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The NOSE Platform®: A Real-Time Solution to Forecast & Monitor Nuisance Odours

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In recent years, the public's awareness and response to nuisance odours have risen markedly. Accordingly, integration of industrial sites, such as wastewater treatment plants and solid waste treatment facilities, within their local environment represents a major challenge for municipalities, particularly with the growing trend of urbanization and the adoption of new and increasingly stringent local regulations regarding nuisance odours.
A global approach to nuisance odour management, emphasizing both technical and human-oriented solutions, has now been reinforced with the development and implementation of real-time odour monitoring and control strategies. The NOSE Platform® is an innovative operational tool that enables real-time diagnosis and forecasting of a site's olfactive footprint as well as the corresponding impact on the surrounding community as a function of site operational parameters, odour emissions data and the prevailing weather conditions.
The NOSE Platform® has already proven to be both a useful diagnostic tool towards minimizing nuisance odours, as well as an excellent reporting and communications tool, allowing for a more constructive and positive dialogue amongst all facility stakeholders including site Management & Operations staff, community residents, and local government and regulatory officials.
This paper will present the implementation and initial results of this operational tool at a solid waste methanization facility, highlighting its role towards ensuring a global and sustainable approach to nuisance odour management by providing a real-time comparison of the facility's measured olfactive footprint with the perceived olfactive footprint.

1. Introduction

In recent years, the public's awareness and response to nuisance odours have risen markedly. The management of nuisance odours represents a specific challenge for the range of activities associated with the collection and treatment of wastewater, sludge treatment and recycling operations and the collection, treatment and valorization of solid waste. Accordingly, integration of industrial sites, such as wastewater treatment plants and solid waste collection and treatment facilities, within their local environment represents a major challenge for municipalities, particularly with the growing trend of urbanization and the adoption of new and increasingly stringent local regulations regarding nuisance odours.
Municipal authorities in Montpelier, France identified the effective control of nuisance odours as a key driver for the design and operation of the largest organic waste methanization facility (nominal capacity of 203,000 t/y) in France (Figure 1). The facility, AMETYST, treats mixed household waste and

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biowaste with a Mechanical Biological Treatment (MBT) process, ultimately yielding a high-quality compost and 30,000 MWh/y of electricity production via on-site cogeneration using the 14,400,000 m^3 of biogas produced annually as the primary fuel source.
AMETYST is located in an industrial zone within a highly urbanized region along the Mediterranean coast. Accordingly, the municipality established an odour concentration limit of 3 OU/m^3 in the immediate vicinity of the site.
To address this growing demand for olfactory comfort, previous publications have revealed the importance and benefit of implementing a dual approach to odour management, addressing both technical and human-oriented actions in parallel to provide a sustainable resolution of nuisance odour issues (Dauthuille et al., 2008).
According to the Horizontal Guidance for Odour Part 2 – Assessment and Control (Environment Agency, 2004) odour impact methodologies can be broadly classified into two main types: process (emission)-based assessments and assessments based upon measurements around the source and / or conditions in the community. The NOSE Platform® integrates both approaches by providing a real-time comparison of the measured olfactive footprint with the perceived olfactive footprint in the surrounding community.
Faced with increasing residential encroachment (the nearest housing located approximately 100 m beyond the site's boundaries) and the need for a reliable strategy to address recommendations arising from odour impact studies the NOSE Platform® was selected as an integrated solution to ensure effective management of nuisance odours and respect of the local odour concentration limit.

Figure 1: Aerial View of AMETYST Waste Methanization Facility (Montpellier, France).

2. Methodology & Results

The NOSE Platform® is an innovative tool that enables the real-time monitoring of the critical factors influencing a site's odour emissions, as well as the corresponding impact on the surrounding community. The tool encompasses six primary functions in order to anticipate, monitor and minimize a facility's olfactive footprint:

i. Real-time monitoring of odorant emissions from primary sources,
ii. Real-time evaluation and display of the odour dispersion plume over a representative zone,
iii. Generation of operational alerts concerning on-site odour management performance based upon user-defined threshold values,
iv. Simplified tracking of odour impact (OU/m^3) at pre-defined "critical" locations within the local community and generation of operational alerts should odour concentrations exceed the prescribed regulatory threshold,

v. Reporting function compliant with local regulatory requirements, and
vi. Communications tool for establishing a constructive dialogue with local stakeholders.

The NOSE Platform® is a modular tool, which may be customized to meet site-specific requirements and constraints. It is capable of acquiring, storing, analyzing and interpreting various types of data known to impact a facility's olfactive footprint. This includes odour emissions data derived from via real-time monitoring of key sources using dedicated sensors and electronic noses, theoretical models of Odour Creation Potential which characterize potential odour emissions from key sources by assessing established correlations with the raw material characteristics and process operational parameters and meteorological data originating from an on-site weather station. Visualization of the corresponding data and odour dispersion modeling results is provided via a dedicated user interface. A schematic view of the NOSE Platform® architecture is presented in Figure 2.

An odour audit of the AMETYST facility, employing both sensorial and analytical approaches, identified the primary odour sources as the waste reception pit, the outlet of the foul air treatment system and the biogas flares. The results of this study allowed for the local tool to be tailored to the site's activities.

The NOSE Platform® installed at AMETYST employs three electronic noses, providing constant verification of critical odour emissions from the outlet of the biofilter serving as the primary air treatment (180,000 m^3/h) for the facility, as well as environmental monitoring of ambient air at the perimeter of the site in the direction of prevailing winds and sites identified as "critical receptors", such as residential neighbourhoods, pedestrian areas and a tramway station.

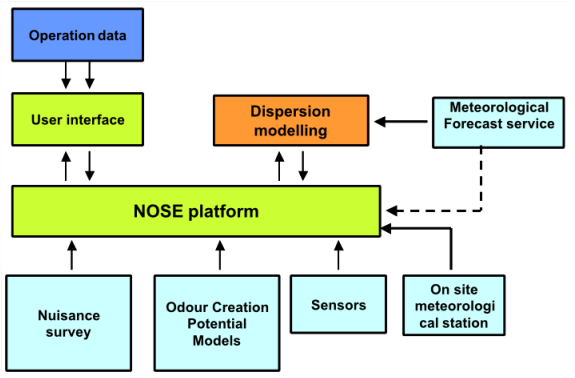

Figure 2. NOSE Platform® Architecture.

Additionally, the use of the odour emission inventory coupled with process operations data collected from the facility SCADA (Supervisory Control and Data Acquisition) system enabled the development of Odour Creation Potential (OCP) models for the primary odour sources. The integration of process operating data with odour emissions data supports the calculation of odour emission fluxes, allowing for the site's actual operational conditions to be accounted for during the real-time assessment of its olfactive footprint. For example, the OCP model for the waste reception pit accounts for the quantity of mixed household waste received and the status (open or closed) and opening time for the two pit doors in order to calculate the odour flux emitted from this key source.

An integrated odour dispersion modeling function serves to evaluate the site's olfactive footprint via illustration of the odour dispersion plume (in OU/m^3) for a 6 x 6 kmzone around the site. The dispersion modeling software employed is ADMS 4, a new generation Gaussian air plume dispersion model, developed by Cambridge Environmental Research Consultants. A weather station (sonic anemometer) located on the roof of the administration building furnishes the relevant meteorological data including the wind direction, speed and temperature and atmospheric stability.

Implementation of an innovative data processing tool having various access levels and screen configurations is used to support the real-time display of the pertinent information and results, addressing the various needs of Plant Management, Site Operators, Environmental Officers and even the local municipality via remote access with an internet connection.

Atmospheric dispersion modeling is conducted in real-time with the odour iso-concentration maps (odour plumes) updated every 15 minor 1 hper an Operator-defined setpoint. The user interface thus illustrates four images representing the evolution of the odour dispersion plume over the past hour, or 4 h, according to the setpoint employed (Figure 3).

The platform also provides alerts based on user-defined odour thresholds to inform site Operators regarding potential process variations or equipment malfunctions contributing to nuisance odour generation, allowing for rapid implementation of corrective actions. For example, should one of the pre-defined “critical receptor” sites exceed the 3 OU/m^3 odour concentration threshold, an Operator alert is sent and the point appears in red on the aerial map. As the NOSE Platform® calculates the contribution of the various potential odour sources to the plume detected at this point, site Operations staff are greatly assisted in their efforts to determine the source having the greatest impact at the time in question, facilitating process optimization and resolution of the issue.

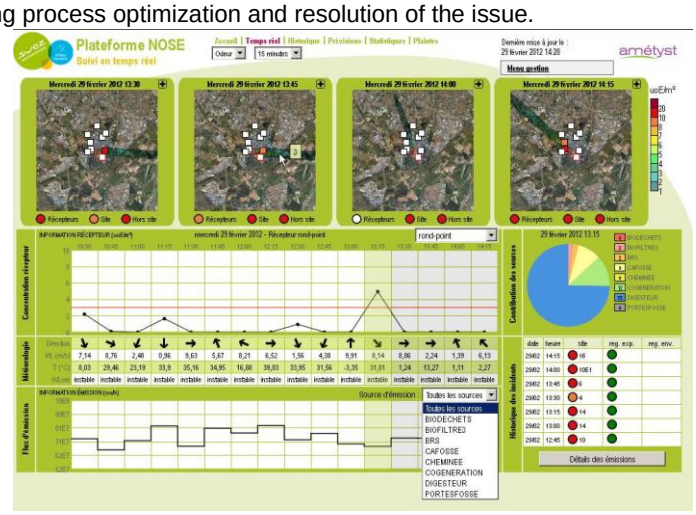

Figure 3: The NOSE Platform® User Interface.

To facilitate the integration of sensorial data, a resident “nose” panel led by a local community association (Air Languedoc-Rousillon) was trained in the use of the Odour Wheel® methodology, as described previously in the literature (Burlingame et al., 2004; Suffet et al., 2004). As the types of odours encountered at the AMETYST facility are very specific to the site, comprising both anaerobic digestion and composting activities, a site-specific Odour Wheel® was created for the facility based upon the participation of the resident panel (Figure 4).

Accordingly, site Management and Operations staff, local regulatory and government officials and the residents use a common language in order to characterize nuisance odours. This allows for the collection of concrete data and constructive dialogue, corresponding to the IPPC odour impact methodology for assessments based upon measurements around the source and / or conditions in the community.

The availability of historical data and statistical analysis capabilities has facilitated the reporting dictated by the local contract in Montpelier. The reporting function may be used to calculate and plot maps of odour iso-concentration, superimposed over an aerial view of the facility and its surroundings, at the 98 and 99.5 percentile values over a defined period (Figure 5). Alternatively, the tool permits the calculation of conditions experienced at defined sites, such as the average hourly odour concentration or maximum hourly odour concentration.

In addition to providing the ability for review and analysis of historical data, the platform supports forecasting of nuisance odour emissions up to 5 days in advance which assists site personnel with the planning and execution of programmed maintenance activities.

Implementation of the NOSE Platform® at the AMETYST facility played a crucial role in the identification and demonstration that the foul air treatment system, as originally conceived, was

insufficient and the corresponding emissions were paramount in terms of olfactory nuisance to nearby residents. This operational tool was used to provide the rationale necessary to justify investment in an additional treatment stage and ultimately the optimization of the installed activated carbon polishing treatment. Since the implementation of the NOSE Platform® and the commissioning of this additional foul air treatment stage the number of odour complaints received at the site has reduced considerably.

Figure 4. Site-specific Odour Wheel® developed for AMETYST Facility.

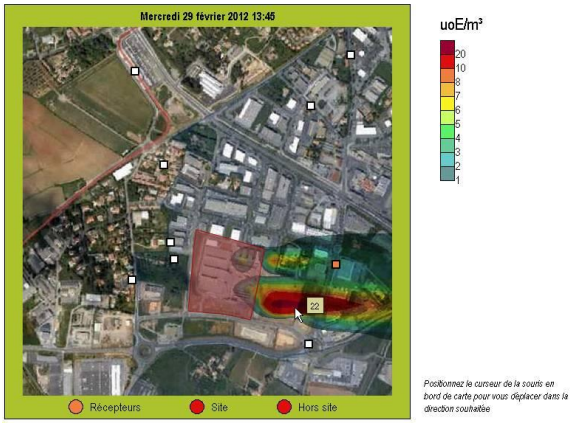

Figure 5. Reporting Function - Odour Plume Mapping.

3. CONCLUSIONS

The NOSE Platform® is an innovative operational tool, which supports a global approach to odour management by providing real-time forecasting and surveillance of nuisance odours and the associated community impact. The use of an integrated atmospheric dispersion modeling function accounts for the combined effects of site operational parameters, measured odour emissions from key sources and the prevailing weather conditions.

The coupling of the NOSE Platform® to a resident “nose” panel allows for ongoing comparison of a site’s perceived olfactive footprint to the measured olfactive footprint, facilitating the investigation and ultimate resolution of odour complaints.

The NOSE Platform® has already proven to be a valuable decision-aid tool for site Operators, supporting an immediate and co-coordinated response to nuisance odour concerns. Additionally, the tool has proven to be an excellent reporting and communications aid, allowing for a positive dialogue amongst facility stakeholders including site Management, local residents, and local government and regulatory officials.

The NOSE Platform® promotes the integration of industrial facilities within their local community by providing the operational support necessary to respect the target olfactory footprint for compliance with local regulations, to establish a constructive and transparent dialogue with local stakeholders and ultimately to prevent the development of odour crises by ensuring the efficient and sustainable management of nuisance odours.

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