

Controlling Odors at Composting Facilities

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WHILE composting transforms organic residuals into useful fertilizer, it also can produce odors during the decomposition process - an observation well known to many veteran managers and plant operators. Problems arise particularly when neighbors live close to working sites. That reality makes those operating in more isolated locations fortunate, especially when potentially odorous feedstocks are being processed.

We were reminded about the advantages of isolated sites from recent communications with Mike Tabor, landfill manager for Seward County, Kansas, who has been processing paunch waste at his composting site since 2002. "National Beef Packing Company wanted us to help them save money on their paunch waste disposal," explains Tabor. Paunch is the undigested contents of a cow's stomach removed during the slaughter process. The company had been trucking the material to Texas for rendering at an "astronomical cost." To compost the paunch, Tabor was advised to add another feedstock or manure. Continues Tabor:

"We finally arrived at a figure with National that would save them money and pay for our composting costs. The Kansas Department of Health and Environment (KDHE) gave us a temporary permit to compost 30 tons/day (tpd) for six months, along with a grant to buy a tractor and an Aeromaster turner."

The pilot was successful and the landfill started taking 130 tpd from National. Tests were done adding cornstalks and manure to the paunch (as it turned out, the paunch is composted without any amendment). The finished material was sent to Woods End Research Laboratory for analysis, and eventually was certified as a garden mulch and topsoil compost. "In late 2004, the compost was tried as topsoil in the vegetative layer of a new landfill closure design. Instead of having to buy a material offsite for closure use, we now had our source. This makes our compost operation very financially stable. And we continue to market to the public. National is delivering a little over 200 tpd of paunch. We just built a new 15-acre composting pad, have purchased a second Aeromaster turner and a used compost spreader, and have two full-time personnel running the operation with assistance from other employees as needed."

To date, odor generation as a result of processing paunch waste has not been an issue for the county landfill. "The site is isolated and prevailing winds take any odors in a direction away from the closest neighbors," says Tabor. "Also, once piles are turned and aerated, potentially troublesome odors are dissipated."

WHEN NEIGHBORS ARE NEAR...

The Woodhue/Eastern Organics Resources (Woodhue/EOR) composting facility in Wrightstown, New Jersey is bordered by a military base on several sides, and farm neighbors on the other. When the site first opened, it primarily composted leaves and yard trimmings. Gradually, it started adding other feedstocks, including water treatment plant sludge, food processing residuals (e.g., from cranberry operations) and preconsumer vegetative materials. Over the past several years, Woodhue/EOR has been servicing a growing number of supermarkets and other commercial

generators (e.g., salad processors) and the amount of food residuals being processed grew to about 200 tpd.

In the spring of 2004, odors from the facility became a concern to a neighborhood near the site. Complaints were called into a county office, and received by the New Jersey Department of Environmental Protection (NJDEP) as well. "The problem was caused by several factors," says David Goodemote, president of Woodhue/EOR. "The windrow turner that we had bought that could accommodate large-scale windrows was breaking down, which meant we couldn't turn the piles at the frequency we needed. Also, our composting recipe was not carbon-rich enough. These factors led to an excess of leachate generation and a fairly consistent anaerobic condition in the piles. The leachate had a very low pH and we were finding that organic acids were the biggest contributor to odor generation." Under certain meteorological conditions, temperature inversions would create a "mushroom cloud" effect of odors that would migrate off site.

Operators tried using water-borne sprays and vapors that contained essential plant oils and surfactants. "The waterborne sprays didn't capture any odor compounds and the essential oils were determined to have a disinfectant smell that the neighbors registered complaints about," says Goodemote. Because of the odor situation, he decided to divert food residuals from the facility for 60 days. During that time, Woodhue/EOR was able to make a number of changes that appear to have solved the odor challenges.

Among the solutions was identifying an odor control product that was effective for the feedstocks and composting process. "We found an enzyme-based product that breaks down more complex odor-causing organic molecules that are better available to microorganisms to degrade," he adds. Woodhue/EOR purchases the enzymes from Enzymatic Odor Solutions in Pembroke Pines, Florida. They are applied via a spray nozzle attached to the Backhus windrow turner. Windrows are turned two to three times a week; enzymes are sprayed as the materials are mixed; a surface layer is applied as the turner goes back across the windrow (without agitating).

The C:N ratio of the initial mix was modified. "We revised our recipes tremendously," notes Goodemote. "We use a combination of leaves, sawdust, wood chips, pulp and paper residuals, waxed cardboard and paper. The recipe takes into account the C:N ratios for all the materials being mixed based on density and moisture content. With good C:N ratios and turning two to three times a week, there is very little leachate generation and the end product is much less dense. So we are making more compost per pound of food waste than we were before."

During the 60-day period, Woodhue/EOR diverted food residuals it had contracted to collect to farmers and animal feed operations. Other site improvements included adding a leachate treatment system comprised of a series of four cells of artificial wetlands (1.5 acres in total) and an improved composting pad. "Another problem with the bulk density of the compost before we made improvements was that we were operating on a sand-based surface," he says. "That also led to ruts in the pad that would accumulate leachate. We decided to go back to our original concrete rubble base, and then added about 1.5 to 2-feet of clay that was available on-site. An 18-inch layer of process concrete (2-inch minus) and slag was put on top of the clay layer and then compacted, creating a hard surface that drains well. The liquid drains into the artificial wetlands."

While site improvements continue, Goodemote says that odor generation has been minimized, and that NJDEP has had a very positive reaction overall. The company is

planning to add an initial in-vessel composting stage, which will further aid in odor management - and allow the site to receive postconsumer food residuals.

VAPOR PHASE APPROACH

More stringent regulations on composting facilities in Japan has led to more enclosed operations, writes Yoshihiro Taniguchi of EcoRo Japan Co. Ltd. "Therefore, counter measures to manage odors are necessary and indispensable," he notes. Taniguchi's company has installed the Ecosorb vaporizing technology in an enclosed composting facility using agitated bay equipment. A PVC pipe distribution system was installed on the ceiling of the composting building. The Ecosorb product - a proprietary blend of essential plant oils, food grade emulsifier and water - is atomized and essentially "misted" in a vapor form over the top of the bay, creating an "air curtain" that traps and neutralizes the odor compounds, explains Taniguchi. "This odor control method has been very effective in composting facilities in Japan."

Tom Minett of OMI Industries, which markets the Ecosorb system, explains the vaporizer is similar in operation to an ultrasonic humidifier. "The liquid is brought into a very fine droplet size, then we use a large blower - from 450 cfm up to 1,200 cfm - to shoot the droplets down a 6-inch PVC pipe that runs the length of the composting area or on an outdoor site's perimeter. The holes in the pipe are sized so that the hole closest to the fan, as well as those furthest away, are blowing out the same amount of vapor at each point. The vapor comes in contact with the odor and chemically reacts with the compound. The amount of odor neutralizer used in an application depends on the intensity of the odor, for example hydrogen sulfide versus ammonia."

In addition to products like enzymes and neutralizers, odor control specialists in Norway have found that lime can reduce emissions of acidic compounds as well as "decrease the microorganisms responsible for odors in collected organics." According to their observations, VOC emissions have been reduced significantly, and the lime is especially relevant when the feedstock is rich in fats and proteins.

QUANTIFYING COMPOST ODORS

Equally important to treating odors is having quantifiable data on their strength and character. Traditionally, the only way to evaluate odor compounds was to take air samples at a composting site and then transport the sealed bags to a laboratory for analysis. More recently, field olfactometers have become commercially available, using a technology that was developed in the late 1950s by the U.S. Public Health Service. These hand-held units have made it possible to respond more quickly to odor complaints received at composting sites. "A field olfactometer creates a series of dilutions by mixing the odorous ambient air with odor-free (carbon-filtered) air," explains Michael McGinley of St. Croix Sensory in Lake Elmo, Minnesota, which markets the units as well as operates an odor analysis lab. "The dilution factor is defined as dilution to threshold, or D/T. The D/T ratio is a measure of the number of dilutions needed to make the odorous ambient air nondetectable. We produce D/T ratios with a field olfactometer by mixing two volumes of carbon-filtered air with specific volumes of odorous ambient air. Increasingly, facility operators, community inspectors and site neighbors can measure odor strength at a specific location around a facility's property line and within the community using a hand-held unit like ours."

Figure 1 is an example of a community map that illustrates the basic community features, which in this example include commercial and residential areas, a factory, wastewater treatment plant and park. An odor monitoring route is determined

using this map. Explains McGinley: "The odor monitoring route is the path that the odor observers follow as they carry out their observation activities. The route needs to include a list of each odor monitoring location, details of each location (including GPS coordinates if possible) and a location code number (see numbers inside the circle on Figure 1). An odor monitoring program will have standard data collection forms prepared in a format that is convenient to use by the observer and easy to read by others."

Figure 2 is an example of an odor monitoring data collection form using the map in Figure 1. "Part 1 of the form lists the observation locations with columns for the strength measurement (D/T in this example), odor descriptors, and additional observational comments," says McGinley. "Part 2 is the weather conditions information that includes sky conditions, precipitation, wind direction, wind speed, temperature, relative humidity and barometric pressure. Part 3 includes additional space for observational comments and the observer's name, signature and code number, if used by the odor monitoring program."

In the September 2004 issue of BioCycle ("Odor Management Strategy Meets Neighbor Approval"), Leland Myers of the Central Davis Sewer District in Kaysville, Utah wrote about his facility's use of St. Croix's Nasal Ranger as part of an odor complaint response and monitoring program. The field olfactometer is used to measure odor strength in D/T. The District also purchased a Jerome 621-X-H₂S analyzer to detect and measure hydrogen sulfide, a primary odor compound associated with wastewater treatment. Using both instruments to measure off-site migration from the District's composting site helps quantify more accurately the extent of an odor problem, especially when complaints are being registered.

Another example is included in a technical paper written by McGinley and his father, Charles McGinley, for a U.S. Composting Council meeting. It involves an odor assessment done at the City of Edmonton, Alberta's cocomposting plant. The Edmonton Waste Management Center includes a landfill, landfill gas treatment, leachate treatment, sludge storage lagoons, a composting facility processing biosolids and mixed MSW and a solid waste recycling facility. In addition, the Center is surrounded by a variety of industries including three chemical plants, two asphalt plants, three feed mills, a rendering plant, a mushroom farm, a chicken farm and a sewage treatment plant.

In 1997, write the McGinleys, the City of Edmonton developed a program to objectively monitor odors in the surrounding community. The odor monitoring program consisted of training city odor inspectors, recruiting citizen odor observers, developing a standard odor survey route, preparing standard odor survey forms, and analyzing/reporting the odor monitoring data. The monitoring program focused on 25 potential odor sources and established 21 odor monitoring locations as part of the routine odor survey route. A standard map was selected for locating the potential odor sources and each of the monitoring locations. All data was collected on a standard "Inspector Log Form." The city odor inspectors conducted odor observations at least once per day during 1997 and 1998 and again during the years 2000 to 2003. Significant conclusions of the study, note the McGinleys, include: "Sources with the highest frequency of odor detection were the biosolids lagoons, composting facility, large chemical plant, feed mills and the mushroom farm; Sources with the highest average odor strength were the biosolids lagoons, asphalt plant and mushroom farm; Some sources caused high strength odors that only impacted a local area, while other sources caused low strength odors that impacted a large area of the community; There was limited correlation between weather conditions and frequency or strength of odor; The odor monitoring

program provided a comprehensive inventory of odor sources and the odor descriptors of each source.”

SOME PARTING ADVICE

Much has been learned about odor management at composting facilities over many years. The following are a few tried and true lessons learned:

Managing Feedstocks - Place moist feedstocks, particularly food residuals and grass clippings, into the mix before they start to decompose. Make sure moisture content is optimal, so no anaerobic pockets are formed which can become a source of nitrogen and sulfur odors. Keep piles well aerated, using enough coarse textured amendment. Each feedstock has a characteristic odor potential, which tends to be released or intensified when decomposing commences. Highly degradable materials should be mixed with slowly degradable feedstocks to get a mix that degrades at a moderate pace.

pH Monitoring - The pH is a key factor with nitrogenous feedstocks, like manures and biosolids which have a naturally high pH. When it's above 8, N compounds are more readily driven off as ammonia during the initial two to four days of composting. If pH is kept below 7.5, that does not generally happen. One to two percent by weight of alum, agricultural grade gypsum or sulfur will provide a short term depression of pH.

Emissions from Conveyors - Cover conveyor belts with hoods and install water misters at hood ends and drop points to “entrain” odors. Add misters on the uphill outlet side of the conveyors because warm odor laden air mostly travels uphill.

Using Aerated Static Piles - Because of forced aeration, the aerated static pile (ASP) method can offer better process control and more opportunities to manage odors. Lack of physical agitation during active composting limits the release of odors, believe some operators, but it also presents some difficulties for managing the process (e.g., adding water) that can lead to odor generation.

Some suggested preventive measures include: Keep the base layer of wood chips moist so composting is active to remediate odors; Limit initial pile depth since deep piles are more difficult to aerate; A wood chip layer on the pile filters odors; Remix or agitate ASP at least once and add moisture, if necessary; Use negative aeration since it makes it easier to capture exhaust air and treat it in a biofilter. If necessary, switch to positive aeration in later stages when odor generation has subsided.

Value of Biofilters - In a recent report in *Compost Science & Utilization*, K.J. Park, M.H. Choi and J.H. Kong of the Agricultural Machinery Engineering Department at Sunchon National University in Korea investigated the efficiency of using biofiltration as a control method for odors from a mix of cattle manure and other feedstocks. They used fresh compost in their biofilter to reduce ammonia emissions. Based on results, they concluded that “ammonia generated during the composting process can be managed with a compost biofilter.” Moisture content of biofilter material increased from the exhaust gas, while pH decreased due to degradation of nitrogenous compounds. As a bonus, they found that the fresh compost used as a medium improved in quality in terms of its nitrogen content.

ODOR MANAGEMENT ADVICE FROM THE EXPERTS

A SPECIAL guidebook about the generation of odors, their public perception, and a number of techniques to control odors before they become troublesome has been prepared by the editorial staff of BioCycle. The title is Odor Management at Composting Facilities.

The book contains detailed information on designing and using biofilters, feedstock management, data on temperature and moisture, selecting the right composting method for the feedstock which you are handling. The price is \$45. You can order a copy of Odor Management at Composting Facilities by calling (610) 967-4135 or e-mailing: biocycle@jgpress.com. Fax is (610) 967-1345. (Please include your credit card details when ordering.)