MONITORING AND REGULATION OF ODOURS – AN OXYMORON?

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1 ABSTRACT

In this paper the author will explore the concept that odour concentrations can be measured and modelled as chemical substances. He will share his experience with the unreliability and irreproducibility of odour measurements in the lab and in the field. Calamitous consequences have resulted for consultants and their clients who relied on them. The author will share challenges in developing ambient odour monitoring programs and will illuminate the regulators' perspective and concern with ambient odour monitoring. As well, the author will present suggestions for compromise positions that could satisfy all parties to odour management situations - the generator, the sensitive receptors and the regulator that is caught in between.

Until recent years odours were an accepted part of community living in forest industry towns and agricultural communities. Odours from rendering plants, while unpleasant, were accepted as an inevitable nuisance and by-product of an essential industry. Changing attitudes toward air pollution and health mean that people who can smell an industry worry that odours signal the presence of hazardous compounds. Regulators are besieged by citizen complainants who act stridently and inexhaustibly to achieve their goals. As a result regulators are also increasingly sensitized to odour issues.

Regulators and industry are hunting for the grail of an objective odour standard. The trend is to treat odours as any other airborne contaminant, as if an odour were a discrete chemical substance such as SO_2 or NH_4. This is assumption is not working.

The Ontario government has been using a limit of one odour unit (modelled 10 minute average) for regulatory compliance. One odour unit is stringent, and both measuring and modelling are complex and rife with uncertainty. Industry is faced with enforcement action and compliance demands based on this odour limitation. Industry wants/needs a quantitative approach in order to evaluate proposals for large capital projects. Industry has problematic encounters with regulators involving the use of environmental data to understand health and nuisance impacts of odours. Once bitten and twice shy, industrialists experienced in dealing with odour control issues are reluctant to commit to achieving a modelled standard. Increasingly, we are considering whether ambient odour measurement is a more reliable indicator.

2 INTRODUCTION

Historically, North American communities with industrial and natural resource industries accepted odours as an inevitable nuisance and by-product of an essential industry. People often compromised their comfort and simply "lived with" unpleasant odours to keep local industry and associated jobs alive. Over the last few decades, the public has developed a heightened sensitivity to air pollution and potential health impacts. Individuals living or working near odour emitting industries worry that the odours signal the presence of hazardous compounds, such as carcinogens. The result is that the regulator has been besieged with citizen complaints and is correspondingly sensitized to odour issues. The regulator's increased sensitivity has served as a catalyst for the quest to set objective odour standards that are fair to industry and also satisfy the public's desire for clean air.

The challenge of achieving objective, practical and credible odour monitoring and regulation is formidable and increasingly pertinent to regulators, industry, and the public. This paper will use case studies to:

- illustrate regulator and industry perspectives on odour monitoring,
- identify problems associated with measuring and monitoring odours, and
- recommend reasonable compromise positions to facilitate discussion and settlement between parties with conflicting interests.

3 HISTORY OF ONTARIO ODOUR-BASED STANDARDS

In Ontario, odour-based standards emerged in the 1970s, during a period where peer-reviewed odour detection threshold studies were scarce.[1] Thirty years passed and the Ontario Ministry of the Environment (MOE) has decided to address the issue of aging standards. On November 30, 2005, a new comprehensive local air emissions regulation will come into force in Ontario.[2] The new regulation will introduce new standards, update air dispersion models, and provide a risk-based decision making process to address implementation issues.[3] Originally, the MOE proposed to include generic standards for odours with no health effects.

For the last decade or so, the MOE has generally defaulted to a 1 Odour Unit (OU) limit whenever the opportunity or need for a quantifiable odour limit arose. This conservative and rigid approach has led to disputes and protracted regulatory litigation.

The stakeholder comments that emerged from the consultations for the new comprehensive air regulation prompted the MOE to develop a separate proposal for a provincial odour policy framework. To move forward, the MOE published a discussion paper entitled "Proposed

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[1] Ontario Ministry of the Environment, *Proposed Revisions to Odour-based Ambient Air Quality Criteria and Development of an Odour Policy Framework* (Toronto: Queen's Printer for Ontario, March 2005), online: <www.ene.gov.on.ca/envision/env_reg/er/documents/2005/PA05E0007.pdf >.

[2] O. Reg. 419/05 Air Pollution – Local Air Quality (replacing O. Reg. 346).

[3] *Supra* note 1.

Revisions to Odour-based ambient Air Quality Criteria and Development of an Odour Policy Framework".[4] The proposal is intended to consider "the most current knowledge and approaches available" and incorporate input gained from industry, consultants, academia, and other stakeholders.[5]

In this Odour Policy Framework document, the MOE proposes to develop a framework that will utilize Ontario's Ambient Air Quality Criteria (AAQC) for odour and allow for the use of predictive odour impacts and direct measurements as well. Specifically, the MOE seeks to establish limits for the intensity or offensiveness of an odour that is based on a combination of:

> *predictive odour impacts, using emission rates of specific contaminants applied to dispersion modelling and comparing the modelled results to contaminant-specific odour-based AAQCs;*
>
> *predictive odour impacts, using emission rates of specific contaminants applied to dispersion modelling and comparing the modelled results to an appropriate olfactometric based criteria (i.e., Odour Units analyzed by an odour panel) based on Odour Units; and*
>
> *directly measured impacts, through field monitoring using olfactometric techniques with the measured results compared to an appropriate olfactometric criteria based on Odour Units.*[6]

Odour generators face uncertainties when using the various odour monitoring methods, as discussed in further detail below. Although the MOE plans to document methods for "odour dispersion modelling, stack and field olfactometric techniques to assess odour impacts, field sampling techniques and laboratory analysis of sampled odorous emissions", odour monitoring uncertainties will make the MOE's task of setting objective odour standards for Ontario a formidable one.[7]

4 UNCERTAINTIES WITH ODOUR MONITORING AND REGULATION

The uncertainties and complexities of odour monitoring compromise the consistency and integrity of odour regulations. The trend is to treat odours as any other airborne contaminant, as if an odour were a discrete chemical substance such as SO2 or NH4. This assumption is not working. Over the years, our clients have experienced first hand the unreliability and irreproducibility of odour measurements in the lab and field. The consequences have been dire for both consultants and their clients who relied on them.

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[4] *Ibid.*
[5] *Ibid.*
[6] *Ibid.*
[7] *Ibid.*

4.1 ODOUR LABORATORY MEASUREMENTS

The regulated community desires standardized laboratory odour measurement techniques so that results may be produced that yield greater accuracy and repeatability. Common methods that are currently used include olfactometry and chemical analysis, discussed below. Ontario has yet to establish a common standard for odour labs, which has adversely impacted odour generators. The Province has recognized this lapse in standardization and is planning on documenting methods for laboratory analysis of sampled odour emissions in its future Odour Policy Framework.[8]

4.1.1 OLFACTOMETRY

Although meaningful measurement and regulation of industrial odours is currently complex and uncertain, the MOE continues to push for a 1 Odour Unit detection limit (10 minute average) at the most impacted sensitive receptor. The MOE's proposed "Air Dispersion Modelling Guideline for Ontario" indicates that

> *In situations where there are existing odour impacts, or in situations where a proposed facility can be anticipated to be a significant source of odour, the facility will be required to demonstrate that the 10-minute average concentration of odour at the most impacted Sensitive Receptor resulting from the operation of the facility does not exceed one (1) odour unit.*[9]

One Odour Unit is the point where 50% of the 'trained noses' on a qualified Odour Panel can smell (detect) something.[10] The MOE's proposed limit follows the long standing guide contained in the MOE's "Interim Guide to Estimate and Assess Landfill Air Impacts" which recommends the use of an odour detection limit of 1 Odour Unit over 10 minutes at the point of reception.[11]

One Odour Unit is difficult to measure consistently, as our clients have experienced. In one case, split samples taken from the same source were sent to two different odour labs for analysis. The analyses from the two labs revealed a marked variation between the split samples, such that the odour concentrations varied by a factor of two to 100 times.

Other jurisdictions have also noted inconsistencies with olfactometry measurements. The University of New South Wales (Australia) indicates that that the use of different olfactometer based methods can result in inconsistent measurements, such that "a nuisance threshold

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8 *Ibid.*

9 Ontario Ministry of the Environment, *Air Dispersion Modelling Guideline for Ontario* (Toronto: Queen's Printer for Ontario, April 2004), online: <www.ene.gov.on.ca/envision/env_reg/er/documents/2004/air%20standards/PA04E0009.pdf>.

10 Ministry for the Environment, *Good Practice Guide for Assessing and Managing Odour in New Zealand* (New Zealand: Ministry for the Environment, June 2003), online: <www.mfe.govt.nz/publications/air/odour-guidelines-jun03/index.html>.

11 Ontario Ministry of the Environment, *Interim Guide to Assess Landfill Air Impacts* (Toronto: Queen's Printer for Ontario, October 1992).

determined as 1 OU using less sensitive earlier equipment could be rated at 3 - 20 OU using modern equipment".[12] As well, a recent interlaboratory study revealed that of the four participating laboratories, only one met the specified accuracy criterion. This study suggested that even though criteria may be in place for the selection of an odour panel and the screening of results, the experience and training of panel members continues to have "a significant impact on the precision of odour measurements".[13]

Often, achieving 1 OU is not economically viable. Frequently it is not technically achievable. Industrial emitters argue that this is an arbitrary target and is not equivalent to an adverse effect.

In Ontario, Section 14(1) of the Environmental Protection Act (EPA) indicates that:

> *Despite any other provision of this Act or the regulations, no person shall discharge a contaminant or cause or permit the discharge of a contaminant into the natural environment that causes or is likely to cause an adverse effect.*[14]

An "adverse effect" is defined in the EPA, subsection 1(1) to mean any one or more of the following:

- *impairment of the quality of the natural environment for any use that can be made of it,*
- *injury or damage to property or to plant or animal life,*
- *harm or material discomfort to any person,*
- *an adverse effect on the health of any person,*
- *impairment of the safety of any person,*
- *rendering any property or plant or animal life unfit for human use,*
- *loss of enjoyment of normal use of property, and*
- *interference with the normal conduct of business.*[15]

In practice, MOE's odour enforcement is driven by neighbour complaints and not by detection limits. As such, the MOE should consider incorporating additional parameters into its future odour policy, which will support industry compliance with the EPA versus setting arbitrary

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12 University of New South Wales, "Odour Impact Assessment" (Updated: 6 July 2005), online: <www.odour.unsw.edu.au/odour-impact-assessment.html>.

13 Bardsley, T. and Demetriou, J., "Interlaboratory odour study conducted with EPA approved method", Publication SR2, (Australia: EPA Victoria, July 2003), online: <http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/2f1c2625731746aa4a256ce90001cbb5/e667c3348b14b968ca256d94001ed2fb/$FILE/SR2.pdf>.

14 R.S.O. 1990, c. E.19.

15 *Ibid.*

limits and thresholds. The MOE itself recognizes that complaint thresholds are typically 3 to 5 times the detection threshold for any specific substance.[16]

4.1.2 CHEMICAL ANALYSIS

Another method for measuring odours is chemical analysis. This method assumes that by measuring for the presence of a particular chemical compound that the amount of odour present can be estimated.[17] Although this assumption may be workable where an odour is caused primarily by a single chemical compound, the method's application is limited when multiple chemical compounds are the source of a particular odour (i.e., the problem of dealing with masking or additive effects of multiple chemicals).[18] When a mixture of chemicals is responsible for an odour, olfactometry is the most reliable method of measurement.[19]

4.2 ODOUR MODELLING

Odour dispersion modelling is used to predict the concentration of an odour downwind of a source via computer program.[20] Dispersion modeling, for odours in particular, is a complex and inexact science, often with large discrepancies between actual measured results and those predicted by models.[21] Models are considered to perform well if their variance is within a "factor of two".[22] This means that a model output value of 10 could correspond to a measured value of 5 or 20.

Dispersion models are used by the MOE to determine worst-case scenarios for compliance. Many of our clients have been forced to appeal control orders or stringent approval conditions based on speculative modelling results.

Models are not reliable prosecution "evidence" for a POI offence (i.e., In re Voluntary Purchasing Groups, Inc.).[23] However, in one case, the MOE initiated a prosecution based on modelling predictions. We pointed out that the uncertainty in the background data and modelling would not be reliable evidence to support a prosecution. The Crown dropped the charges.

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[16] *Supra* note 1.
[17] Ministry for the Environment, *Review of Odour Management in New Zealand: Air Quality Technical Report No. 24* (New Zealand: Ministry for the Environment, August 2002), online: <www.mfe.govt.nz/publications/air/odour-tr-aug02.html>.
[18] *Ibid.*
[19] *Supra* note 1.
[20] *Supra* note 10.
[21] New South Wales Environment Protection Authority, *Assessment and Management of Odour from Stationary Sources in NSW* (New South Wales Environment Protection Authority, January 2001), online: <http://www.epa.nsw.gov.au/resources/odourpol.pdf>.
[22] United States Federal Register, April 15, 2003, "Revision to the Guideline on Air Quality Models: Adoption of a Preferred Long Range Transport Model and Other Revisions; Final Rule", Environmental Protection Agency, 40 CFR Part 51, Vol. 68, No. 72, online: <www.epa.gov/ttn/oarpg/t1/fr_notices/gaqm_aqac1.pdf>.
[23] *In re Voluntary Purchasing Groups, Inc*., Litigation, 2000 U.S. Dist. LEXIS 18561 (N.D. Tex., Dec. 14, 2000).

In addition, model uncertainty is exacerbated by inconsistent input data from source testing results. In one case, a consultant recommended that the client build a taller stack to solve its odour problems, based on source testing and model results. The client took this advice and made the stack taller. The consultant subsequently took source testing data from the taller stack and modelled new results that indicated non-compliance for the plant. The recommendation to increase the stack height did not in fact reduce the odours. The source testing results gathered after the stack height was increased proved to be markedly higher than the results recorded when the stack was at its original height. Such a discrepancy in source testing data (i.e., model input data) simply adds to the uncertainty surrounding the use of models and illustrates the need for a multifaceted approach to odour monitoring (i.e., ambient monitoring).

Another case demonstrated the business consequences of selecting the correct model. The client's consultant originally modelled individual chemical parameters, and based on the results, recommended that the client increase the stack height. Subsequent modelling, utilizing the PRIME algorithm, identified odour problems from passive roof vents. The results from the PRIME algorithm correlated with observed results (i.e., complaints) and showed that investing in a taller stack would not have reduced the local odour problem.

The uncertainty associated with modelling, combined with the serious associated compliance-based repercussions, has created a contentious climate for clients and consultants. The dire consequences associated with uncertain odour modelling results may compromise the trust held by clients and result in a loss of business for consultants.

Given the inherent uncertainty related to models, regulators should consider additional tools (i.e., ambient measurement) in developing an odour regulatory scheme that increases the regulated community's confidence in and compliance with odour regulations.

In fact, this appears to be the trend Ontario regulators are likely to follow. Under the new local air emissions regulation currently being phased in, the MOE policy is that a combination of modelling and monitoring will be preferred over either monitoring or modelling alone.

4.3 INDUSTRY PERCEPTION

Industry's use of cost-benefit processes (e.g. 6-SIGMA) to evaluate potential capital investments for effective emission control systems is often frustrated with the uncertainties related with the odour monitoring process. These uncertainties paralyse companies from making such investments and results in the status quo being maintained. This effectively stymies growth, flexibility and ultimately profitability.

Industry wants and needs a credible, quantitative approach in order to evaluate proposals for large capital projects.

Once bitten and twice shy, industrialists experienced in dealing with odour control issues are reluctant to commit to achieving a modelled standard. Increasingly, we advise our clients to seriously reconsider whether ambient odour measurement is a more reliable indicator.

5 RECOMMENDATIONS

5.1 REGULATION

The regulator should incorporate a multifaceted approach to odour regulation and monitoring and not simply rely on a single standard (e.g., the 1 OU standard). Various techniques and standardized testing protocols should be incorporated that consider olfactometric based criteria, modelling and direct measurement (i.e., ambient monitoring). Such an approach will help to achieve a dynamic odour monitoring program that is flexible and fair to industry and also reduces public complaints related to odours.

5.2 COMPLAINTS

The impacts of odours are highly dependant on the varying sensitivities of individuals. An odour that may be very offensive to one person may not offend another at all. Some odours may even be offensive to people simply because of the activity associated with the odour (e.g., sewage treatment, rendering plants, etc.) and may result in a large number of public complaints, even if the odour is at the barely detectable or even the non-detect level.[24]

Public complaints are an important consideration for the regulator and industry, as they are often the catalyst for compliance actions.

How the regulator and industry respond to complaints is important to future credibility and satisfaction on both sides. The common perception is that the regulator has a tendency to take complaints at face value (i.e., that every complaint is legitimate). Conversely, industry is perceived as having a tendency to characterize complaints as the result of hyper-sensitivity or vindictiveness on behalf of the public (i.e., the public wants industry to relocate).

In order to eliminate such perceptions, there needs to be a systematic, objective, competent approach developed to deal with complaints.

5.3 MONITORING AND MEASUREMENT

Although we recommended that olfactometric based criteria, modelling and direct measurement (i.e., ambient monitoring) be incorporated into an effective odour plan, various issues related to these must be reconciled first. These are:

- Olfactometric odour measurement techniques need to be standardized so that clients can have confidence in the accuracy and repeatability of associated results.
- Modelling results should be verified in the field. Increasingly, clients are refusing to accept modelling results at face value and need further assurance as to accuracy.
- Ambient monitoring should be considered in comparing options for odour mitigation.

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[24] *Supra* note 1.

6 CONCLUSION

Developing clear regulatory standards for industrial odour compliance is a work-in-progress that is going to take time, effort, science and goodwill to resolve. The regulated community has experienced numerous challenges with the measuring and monitoring of odours. Inconsistent results have shaken industry's confidence in odour monitoring and acted as a hindrance to capital investments in emission control technologies. The regulator needs to develop a flexible and dynamic odour policy that will satisfy the public, reduce related complaints, and at the same time treat the regulated community fairly. Unfortunately, the long road to this end is proving costly for companies who are guinea pigs in the odour policy development process.

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