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REDEFINING RESOURCES

WHITE PAPER

Real-time odour impact analysis and complain management

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Introduction

Odour is the perception of smell; it may range from being unpleasant (like the rotten smell of garbage) to pleasant (fragrance). Odours, pleasant or unpleasant; are produced by inhaling air-borne volatile organic and inorganic compounds. Populations do not generally perceive other common air pollutants, even if the exposure limit concentrations are exceeded. On the contrary, odours can be perceived even at below-normal exposure limit concentrations. Also, due to its subjective nature, the level of odour sensitivity can vary from person to person within the same community. It is therefore very important to measure odour in quantifiable units to be able to control it. Olfactometry is the method of converting human sensory signals of odour perception into measurable values. Usually, a group of people are employed as a human panel for odour detection and assessment.

> *A sensation resulting from the interaction of volatile chemical species inhaled through the nose, including sulfur compounds (e.g. sulfides, mercaptans), nitrogen compounds (e.g. ammonia, amines) and volatile organic compounds (e.g. esters, acids, aldehydes, ketones, alcohols)*
>
> *- Brancher et al. (2017)*

Although odour sensitivity differs from person to person, at sufficiently high concentrations, odor-ous compounds can have impacts on human health and well-being. If the offensive odour persists, it generally leads to headache, nausea, stress, anxiety, vomiting, sleep disorder, behavioural changes. Moreover, the odour generating pollutants also cause irritation to eyes, respiratory tract, skin, bronchi, lungs and prolonged exposure can cause serious health issues. People are increasingly complaining about their inability to enjoy their own property and outdoor activities such as gardening, playing outside etc. due to odour nuisance in their neighbourhood. Complaint management of odour impact is crucial for improved odour management and mitigation. Data from real-time odour monitoring provides essential inputs to carry-out odour impact analysis which helps in the effective resolution of odour complaints.

This paper presents how real-time odour impact assessment can be carried out and how that helps in the effective management of odour complaints.

Basics Of Odour

Development of odour nuisance is directly influenced by characteristics of odorous compounds released from the source, effect of atmospheric dispersion and dilution, the threshold value of odorant, the concentration of the released compound. To be able to manage odour complaints effectively it is imperative to understand the basics of odour, its properties, effects and various methods of its measurement.

Properties Of Odour

Odour is the perception by the brain's response to the chemicals present in the air that we breathe. Various odour properties that govern the perception of odour, serves as the basis for odour measurement.

Odour Intensity

Odour intensity is the perceived strength of an odour at a given concentration. The perception of the intensity of an odour is in direct logarithmic relation with the concentration of odorant. Intensity can be assessed on a common seven-point intensity scale from no odour (0) to strong odour (7).

Odour Character

Odour character or quality is the property to identify an odour and to differentiate it from other odour of equal intensity. Odour character is what the substance or compound smells like. Odour character can also change with concentration. For example, butyl acetate has a sweet odour at low concentrations but smells like a banana at high concentrations.

Odour Persistence

It is used to characterize the decrease in intensity of an odour as it is increasingly diluted with air. Some odour and odorants persist even after the air is diluted, while some odour dissipates quickly. For example, hydrogen sulfide and manure odour are more persistent than ammonia.

Hedonic Tone

The hedonic tone is a subjective measure of general offensiveness of the odour. The hedonic tone is independent of odour character and is often ranked on a nine-point scale ranging from extreme unpleasant (-4) to extremely pleasant (+4) and zero (0) being a neutral odour.

Odour Detection Threshold Value

Substances with odorous properties have a unique threshold value. The detection threshold value is the concentration of an odorous compound when it is just detectable by a human olfactory system. It is expressed in µg/m3 or ppb. Odours and odorants with low threshold detection value are easily detectable even at low concentrations and they are perceived as being strong (have a high intensity). For example, H2S has a low odour detection threshold value (0.4 ppb) compared to that of formaldehyde (500 ppb).

Development Of Odour

There are five main factors that determine the

development of odour nuisance. Together they are commonly known as FIDOL factors.

Frequency	How often an individual is exposed to odour
Intensity	The strength of the odour
Duration	The length of exposure
Offensiveness / character	The character relates to the "hedonic tone" of the odour, which may be pleasant, neutral or unpleasant
Location	The type of land-use and nature of human activities in the vicinity of an odour source

Classification Of Odour Effects As Chronic Or Acute

Chronic or acute odour effects can arise from different sources and are assessed based on various combinations of FIDOL factors. Acute odour arises due to high intensity and/or highly unpleasant odours occurring infrequently or for short periods (a few minutes to an hour). Typical causes are abnormal or upset conditions such as highly variable and uncontrolled discharges, process malfunctioning, an oxidation pond turn ing anaerobic, etc. Chronic odour arises due to low-intensity and/or moderately unpleasant odours occurring frequently or continuously over a long period. Typical sources of chronic odours are discharges from processing and manufacturing.

Receptor Sensitivity

This is the 'L' for location in FIDOL. The sensitivity of the odour receiving environment must be taken into account and should be part of any odour assessment. Odour complaints are more common from sensitive environments such as residential areas, schools etc. As the environment and land-use determine the activities of people it is an important factor in assessing odour impact on them.

Low Sensitivity	Moderate to High Sensitivity	High Sensitivity
Public roads, rural areas, industrial areas	Rural residential areas, commercial, retail markets, open space recreational	Hospitals, schools, childcare facilities, rest homes, old-age homes, residential areas, tourist and cultural conservation areas, etc.

Odour Management

Odour nuisance is particularly very common withlandfill sites, wastewater treatment facilities, and industrial plants. People living in the vicinity frequently complain about objectionable odours. Due to the very serious health implications of odorous compounds emitted from such activities, it is very much important to resolve such complaints and mitigate the odour and its impacts on people.

> *Odour is a sign that unhealthy chemicals surround us.*
>
> *K. K. Agarwal, Former President, Indian Medical Association*

Also, the regulatory mechanism and legislation of different regions and countries enforce odour control. Such regulations are usually based on controlling the emission concentration of various odorous compounds. Due to different threshold detection values of each compound, odours can be objectionable even at concentrations which are lower than the enforced limit. As a result, odour complaint becomes a very important and crucial part of odour mitigation.

Odour Complaints

Time and place of odour complaints provide vital insights regarding the probable source of the odour, odour characteristics, intensity, frequency and duration of odour, the extent of odour nuisance etc. Usually, officials from land-fill sites, industrial plants or respective government agencies visit the complaint sites. The officials assess FIDOL parameters and record wind speed and wind direction. The primary aim during a field visit at odour complaint place is to comprehensively document the odour assessment in order to identify odour source and assist in the resolution of odour complaint.

Fig1. The figure shows the geographical spread of complaints, which helps in understanding the extent of odour.

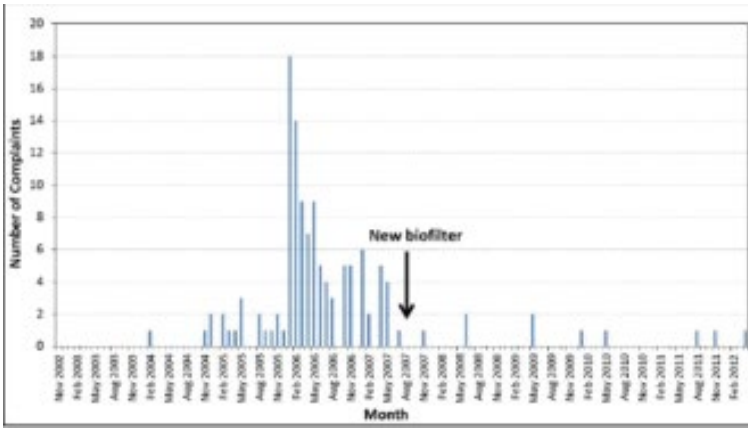


Fig. 2 The time of odour complaints provides helpful insights inidentifying probable cause of odour generation.

Field Observations For Odour Assesment

Field observations typically begin at the complainant's location and odours are traced back

to the source. If a specific facility is named, observations will usually be made upwind and downwind of the facility and other potential sources, and at the fence line of the suspect facility. Field observations provide immediate feedback to assess the relative level of odour present beyond the plant fence line. Field observations are also carried out for community survey, which develops the understanding of the community's sensitivity to odour, background odour sources and long-term odour trend. Further, field observations play a crucial role in validating results of dispersion models.

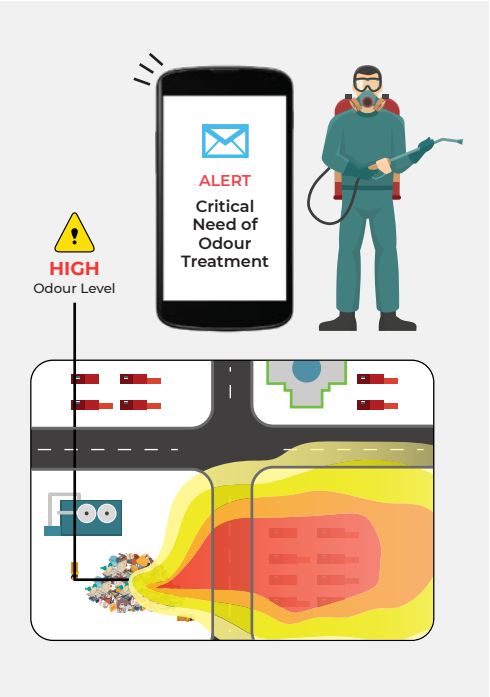
Real-Time Odour Monitoring

Also, the regulatory mechanism and legislation of different regions and countries enforce odour control. Such regulations are usually based on controlling the emission concentration of various odorous compounds. Due to different threshold detection values of each compound, odours can be objectionable even at concentrations which are lower than the enforced limit. As a result, odour complaint becomes a very important and crucial part of odour mitigation.

Dispersion Modelling Assesment

There are various factors that affect the dispersion and transport of odour from the source of generation to the receptor. Common factors that affect dispersion and perception of odour are properties of odorous compounds, wind speed, wind direction, terrain, temperature, relative humidity etc. Modelling the odour dispersion helps in predicting the concentration of odorous compounds downwind to the generation source. Dispersion modelling is commonly used to predict the potential effects of new odour emitting activity.

Real-time monitoring data along with meteorological and land-use data are fed into a model, which provides concentration contours. The output of these models is very much crucial to carry-out the real-time impact assessment of odour. It also helps in understanding the extent and potential of odour nuisance. Based on these results, community alerts can be automatically issued in case of emergency.



Impact Assesment And Complaint Resolution

With the help of data generated by field observations, real-time monitoring of odorous compounds and dispersion modelling, detailed impact assessment can be carried out. Integrating which to a GIS platform helps in understanding odour exposure and potential impacts on population centres. Also, it helps in verifying and investigating odour complaints, complying with industrial permits and odour legislation, assessing long-term odour impacts, and raking potential odour sources.

Further, the impact assessment facilitates the development of odour index, and also helps in enforcing and updating odour regulations. The data is either generated by industrial plants or respective government agencies. However, it also helps private bodies, including industries itself by providing crucial insights of odour control efficiency, and leakage warnings. Better odour control technologies can be developed based on it. Smart complaint resolution improves a company's image and provides citizens with a clean, healthy and productive outdoor environment.

Oizom's Offering To Odour Management

Landfill sites, wastewater treatment facilities and industrial plants are common sources of odour generation due to the presence of a number of odorous compounds. For example, hydrogen sulfide emission is the main cause of odour at wastewater treatment plants while mercaptans and hydrogen sulfide at pulp and paper industries, and ammonia and nitrogen compounds at fertilizer industries are the dominant cause of the odour. The generation of the odour depends upon the source, for which OIZOM has three application-specific odour monitors to offer.

Product Variant	Product Application	Product Parameters
Odosense Lite	General applications	SO_2, H_2S, NH_3, Temperature, Humidity
Odosense Smart	Extensive applications	SO_2, H_2S, NH_3, CH_3SH, CH_4, TVOC, Temperature, Humidity
Odosense Pro	Critical applications	SO_2, H_2S, NH_3, CH_3SH, CH_4, TVOC, CH_2O, NO_2, Cl_2, Temperature, Humidity

Monitoring devices are placed near the potential sources of odour generation. If the odour generated from one source only (point source – for example, aeration tank), the device is usually placed in the downwind direction. However, if the odour generation is fugitive (multiple sources, for example – landfill sites), the monitors are placed in the periphery, as well as in the vicinity if sensitive receptors are located. The number of monitoring devices depends upon the nature ofapplication, area of the industrial plant or landfill site, land-use type of vicinity etc. Real-time meteorological data and real-time odour monitoring data is integrated into odour dispersion models to generate odour concentration maps, which can be updated every hour. Adding additional layers of the population, land-use type etc. impact assessment of odour can be carried out. Real-time odour data and advanced prediction & impact assessment methods facilitate plant managers, government agencies and citizens to take data-driven smart decisions. It improves plant efficiency and also provides a smart and effective complaint resolution.

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With an experience of more than 10 years promoting various Environmental Technologies, Ayyan Karmakar currently leads marketing at Oizom. He is an industry professional with core Environmental Engineering skills with a spirit of continuous learning.

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