KEEPING PROJECTS ON TRACK

NEIGHBOR-FRIENDLY ODOR MANAGEMENT

Critical ingredients include understanding human response to odors, opting for public relationships and not PR in interactions, characterizing and monitoring odors generated, and using third party oversight of organics recycling activities.

Nora Goldstein

MANY years ago, there was an advertisement in *BioCycle* by a company that built composting facilities. The ad essentially stated, "We have an odor-free composting operation." The facility started up, had odors, didn't have the financial capacity to make necessary infrastructure and operational changes, and they closed. It was a very expensive lesson on the critical need for odor management. And this story is not uncommon.

One of the fundamentals of odors is, if it can stink, it will stink. Composters are handling materials that as they break down, can emit a host of unpleasant odors. One consultant noted several years ago that some feedstocks "do not degrade gracefully." The positive side of this picture is that if it does stink, it usually can be fixed. The field of odor management is very advanced in its understanding of odor characteristics of feedstocks, how to detect and treat various odor compounds, process control methods to minimize odor generation, and optimizing odor treatment systems, including biofiltration and scrubbing of process air.

Hand-held field olfactometers are used by inspectors at biosolids land application sites as part of an oversight, monitoring and public outreach program operated by Maryland Environmental Services for the District of Columbia Water and Sewer Authority.

Less understood in the formula for successfully managing odors is the human side — the physiological and psychological reactions to odors — and productive strategies to work with individuals impacted or potentially impacted by composting, mulch production and land application activities. Several years ago, we were introduced to research conducted by Pamela Dalton and colleagues at the Monell Chemical Senses Center in Philadelphia. An article in the November 2003 issue of *BioCycle*, "How People Sense, Perceive and React To Odors," describes the inner workings of the human sensory system and evolutionary factors that cause people to react to certain odors in a fearful way. Dalton's research (which *BioCycle* will update in an upcoming issue) helps lay the groundwork for implementing outreach strategies with facility neighbors and the broader public, including elected officials and regulators.

The Nose: Smell is the oldest and most sophisticated sensory system that mammals have for detecting information about their environment at a distance, explains Dalton. "Although humans largely rely on vision and hearing, we are still remarkably responsive to odor cues to guide our judgments about our environment and the risks that surround us."

Bad Odors, Bad For You?: "Long before we understood that germs were the basis of disease transmission, there was a concept, called the 'miasma theory,' that it was the odors associated with sickness and disease that were causing people to become ill," says Dalton. "This hypothesis was the result of a simple co-occurrence of disease and bad odors in which people attributed causality to the odors because they were perceptible, while germs were not."

Odor Memories: The smell of feces or rotting food where one doesn't expect it can con-

"The science of olfaction, how we smell, is fascinating, though it should be acknowledged that some of the process remains a mystery," says Dr. Pamela Dalton.

jure up fear. Explains Dalton: "Odors related to a natural vector of disease such as fecal matter ... often acquire all of the aversive characteristics of that vector. So when people smell the odor of feces, they are primed to think about the source and its potential hazards and do not realize that the odor molecules can be devoid of any pathogens or disease-producing materials present in the source."

Human Responses: "The science of olfaction, how we smell, is fascinating, though it should be acknowledged that some of the process remains a mystery," wrote Dalton when introducing the section of her article on perceiving odors. Complicating the intricate physical detection and reaction mechanisms of the sensory system are the influence of cognitive factors — how people's beliefs about the effects from odor are influenced by personality traits, personal experience, social cues and so forth. It is critical for anyone working in the field of organics recycling to understand the physical and cognitive factors and related responses, preferably before a project that has the potential to generate odor impacts gets underway, but absolutely when there have been odor impacts. For example, although some malodors associated with organics recycling can be smelled in minute concentrations, "simply being able to smell the malodor does not signify that it is present in a harmful concentration.....Research has shown that environmental malodors are typically present at concentrations greater than those capable of generating odor perception but short of those concentrations capable of generating sensory irritation or other acute health effects. The challenge is to identify the reasons behind community reactions to odors and to understand whether the volatile odor chemicals (i.e., odorants) elicit health symptoms through direct physiological mediation or through psychological or stress mechanisms (e.g., altered breathing patterns that can cause light-headedness)."

RESPONSIVE RELATIONSHIPS

About the same time we were introduced to Pam Dalton's research, I was involved in a project that was researching public perceptions of biosolids recycling. The New England Biosolids and Residuals Association (NEBRA) was awarded a research grant from the Water Environment Research Foundation to examine the social science factors that are in play with biosolids recycling programs. The Northwest Biosolids Management Association, the Consensus Building Institute and several other subcontractors (including *BioCycle*) also participated in the project (see "Public Perceptions of Biosolids Recycling," April 2005 for a summary of the research findings). In a nutshell, the insights gained from Dalton's research, combined with the insights gained from studying risk perception, risk communication, public participation and the overall social context in which biosolids recycling programs operate, led to a new appreciation of what is involved in building and maintaining public support for any waste recycling activity.

For many recycling programs, odors may be people's first introduction to the fact that the activity is taking place in their community. As part of the permitting process for a composting facility or an agricultural land application program, there is usually some sort of public notification required. Potentially impacted neighbors may or may not become aware of a project at that stage. Truck traffic once a project is underway may be a clue, but in the majority of cases, it is an offensive odor that gets people's attention. And when "discovered" at that point, a program is instantly working from a deficit in terms of public trust and support — fear has been stimulated, which immediately increases the neighbor's perception of risk.

In Dalton's *BioCycle* article, she describes a four-step process — known as FIDO — that is used to determine what makes an odor annoying. FIDO is the Frequency of an odor; the Intensity at which odor occurs; the Duration of the odor; and the Offensiveness of the odor. Frequency, Intensity and Duration are all factors that can be measured analytically with instruments. However, understanding offensiveness, says Dalton, requires measuring people's reactions — the nonsensory attributes (cognitive and emotional factors) that can produce heightened odor awareness, annoyance and/or reported physical symptoms, all of which can contribute to a sense of personal risk.

One of the key tenets of risk perception and risk communications learned from the WERF study is that a person's perception of risk *is* their reality. And that reality, for anyone involved in organics recycling, becomes your (the project managers, regulators, etc.) reality. The reaction that people have to odors is shaped by their attitudes and expectations brought to that odor experience, as well as possible physiological responses (e.g., eye irritation, nausea from an unpleasant smell). That odor receptor's perception is your reality. And that reality, not what you know based on research and analytical measurements, is where the dialogue starts. Data and analysis play an important role in the response and future cooperation, but compassion, understanding and concern are Step One.

Dr. Peter Sandman, a researcher on risk perception and risk communications (see www.psandman.com) and currently an adjunct professor at Rutgers University, is well-known for the formula, Risk = Hazard + Outrage. With the chance of oversimplifying, how an individual perceives a risk is a combination of the actual hazard plus the level of outrage they are feeling. Factors that cause public outrage include whether the exposure is involuntary vs. voluntary (imposed on the person vs. something they chose to be exposed to), industrial (not natural), exotic (not familiar, strange), memorable (such as experiences associated with malodors), a closed process (a feeling that regulatory permission has been gained already and the public meeting is just window dressing), and untrustworthiness.

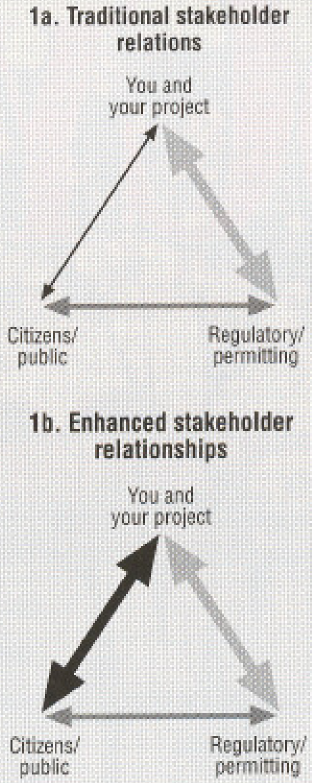
These outrage "triggers" apply to most waste management practices. Fortunately, these same triggers can be used to guide public outreach and relationship-building programs, essentially by taking steps to address, or mitigate, these outrage factors. For example, introducing people to an organics recycling program in an open process before operations get underway helps shift the unfamiliar to the familiar, and presents an opportunity to gain people's trust by being respectful of, and responsive to, concerns that are raised. One step that can build trust among stakeholders is oversight of a program by a citizen's advisory committee or third party inspectors (as is noted later in this article as part of a biosolids land application program).

At the heart of any public outreach process to build support for a recycling program is a critical shift from one-way, public relations-based communications to two-way, public relationship building initiatives. Interacting with those who may be impacted by a project, starting with something as fundamental as a tour of an operation, goes a lot further when a problem occurs than simply sending a press release to the local newspaper about your project or only keeping your project regulator informed. In truly productive public relationships — where site neighbors, elected officials, health department inspectors, and any other stakeholders are fully informed and aware, and the project operators are responsive to concerns and addressing any incidents — there is a better chance that people will be more patient, understanding and even supportive if and when significant problems — such as malodors — are encountered.

A case in point is a composting facility that was under regulatory notification to correct its odor problems. Site neighbors had filed complaints that led, in part, to the regulatory notification. Corrective steps were taken by the facility, and it resumed composting of feedstocks that were contributing to the odor problems. The site operator mentioned in an interview that the regulatory authority was pleased with the outcome. When asked about how the neighbors reacted, he commented that what was most important was for the regulators to be satisfied.

That comment led to the development of the triangles depicted in Figure 1. Ned Beecher, Executive Director of NEBRA and Principal Investigator of the WERF public perception project, and I offer workshops on Building Productive Public Relationships. The workshops cover a range of topics, including how to identify and work with project stakeholders, how to mitigate public outrage, listening and learning from stakeholders and working together to find acceptable solutions, and tips on holding effective public meetings. The triangles in Figure 1 are designed to illustrate two types of public involvement. Organics recycling projects (at the top of the triangle) that are required to have permits to operate must engage with the regulatory community (lower right side of the triangle). As part of that permitting process, the recycling project likely will have to notify the public (lower left side of the triangle) about the activity. That causes an interaction (be it a letter of notification or, in some cases, a hearing) between the project and the public.

Figure 1. Traditional and "enhanced" stakeholder relationships



In the situation just described about the composting facility with the odor problems, the bulk of the interaction (Figure 1a) is between the project and the regulator. And the bulk of the public's (neighbor's) interaction is with the regulator. Very little dialogue is established between the site neighbors and the facility operator, even though they are physically located a short distance apart. That lack of interaction between those two parties contributes to distrust and heightens the neighbor's outrage about being closed out of the process. This is an example of an "unproductive" interaction that does not build improved relationships.

Conversely, in a productive public relationship situation (Figure 1b), the bulk of the communication takes place between the project and the impacted community. There continues to be a relationship between the project and the regulatory agency, but the contact along the bottom of the triangle is minimized. In this kind of scenario, site neighbors typically call the project operator first to report a problem before calling the regulator — if they call the regulator at all.

Interestingly, the composting facility just mentioned recently had its operating permit revoked by the state environmental regulatory agency. The agency noted concerns about the quality of life of residents in the area. While this situation can be resolved, the fact that site neighbors were not fully engaged in the odor remediation steps and evaluation of their effectiveness will make it very difficult for the operators to garner community — and regulator — support.

ANALYTICAL TOOLS AND PROJECT OVERSIGHT

When reaching out to site neighbors, especially when the potential for odorous emissions exists, it is important to provide information about the characteristics and nature of the odors, and their known effects (based on the levels to which they could be exposed). The more individuals are familiar with the odors they may encounter, the less fearful they may be. The degree to which the odors become a nuisance depends on their frequency and how the facility or land applier responds when they occur.

Another, more direct option is to actually train site neighbors to be odor monitors. Hand-held field olfactometers, such as the Nasal Ranger supplied by St. Croix Sensory, directly measure and quantify odor strength in the ambient air. Those involved in an oversight program can be trained how to use the field olfactometer, and a monitoring program and response plan can be established. The data log sheet used by the monitors notes the time and location where a measurement was taken, and the weather conditions, including precipitation, and wind direction and speed. The sheet also asks for an odor descriptor. The operations manual for the Nasal Ranger divides the odors into eight general categories (floral, fruity, vegetable, earthy, offensive, fishy, chemical and medicinal) and then within those categories, lists specific smells. For example, earthy includes ashes, grain silage, grassy, smoky; Chemical includes diesel, paint, solvent.

A related step involves mapping out the area to be monitored. For example, a site neighbor may always monitor from one location, e.g., the back porch of their house. Ideally, multiple locations around a site (and varying distances away from the site) should be monitored, including points where odors are most likely to occur as well as points where odor impacts would be unlikely. This will help to eliminate bias. Once those monitoring points and frequency of monitoring are established, they should remain consistent.

When selecting monitors, it is helpful to assess their levels of odor sensitivity. St. Croix developed an Odor Pen Kit for measuring olfactory sensitivity. The kit contains a set of odor pens, a blindfold for the individual being tested and odorless gloves for the test administrator. The sticks are felt tip markers (pens) impregnated with n-butanol, the odor agent used for olfactory threshold screening. Fourteen pens contain the n-butanol solution at different concentrations, and two pens are odorless. Testing starts with the pen with the lowest n-butanol concentration and the two odorless pens. The test individual is required to distinguish between the three pens by declaring which one contains an odor. If no odor is perceived, the next level of n-butanol is introduced and so forth. Ultimately, the level where a pen is correctly identified for the first time as the odor pen becomes the odor threshold score for the individual.

“”Hardly anyone in the population can smell the n-butanol in its lowest concentration, whereas 99.9 percent of the population can smell the number 2 pen, the second to the strongest,” explains Michael McGinley of St. Croix Sensory. “Each pen in between is a gradient of a concentration of n-butanol. The general population can detect the n-butanol around pen #8. So if someone detects an odor at pen #12, they are probably too sensitive to serve as an odor monitor. Conversely, someone who doesn’t detect an odor until pen #3 is not sensitive enough.” He adds that in the laboratory, n-butanol is used to train and qualify odor panelists. “We’ve found that n-butanol is representative of people’s sensitivity to other smells.”

The olfactory sensitivity test is used by regulatory agencies as well project managers

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to screen field inspectors hired to conduct tasks such as investigate odor complaints, confirm compliance with odor emission limits or provide independent, third party oversight of programs. "The test helps determine who is qualified to be inspectors," says McGinley. "For example, state agencies have disqualified candidates who show up as very insensitive or too sensitive. Once the inspectors have been selected and are working in the field, the olfactory sensitivity test is performed on a periodic basis to make sure the inspectors haven't changed dramatically in their levels of sensitivity. It also helps to monitor reports filed by the inspectors to see if one inspector is measuring levels significantly different than the other inspectors."

He recommends that after the inspectors are trained on how to use the hand-held olfactometer and are working in the field, a good follow-up training exercise is to go out in groups of two to three people. "You can compare the responses, which helps identify if someone is using the device incorrectly or has a nose that is more or less sensitive than originally measured in the olfactory sensitivity test."

INSTITUTING A FIELD INSPECTION PROGRAM

The District of Columbia Water and Sewer Authority (DCWASA) produces 1,200 wet tons (320 dry tons)/day of Class B biosolids (fecal coliforms are regularly below 1,000 mpn/g, the Class A standard). DCWASA currently has permits to land apply biosolids in 39 counties in two states. A typical month consists of land applying in 10 to 20 different counties, making interaction with the local community a challenge. That reality led DCWASA to contract with Maryland Environmental Services (MES), an independent state environmental agency, to provide inspectors at the fields where biosolids are being land applied. In addition to being available to respond to any questions and ensure that standard operating procedures are being followed, the inspectors are equipped with Nasal Rangers to conduct odor monitoring.

"In July 2004, we refined our odor investigation procedures by purchasing field olfactometers and providing training to produce qualified observers," explains Chris Peot, biosolids manager for DCWASA. "Inspectors designated to use the field olfactometers attended an odor training class offered by St. Croix Sensory. As a follow-up to the training, MES developed an odor monitoring standard operating procedure (SOP) for field inspectors. In addition, every six months, the inspectors are given the olfactory sensitivity test so we can compare those results to the data being recorded in the field. It helps us better understand the information they are reporting in the data base."

The inspectors also interact with local health department and biosolids monitors to address or identify geographic/geologic specific concerns. MES field inspection staff has conducted meetings with local biosolids coordinators prior to the start of landspreading in new counties. MES also has a role in public outreach. Its staff will provide the public with analyses of biosolids produced at the sewage treatment facility, explain quality assurance issues, and provide contractor contacts and details on the delivery of material to the application sites. The field supervisors also are in constant contact with state regulators in Virginia and Maryland by phone, email and in person. MES and state reports are shared and exchanged regarding problems in both states.

The contract with MES was part of a much larger initiative begun at DCWASA after odor complaints about five years ago — due to application of stored odorous material — almost derailed the agency's biosolids recycling program. "We had a very inconsistent product in terms of odors and fecal coliforms, and complaints poured in after that odor incident," says Peot. "Changes were necessary or our program might have collapsed under the weight of the complaints. Basically, we were in a reactive mode at that time."

Initiatives were taken on multiple fronts to shift from a reactive to a proactive management mode. DCWASA enrolled in the National Biosolids Parntership's (NBP) Environmental Management System (EMS) program, which requires a full system review of operations, identification of critical control points throughout the biosolids value chain (from sewage collection through end use and disposal), and interactive/responsive staff management. DCWASA received its NBP EMS certification in September 2004. It already had been involved with odor research initiatives, including development of an Odor Index that helps predict — based on a host of operating conditions at the treatment plant — the odor quality of the biosolids being sent out for land application (see "New Frontiers For Odor Research," September 2001). A nutrient rebate fee is collected from land application contractors, which DCWASA is obligated to use for biosolids research and outreach ($250,000 annually). A full report on these aspects of DCWASA's program will be covered in an upcoming issue of *BioCycle*.

One research project was specifically related to a comparison of the data reported by the field inspectors using the portable olfactometers, compared to a statistical model that predicts the characteristics of the odors based on a variety of operating parameters at the plant. The statistical model, developed by a professor at the University of Maryland and several graduate students, factored in sludge blanket depth, doses of lime, polymer and ferric chloride, and time and storage. "Those parameters were thrown into the model and the graduate students looked at how closely the odors predicted mimicked actual odors in the field," says Peot. "We used data from one particular inspector who has a really accurate nose. The data shows that the statistical model does a good job of predicting what odors were actually measured in the field." ■

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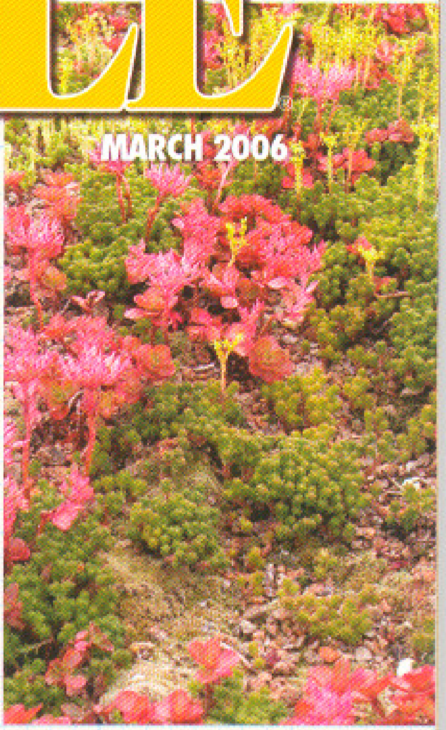

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