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information on Bio-Hygienic's

MSW Management

Great American Thinkers

Conquer Compost Odor

Henry David Thoreau once said, "There is no odor so bad as that which arises from goodness tainted." Apparently there was as much goodness-tainting going on near the nineteenth century naturalist's cabin on Walden Pond as there is at composting facilities worldwide, which generate less eloquent complaints.

By Lori Lovely

With all that goodness gone bad, it's surprising Thoreau didn't title his book "Walden Pong." The complex study of odors has determined that the human olfactory system can detect thousands of scents based on minute airborne concentrations of dissolved chemicals and gases, and recognizes that psychological factors play a role in perception.

In 2002, a Penn State team of environmental engineers developed an Odor Index, a standardized, instrument-based process to quantify the odor of air samples and identify the offending chemical components. Because most odor problems originate from airborne or surface contaminants—like bacteria and fungus growth, spores, and chemical fumes—a genuine health threat accompanies odors. Air contaminants can be a major source of respiratory diseases. Therefore, odor control remains one of the most significant challenges for composting facilities today.

Assessing the Problem

The challenge is so daunting that many composting facilities have closed as a result of odor problems or been forced to undergo expensive redesigns, according to Calvin Pride, president of Ambio Biofiltration Ltd., Rockland, ONT. "The potential for odor comes from three things," says Tim O'Neill, president and founder of Engineered Compost Systems in Seattle, WA. "Material-receiving, primary composting, and curing. Odors from each has caused facilities to close or get sued."

To be truly effective, an odor-control system should be an integral part of the planning and design of a composting facility. However, all too often, “odor is an after-thought in building these facilities,” Pride says. “They worry about the composting process, but don’t allocate funds to control odors.”

Ian Howard, vice president of Toronto-based Ecolo Odor Control Systems Worldwide, disagrees, believing that the proximity of less-tolerant populations, increased market size, and improved technology have led facilities to include odor control in their budgets. “This business is fueled by complaints. By being proactive, you can avoid many problems.”

Although most regulations at the state and federal level don’t require odor control (only eight states currently have numerical standards for odor control), according to Ed Repa, environmental programs director for the Environmental Industry Associations, Pride has encountered some states and provinces that are very strict on odor. “Prince Edward Island’s Number 1 priority is ‘no odor.’ Their Number 2 priority is that the composting works. California is also very tough.”

No matter how strict or lax the regulations, facilities must respond to neighbor complaints, which is when odor control frequently begins. Thanks to urban sprawl, homes and businesses are reaching even formerly remote facilities, generating more complaints. In addition, because of the need to conserve landfill space, compost operations are springing up in congested urban areas.

While some facility managers might grumble about what they believe are unreasonable complaints from overly sensitive synesthetes suffering from parosmia (a distorted sense of sensation, often resulting in phantom, non-existent, and mostly unpleasant smells) actual health concerns can accompany odiferous situations. “Ammonia is a byproduct of composting,” explains Pride. “If you can smell it, it’s a problem for your health.” For employees, he recommends protective masks and frequent air changes, but that does little to stem the threat to nearby residents, particularly those with asthma or chemical sensitivity. Dr. Sam Sofer, president of Air & Water Solutions Inc. in New Jersey, elevates the concern to one of national security, raising issues such as avian flu. “There’s always going to be trash, and in the future there will be more trash. It’s a point of vulnerability for air contamination.”

Solutions Start With What Not to Do

Thoreau posed the question, “Of all ebriosity, who does not prefer to be intoxicated by the air he breathes?” Some argue that no one should be intoxicated by masking agents, which attempt to cover up—rather than remove—

odors. As Pride summarizes it, “If you spray perfume in a pig barn, all you get is a stinky, perfumed pig. Masking tries to hide odors with something more compounds into the air, increasing the health risk. Pride suggests that the only way to get rid of odor is to break down or trap the compounds that cause it.

Traditional methods of odor control include chemical scrubbers and biofilters, but Pride insists that the best odor treatment is prevention. “If composting is done right, the odor is not that offensive.” Good housekeeping is imperative, he insists. The facility needs to be kept clean to retard the growth of bacteria. Pride says he’s familiar with two well-run facilities in Toronto that have no odor problems and are so clean, “you can almost eat off the floor.” It’s a management issue facing all facilities. In addition to good housekeeping, O’Neill says, “you need operators who know something and give a damn.” But Pride says that’s difficult, “because it’s hard to make money in this business, most facilities operate on small margins, so they pay low wages. The quality of the people is not always good.”

Cost is an overriding issue. The choice of system—or systems—shoulddepend on factors such as the type of organic materials, the environment and level of environmental control, and the facility’s footprint requirement and space. But as O’Neill says, it’s usually “bottom-line driven, especially as transportation and landfill costs escalate.” Ultimately, Pride says, somehow you have to minimize odor generation and maintain a good system to treat the inevitable odors.

Bio-Filtration

“A bio-filter is the only economical way to reduce smelly air,” Pride claims. It’s cheaper, he explains, because there’s “not a lot of overhead, the capital cost is minimal and energy requirements are low.” In addition, maintenance costs are insignificant because the system requires little more than greasing the fan bearings and changing the filter material every five years, depending on the application. And because it uses no chemicals, it can save 5% to 10% of operational costs compared to other systems: no shipment, storage, or pumps. Low cost and high efficiency combine to make bio-filtration the most commonly used odor-control technology.

With a bio-filtration system, odorous air is directed through a series of perforated pipes laid in a bed of gravel covered with organic media—typically wood chips, mulch, and cured compost. As air filters through the media, odorous compounds are removed by physical, chemical, and biological processes as naturally occurring microorganisms break down and eliminate offending gases in an environmentally safe process.

Ambio is the only Canadian company involved exclusively with bio-filtration, with technology imported from Germany, where Pride says a compost facility can’t be built without a biofilter. However, just as Thoreau contributed to continuing

education, so, too, has Pride, by improving on European technology through links with German researchers and engineers. One of Pride's "little tricks" to keep odor from escaping up side walls is to build an air plenum, over which he drapes filter material. "It's cheaper because you don't need concrete side walls," he says, "and it works better."

One of the potential downfalls of bio-filtration is the tendency of the media to dry out. Pride cautions against homemade biofilters that skip the humidification step to save money. "Bacteria need to be moist to live; the air has to have 100% humidity. If you skip this step, or just sprinkle the beds, the beds dry out and no odor removal occurs. You can't cut corners."

He uses MicroCool devices to humidify the air. The Thousand Palms, CA-company produces high-tech fogging systems. "Microorganisms like humidity," explains MicroCool's Jim Murphy. "We humidify air, which helps destroy more odors in a bio-filtration system." He describes his company's specialty as the elimination of fugitive dust and the alleviation of malodors in municipal waste transfer stations. "It's all about placement and configuration."

It's also about 10-micron droplets of odor control chemicals evenly distributed by a grid of high-pressure swivel nozzles installed at the point source emission of odor and dust problems or around the perimeter of a facility. Wind sensors and controllers incorporated into landfill applications can introduce an economy cycle to reduce operation time—and cost—of the system.

After the Dust Clears

Chemical wet scrubbing—which dissolves odorants into a liquid phase, then removes odorous compounds from the air through the absorptive and oxidative capacity of chemical solutions—has made significant advances in recent years, although it continues to suffer drawbacks, such as difficulty maintaining effective chemical feed rates, creation of chlorinous odors in the treated effluent, and plugged nozzles and filters. Other issues involve chemical handling hazards; potential release of halocarbons into the environment as a result of the chemical reaction of chlorinated water with odorous gases; production of chlorine gas by some chemicals; high dosages required for effectiveness of some chemicals; long reaction time of certain chemicals; and higher pumping expense. On the other hand, chemical systems require less space than biofilters.

The typical system consists of centrifugal dust collectors, followed by scrubbers. Dust suppression constitutes the bulk of MistAMERICA's business; the Scottsdale, AZ, company is new to odor control. Originator of the 316L stainless steel mist/fog system, MistAMERICA was the first to use surgical-grade stainless steel atomizing nozzles, claims founder and president Jon Marsh. The company produces custom-designed high-pressure mist/fog systems with fans to disperse the fog, although Marsh says the equipment hasn't changed much—it's the control systems that have become more sophisticated as technology advances.

MistAMERICA has performed installations worldwide, including a recent transfer station in nearby Phoenix. He jokes that Scottsdale has an innate form of odor control: dryness. However, when it rains and it's hot, "it smells!" Since Scottsdale doesn't want odor in its posh neighborhoods, Marsh's business is growing fast. "Every transfer station open to the outdoors will have a problem with odor. This is a litigious society, so municipalities are performing due diligence."

Another relative newcomer to the dust business is Dust & Odor Control Technology in Peoria, IL. About a year ago, founder and president Edwin Peterson introduced a patent-pending system, the DustBoss, a portable, automatic, oscillating ducted fan incorporating a high-pressure misting system. Peterson claims the benefits of his system include fast payback (typically under one year); fuel savings because it puts less water on the material than hoses do, so material is lighter and tipping fees are less; safety, due to elimination of puddles; improved working environment, due to lower temperatures resulting from the flash effects; better air quality; better coverage; flexibility and fewer installation costs because it's portable; and reduced labor costs.

Kevin Tritz, site supervisor at an NRG Processing Solutions LLC transfer station in Bloomington, MN, says the DustBoss solved his problems with over-saturation, the expense of an employee watering with a fire hose, and the dust cloud that hung in his enclosed building. "We're no longer wasting four to six man-hours per day, 250 days per year, to keep the dust down. Also, we don't need to change the air filters on our wheel loader and other heavy equipment as often."

Peterson says feedback has been so positive, his system is becoming standard with transfer stations and demolition companies. He's even spoken with FEMA about sending units to help with the cleanup in New Orleans, explaining that anti-bacterial chemicals can cover an area of 25,000 square feet.

Getting Misty

There are several technologies available if you're using chemicals, says Bruce Latta, director of marketing for Deerfield Beach, FL's Fogmaster Corp. But with high-pressure systems, expect the nozzles to clog and wear out—and don't be surprised about high installation costs. Conversely, mechanical foggers produce small droplets by turbulent air shear in the fogging nozzle. The typical air source is a high-velocity fan, usually integrated with the fogging nozzle as a stand-alone component. Liquid pressures are low and, since nozzles have no small orifices, plugging is usually not a problem.

Fogmaster manufactures several hand-held and drum-mounted units, as well as Sentinel II modular fog heads for permanent installation. These mechanical, or cold, foggers create 7-micron droplets that Latta says are so small, they act more like a gas than a spray, able to "float around until they find an odor to stick onto. That's the issue: get the mist to where the odor is and make it hang for a while."

Other advantages include ease of use; low maintenance; low up-front cost; and the fact that the systems aren't particular about the water supply. Latta says they can be hooked up to a garden hose. They have humidistats, and some units have sensors and computer systems for automated operation. The downside, he confesses, is that they require electricity and they're easy to run over. But basically, Latta says, "we made these units for customers who want a 'bullet-proof' option so their employees couldn't screw it up. The only thing they have to figure out is the right mixture."

Understand how the chemicals work and react with the equipment, he urges. Although Fogmaster uses fuel-grade stainless steel tubing, some chemicals eat up the foggers.

Chemical Warfare

Incorporating the "three S" plan of system, solution, and service—Ecolodesigned a system specifically to work with its chemical solutions—a range of more than 50 formulations for odors and gases because, as Howard explains, "no one solution can eliminate all odors."

All of Ecolo's solutions are environmentally friendly, nontoxic, biodegradable odor-neutralizers derived from essential oils from plant extracts custom-blended for specific odors, and are competitively priced, Howard says. In the vein of Thoreau, Ecolo's staff of engineers and chemists, including Nadia Gondick, believe that ongoing research and development are very important. "It's the key to continuing to evolve," she says, adding that the best way to test new products is to test onsite. "It's our policy to use our customers to test new products."

A new solution for composting, No. 9149, is most effective when misted above and adjacent to the windrow, but may also be sprayed from the windrow turner or a portable system. At contained facilities, it can be sprayed into the exhaust ventilation or from a ceiling-mounted system. Tested in the lab and at municipal compost sites, No. 9149 reduced odor, ammonia, and other gases.

Another chemical compound that has been proven safe for humans, animals, and the environment, passing all EPA testing, is a proprietary blend of essential plant oils and water known as Ecosorb Natural Organic Odor Neutralizer. Produced by OMI Industries of Barrington, IL, it's a broad-spectrum odor neutralizer that's effective against both organic and inorganic malodors.

Applied via atomization systems into the air, the mixture forms a thin film over the droplets, creating an electrostatic charge that facilitates the adsorption of malodor molecules onto the surface, followed by absorption into the droplet (solubility).

"It works in three phases," explains Tom Minett, OMI's national sales manager. "The odor goes away when it's solubilized into droplets. That's an instant, on-

contact odor elimination. Second, a chemical reaction occurs with the majority of gases that instantly react with the mixture, forming an organo-sulfur molecule. The hydrogen and sulfur break, leaving ammonia salt and chlorine salt. Third is biodegradation. It doesn't chemically react with all gases, like benzene gas, but it still improves solubility by 250 times. Then it 'rains' onto the ground for cleanup or biodegradation."

Ecosorb can be used with most types of equipment in diverse applications, including fogging, scrubbing, dropping, and injecting. Minett says it's effective in windrow operations. "It runs off a 12-volt system that can be attached to a tractor. You place the atomization bar at a 45-degree angle and atomize over the back end of a windrow turner. It captures the gas immediately." He says it also works on high-pressure perimeter-wall misting systems.

"It's a dream product," Minett claims. "It's absolutely low-cost; it outshines the performance of other systems; it's 100% effective; and it's usable in so many industries."

Bio-Hygienics

Some facility managers don't like to spray chemicals because it increases the loading in the air, according to Sofer, and because they don't like to haul barrels of chemicals around. The bio-engineer and former professor points out that because there are some solvents carbon doesn't absorb, such as methanol and alcohol, biofilters can't do the job alone either. Those are just some of the reasons he insists that the future of odor control has to be bio-hygienics.

Bio-hygienics is the application of compact treatment plants utilizing bio-oxidation to completely destroy gases, volatile organic compounds and odors, and to remove particulates. Venting cannot capture odors and particulates; they are electrically charged and their motion is controlled by electrical fields, not by air flow. Airborne contaminants are first captured and subsequently digested biologically. "It's the only air-cleaning technology that handles airborne particulates, VOCs, and gases."

Clean Air Plants are stand-alone bio-oxidizers that provide internal air-mixing and capture particulates by attracting them to a clean air zone, where charged particles are removed by electrical grounding, and organic compounds are oxidized. Bio-oxidation is a sustainable technology that doesn't require elevated temperatures or pressures.

Other advantages Sofer lists include lower maintenance costs, because it doesn't use a big motor and no carbon beds have to be changed; capital investment is one-third less than other systems; the facility's floor and roof last longer, because gases aren't rotting and rusting them; it adapts to indoor and outdoor applications; and it's safer for workers. "For every 10% improvement in air quality, there's 1% improvement in worker productivity." Not to mention that one

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in 50 workers experiences chemical sensitivity, and that workers breathe in particulates, diesel fumes, paper and plastic fibers created by the bursting of trash bags, and what Sofer calls “trash juice”—the anaerobic substance sprayed into the air as bags are crushed—all of which can be avoided with Air & Water Solutions’ advanced bio-filtration systems.

“The secret is breakthrough immobilization technology that brings the power of enzymes and microorganisms to the small user,” Sofer explains. “Cleaning enzymes capture and kill non-pathogenic microorganisms, getting the germs out of the air. It’s a new way of odor control, a new mechanism, a new way of thinking. People don’t know it exists, but it uses so much less energy and fewer chemicals. It removes liability and it’s good for the neighborhood. It’s future technology that saves money.”

Contained

Jesse White, president of Resource Management Group Inc., in Sarasota, FL, received a grant from the Department of Environmental Protection to explore food-waste composting options. After analyzing different technologies, and keeping in mind state regulations, White opted to contain the waste and odors with the Ag-Bag. Available in two sizes up to 200 feet in length, round or square, the plastic silage bags offer oxygen-free storage. White says the equipment looks like a giant sausage-stuffing machine.

He mixed green waste with the food waste to increase moisture and balance the porosity. “We laid pipe, sealed the bed, and pumped air through the pipe to keep it aerobic,” White enumerates. “The purpose was to encapsulate the waste so it wasn’t exposed to the environment. You could say we were protecting the environment from the compost, and vice versa.”

A more costly solution than a windrow system, the Ag-Bag also creates additional waste; the bags are not usually recycled because they would introduce plastic into the system.

Although odors were “very minimal,” the Ag-Bag experiment was flawed. It didn’t completely encapsulate the waste. “Birds were attracted to the plastic,” White muses. “They pecked minor vector holes in it, but there were no major breaches.” Another downfall was incomplete decomposition. White solved that by incorporating a second-stage windrow operation. “It’s still a viable alternative to having the entire site paved with leachate.”

There were additional operational challenges, White confesses. Ideally, the bags should be placed on a hard surface: Soil Cement or asphalt. But this project, conducted within the cell of a landfill, rested on 2–3 feet of yard waste. “Initially it provided a firm base, but six to eight months later, the yard waste began to decompose, and our surface deteriorated.” White also notes that, during the

experiment, Florida was subjected to two 100-year storms that compromised the integrity of the mulch base.

“In-vessel always provides the best odor control,” claims O’Neill. Within the industry, he explains, in-vessel signifies the volume is completely enclosed. The goal is to achieve low head space, with only a few feet between the roof and the top of the pile. “No one goes in once it’s filled.” In addition to that safety aspect, this design provides more uniform temperature.

Site-built stationary or modular vessels with automated aeration controls are selected based on an analysis of performance requirements and assessment of risk factors such as capital costs and impact on the facility’s footprint. Vessels may cost more than an aeration floor in an open building, but because a smaller building is all that’s needed, construction costs are reduced. “The more air volume you own in a building, the more it costs to ventilate.” High-tech coatings aren’t required

But an additional step is required. At a facility under construction in Mariposa County, CA, where 14,600 tons of unsorted MSW from the county and Yosemite National Park will be processed annually, a turnkey, in-vessel compost system is being installed. After manual floor separation, mechanical bag-breaking, and debris roll-screening, the compost fraction will be blended with amendments before being conveyed to the in-vessel composting hallway. After 16 days, the biomass will be further stabilized on an Engineered Compost Systems aerate static pile system (ECS ASP). “A good mix and control of temperature and oxygen levels not only limit odor generation, but also make for quicker composting,” explains O’Neill.

Simply put, O’Neill combines high-value component development with integration of commodity technologies to design custom compost systems specific to client needs. Thoreau, an experienced botanist accustomed to using scientific methods, who once proclaimed, “Simplify, simplify, simplify!” would have been proud. Of course, he also wrote “Live deep and suck out all the marrow of life,” a rather unsavory thought in the world of composting.

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