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Monitoring and controlling odours is essential to the expansion and widespread public acceptance of waste treatment plants – as one French example demonstrates. BouAlem Mesbah explains



The smell of success

Odour management in sludge treatment

Production of municipal solid waste (MSW) is increasing worldwide, although many – primarily industrialized – countries are making major efforts to cap that growth. In France, for example, MSW production has tripled over the past 25 years. In 2006, the country produced 30 million metric tonnes of municipal solid waste, with a substantial portion of this waste ending up in landfills. In keeping with many other countries, French authorities aim to stabilize domestic waste production in 2008 and, in the long-term, restrict landfilling to residual waste only, i.e. to the material left after everything of value (in terms of recycling or energy recovery) has been recovered.

Such goals necessitate the construction of new infrastructure to treat and sort the waste, thus maximizing the quantities recovered. This is all fairly straightforward logic, but the practicalities of implementing appropriate solutions within a populated environment can be problematic, particularly when it comes to odour control.

Managing odour concerns

Typical deodorization processes on waste management sites include:

- burners
- biofilters
- chemical scrubbers
- chemical neutralizers

Burners are flares, which openly combust the landfill gas with ambient or forced air, or incinerators using an enclosed combustion

process. Biofilters use micro-organisms to remove air pollution. Scrubber systems are a diverse group of air pollution control devices that can be used to remove particulates and/or gases from industrial exhaust streams. Traditionally, the term 'scrubber' has referred to pollution control devices that used liquid to 'scrub' unwanted pollutants from a gas stream. The term is now also used to describe systems that inject a dry reagent or slurry into a dirty exhaust stream to 'scrub out' acid gases. Scrubbers are one of the primary devices that control gaseous emissions. For big open-air sources, such as compost windrows or landfill cells, chemical neutralizers can sometimes be a solution. These are a broad range of chemicals used to neutralize the compounds that cause the odour, or alternatively mask the odour by releasing other, overshadowing odours that are perceived as pleasant. Overall, good management is the key for odour reduction.

While odour control strategies can be implemented to reduce the odour emissions of certain industrial sites, the very nature of waste management activity generates unpleasant odours. And the situation is becoming more complex.

The downside of integration

In France and elsewhere, the MSW landfill sector has started to broaden its offering to encompass other treatment options. Landfilling and composting on the same waste remediation site is becoming increasingly common. Such diversification is common to other waste management industries too.

While developing integrated solutions has numerous advantages, in the context of odour management, it can also create problems. This



is because the integration of new activities – which often generate additional odours of their own – tends to increase the odour nuisances generated at a particular waste management site, thus impacting negatively on the social acceptance of such sites. And if this potential concern is not handled appropriately, it may impact on the development of much-needed infrastructure.

The goal is clear: to reduce, as much as possible, the release of any odours into the neighbourhood and, ideally, to be proactive in managing odour complaints rather than reactive. A means of instant measurement and forecast of odour emissions and impacts is crucial for responsible, accurate management.

Sensing a solution

Designed and marketed by Odotech Inc., a Canadian company, the OdoWatch® electronic-nose (e-nose) system is precisely that kind of tool for continuous odour monitoring of landfills, composting facilities, rendering and wastewater treatment plants.

The network of e-noses continuously measures the odours and sends the related data to a central computer, which also receives the weather data from the system's meteorological station. The OdoWatch software then models the atmospheric dispersion of the odours, and displays the result as an odour plume colour-coded for odour concentration. The constantly changing odour plume on the screen is overlaid onto the site map, enabling the operator to see at a glance whether or not his plant is causing an odour problem, how big the problem is, who is being affected, and what source is responsible.

This technology was launched commercially in 2006 and a series of improvements and new capabilities, such as user-programmable odour alerts and instant display of past history of odour events, were

formalized in OdoWatch Version 2.0 launched in January 2008. In the following section we review an example of this technology in action.

Odour management in practice: the Ortec landfill

Located in a rural area in Provence, France, the Ortec landfill and composting site is bordered by the residential area of Val-de-Sibourg, 1 km away. Its landfill occupies an area of 4.5 hectares (11 acres), and its composting site receives a broad range of domestic and wastewater treatment sludge at varying intervals. The activities of the site were producing odours which in turn generated complaints from local residents.

AIRFOBEP, the air quality monitoring association for Étang de Berre, in association with the French Government organizations ADEME and INERIS, was tasked in June 2005 with assessing the causes and magnitude of the odour nuisances to which Val-de-Sibourg residents were being subjected.

In order to calm tempers, a neighbourhood committee made up of residents of Val-de-Sibourg was set up to evaluate and identify, on a daily basis, the odours perceived as likely to have originated at the Ortec site. In parallel, the OdoWatch real-time odour measurement system was installed for continuous monitoring of the Ortec site's odour emissions.

Description of the site

The Ortec site consists of a sludge composting site and a domestic waste landfill. The composting site treats chemical and biological sludge, for which it has a receiving area, mixing area, ventilated fermentation area, and maturation area. Lixivate, the liquid carrying the solutes from the waste, is collected in pools at the bottom of the site.

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LEFT TO RIGHT Overview of the Ortec landfill and sludge composting site in Provence, France ■ An electronic nose in close up

The OdoWatch system implemented on the Ortec site consists of three e-noses, a meteorological station and a central control. A fourth e-nose had been planned, but was not implemented. E-nose #2 positioned at the lixivate recovery pool of the landfill, was designed to monitor the odour of fresh waste. E-nose #4 was positioned at the edge of the sludge composting area in order to monitor the odour of the composting windrows. E-nose #3 was located on a small hill between the landfill and the composting area. After calibration effected using the data collected on the site and analysed by dynamic dilution olfactometry according to European Standard EN 13725, the e-noses recognized and quantified in odour units (o.u./m³) the odours emitted by the site.

Central control merges the weather data received from the meteorological tower with the odour emissions measured and transmitted continuously by the e-noses. The system then models the atmospheric dispersion of the odours and displays the odour plume (colour-coded for concentration), superimposed onto the aerial map of the site. The operator can visualize in real time the odour impact generated by his own operations.

Testing the system's accuracy

As part of this work, the accuracy of the system was tested by comparing the observed readings taken from the Ortec site against the values predicted by the system. From analysis of the results, it was possible to calculate the root-mean square error (RMSE) associated with e-nose measurements. For e-nose #4, the RMSE is 1.54%. For the odours and e-noses as a whole, the RMSE of this project was below 3%, which is acceptable.

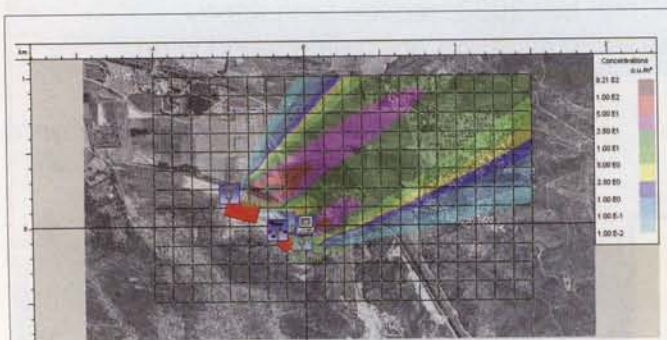


FIGURE 1. Odour dispersion at 2:00 p.m on 22 February 2007

Analysing the results

Neighbour observation data from 23 October 2006 to 25 February 2007 were compiled. There were 838 hours of observation, i.e. 10,056 observation entries overall for the 12 participating neighbours. Such a volume of data supported a meaningful comparison between the data obtained by OdoWatch and the observations effected by the neighbours, thereby determining the annoyance rate predicted by the system.

Figure 1 shows the modelling of the atmospheric dispersion of the Ortec site odours for the day of 22 February at 2:00 p.m., where observers #4, #5, #9 and #10 observed a waste treatment odour.

For the other observations effected by the observer committee, the mean odour concentration given by the OdoWatch system was 4.5 o.u./m³. As a result, it was possible to establish the odour alert threshold specific to the Ortec site, defined as the threshold at which odour observations can be formulated by neighbours. As a rule, 5 o.u./m³ corresponds to the net odour perception threshold – the level at which one can assess the odour clearly.

Over the duration of this study, the odour concentration at neighbouring homes was above the odour alert threshold 1%–3% of the time, depending on the precise location of the neighbours. Over that same period, there were a total of 17 hours during which odour was perceived by the neighbours.

Before looking at the conclusions from analysing the data, one should mention the resolution limits associated with these comparisons:

1. Modelling involves some degree of inaccuracy in the estimation of the impact area
2. Odour perception by neighbours involves an error factor in the reporting of odour events. Mainly, it is difficult to take into account the personal data peculiar to each neighbour (absence, hurry, forgetfulness, etc.).

What does the Ortec case study tell us?

The project found that

- the olfactometric calibration of the e-noses yields a relative root-mean-square error below 3%
- there was a good correlation between the neighbours' observations and the OdoWatch alert system measurements
- the odour alert threshold was determined to be 4.5 o.u./m³.

This is therefore a valid instantaneous odour management tool for plant managers. Indeed, with its programmable alert system, the user may pinpoint on the map the GPS co-ordinates of neighbours who



complain about the site's odours, and programme in a maximum odour value not to be exceeded at those points (for instance, 4.5 o.u.). Whenever the system predicts 4.5 o.u. or more at pinpointed locations, OdoWatch gives an alert to make the operator aware of the potential problem. In addition, the system can be used to monitor the odour abatement effectiveness of the means used by the operator to control odours. The use of chemical odour neutralizers, for example, can be optimized in this way.

Outlook

Beyond sludge treatment, the entire waste industry faces challenges in measuring odours, monitoring them in terms of sources and impact, reducing the odours and dealing with the neighbours and regulators.

The current 'manual' sampling and measurement methods used for odour impact studies in most countries are slow, costly and – above all – yield only a snapshot, a single odour value that is only representative of the very instant when the air sample was taken.

Knowing that odour sources can be highly variable over time, on an hourly or daily cycle depending on the production process, and that in addition the weather, on which atmospheric dispersion (and thus the odour impact) depends, can change from one minute to the next, it can be readily seen that a snapshot taken three weeks earlier will not tell you very much about what is happening right now.

This is one of the virtues of continuous monitoring that has now become possible. By archiving the real-time odour data measured continuously, a site operator using a tool such as OdoWatch can always check retroactively what the odour situation was at the time of an odour complaint made well after the fact. And having the capacity

to programme odour threshold alerts can also be of immediate and direct assistance: the user can use GPS to pinpoint specific neighbours and set certain odour concentration values not to be exceeded at those locations. Whenever that threshold is reached, the operator can be informed that the potential for an odour complaint exists and take appropriate steps.

There is scope for applying continuous odour monitoring systems in a variety of different waste management sectors, such as landfilling, composting, rendering, wastewater treatment and livestock operations. And, as mentioned earlier, as environmental solutions become more integrated the boundaries between such sectors are likely to become increasingly blurred. Regional and national environmental authorities are starting to pay close attention to the potential applications of this enhanced knowledge.

Odour regulations, which have been changing rapidly, are starting to mention or prescribe the use of electronic noses. In France, for instance, new regulations for rendering and composting operations include the use of electronic noses for continuous odour monitoring. If this movement continues, there is a strong likelihood that this type of technology will become widely used and known. By applying odour management tools as standard in the waste industry, the developers and operators of vital new plants will be empowered with clear data that help them to calm public concern and support effective odour management.

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