of adequate aeration to control temperatures and achieve drying.

The moist and odorous air driven off the compost is contained within an enclosed structure and exhausted from the building using fans located outside of the facility (odorous air is passed through a biofilter to remove odors. The efficacy of simple biofilters to remove compost odors (largely mixtures of reduced sulfur compounds) has been demonstrated through testing at other agitated bed facilities (see Amirhot et al. 1995). The enclosed compost facility began operation in October 1994, using proprietary agitated bed equipment including agitators and computer control system.

**COMPOST MARKETING**

The agitated bed system allowed the town to avoid the use of wood chips as a bulking agent and use fine-textured wood shavings as an alternative. This substitution resulted in a finer-textured product compost that was screened to a ½ inch (15.9 millimeter) size to produce a uniformly textured product, increasing the product’s market value. Distribution and marketing of the compost was a concern for the town, so it entered into a compost marketing contract with a third-party compost blender and marketer. Except for some limited local sales, all compost is distributed through the third-party marketer in bulk. The local sales and give-away involves the town receiving mix following the agitation process. A charge contains approximately 6 yd³ (4.6 m³) ~ 4 tons (3.6 tonnes) of biosolids and 8 yd³ (6.1 m³) ~ 2 tons (1.8 tonnes) of wood shavings. Each bay is designed to be agitated five times per week (once each working day). After about a 21-day retention, the compost is discharged from the bays and transferred using a front-end loader to uncovered outdoor curing. Approximately 7 yd³ (5.5 m³) of compost are discharged from each bay with each agitation. Compost removed from the enclosed facility is cured outdoors in open windows for a minimum of 30 days. Paved areas previously used for the ASP operations now provide a location to cure, screen, and store compost. A wooden pole building also constructed for the original ASP facility store the bulking agent.

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emissions from composting compared to those from landfill disposal. The NEBRA study (Beecher 2009) concluded that the composting option generates significantly fewer GHG emissions than landfill disposal. Although composting has higher energy requirements than landfills, the latter method generates methane, a more potent GHG than carbon dioxide. Calculations indicated that future landfill disposal would emit 2.5 times more GHG equivalents than the current composting operation. With improved dewatering at the treatment plant factored in, the landfill option would generate 3.4 times more GHG than the composting option.

COMPOST FACILITY UPGRADES

Based on the 2008 review the town moved forward to renovate the compost facility at a cost of nearly $2.9 million. The project replaced the roof, computer control system, and compost agitators. The roof was a modified membrane roof with vapor barrier, with 1.5 inches (3.8 centimeters) of foam insulation under a rubber membrane. One-third of the roof (the front area where most moisture was generated), consisted of stainless steel under a hot dipped galvanized roof panels. The facility also received all new purlins, and all bolts were replaced on the main supporting members.

The town also replaced the original three agitators with two new machines. The original agitators had lasted more than 20 years, and the three 25-horsepower (hp) [18 kilowatt (kW)] agitators were replaced with two 50-hp (37-kW) agitators to process the same 15 bays in an eight-hour workday. This change saved the town a lot of money and opened space in the mixing area for better loader movement.

The facility renovations and installation of the new agitators were completed in the fall of 2013. The composting operations continued on a reduced schedule as the work was performed.

FUTURE FOR MERRIMACK

The town supported the investment in the renovations to the enclosed agitated bed composting facility. Warrant articles require a two-thirds affirmative vote with all-day voting one month after the traditional town meeting. This hurdle was easily cleared, indicating broad acceptance of composting. The town had, since the early 1980s, provided a giveaway program for residents, and that popular program was likely a factor in the successful vote.

The investment in the renovation underscores Merrimack’s long-term commitment to a composting program. This commitment has endured through changes in town staffing and successive public works directors and plant superintendents. Treatment plant staff have faced numerous operational challenges and embraced the attitude that they manufacture a valuable product and are not just treating wastes. Working with a private marketing company has enabled the town to maximize revenues from product sales and control its destiny. The town has also successfully taken on biosolids from other communities and runs the facility at near full capacity, thus operating with greater economic efficiency.

REFERENCES


ABOUT THE AUTHORS

- Geoffrey Kuter is chief executive officer of Agresource Inc. Prior to his position at Agsource, he was vice president at Wheelabrator and part of the team responsible for the design and start-up of the Merrimack agitated bed composting facility.
- Richard Nicoletti is the compost system manager for BDP Industries. Prior to joining BDP in 2013, he was with IPS Composting Systems for nearly 20 years and has been responsible for the design and installation of more than 20 agitated bed facilities. He was involved with the supply of the equipment used in the renovation of the Merrimack Composting Facility in 2014.
- James Taylor is assistant director of public works/wastewater with the town of Merrimack. He has been actively involved with the operation of the treatment plant and the biosolids management for more than 35 years.
- Leo Gaudette is chief operator at the Merrimack wastewater treatment facility and has been with the town of Merrimack since 2006. His responsibilities include operations of the composting program and the wastewater plant.