9th IWA Odour & VOC/Air Emission Conference
26-27 October 2021 Bilbao, Spain

ABSTRACT

THE LONG AND WINDING ROAD OF CEN/TC264/WG41 DEVELOPING A STANDARD FOR VALIDATING INSTRUMENTAL ODOUR MEASUREMENT SYSTEMS

Anton P. van Harreveld
Convenor CEN/TC264/WG41 IOMS, The Netherlands

WG41 was established to define methods to validate the use of IOMS (formerly known as e-noses) in applications for implementation of air quality regulations and licenses, where odour is a concern.
The group has attracted a number of experts from the following countries: Belgium, France, Germany, Italy, the Netherlands, United Kingdom.
The measurement tasks where an IOMS could be used were defined as:

- Detecting the absence or presence of the odour under study
- Classifying the presence of multiple odours under study (odour A, odour B, ….., odour X) or the absence of all of these odours
- Measuring the odour stimulus indicator, as a measure of the amount of odour present, an indicator for odour concentration.

IOMS can be applied at the source, at the fenceline or at a receptor location.
The task of WG41 has turned out to be a complicated one. A major objective of this effort was to clearly separate between the sensory process of olfaction and the instrumental process of detecting ‘odour stimulus indicators”.
To simplify the task, WG41 took an early decision to not give consideration to the IOMS instruments and their technical design or workings. Neither did WG41 consider the training of these instruments, which uses a variety of methodologies, from simple linear approaches combining a few sensor signals to advanced AI algorithms.
WG41 considers the IOMS as a black box, which offers a response when exposed to air, and air containing odorants.
The main objective of WG41 is to define validation procedures for IOMS instruments in the application. How predictive are the indicator values of an IOMS for the sensory perception of a human assessor?
For absence/presence and classification of “odours under study” this was relatively straightforward.
However, validating the quantity value output of an IOMS as an indicator value for the odour concentration proved to be a major challenge.
In metrology, typically a reference method is defined with an uncertainty that is an order of magnitude below the uncertainty of the measurement method that is being validated/calibrated.
Using olfactometry as a reference method proves to be problematic, because of the considerable inherent random measurement error of the method. Typically, it is assumed that the real value of odour concentration lies, in 95% of cases, between half and double that value.

A proven approach is to increase the number of replicate analyses. When analysing n = 4 replicates, the uncertainty is reduced to half. Increasing the number of replicates to n =16 reduces the uncertainty to a quarter. It is clearly that the law of diminishing returns is valid in this consideration.
The challenge is to come up with a meaningful relation between the claim a manufacturer makes, on the confidence interval of the IOMS. This range is associated mathematically to the standard uncertainty.
The challenge is to define a minimum programme of validation measurements, on sufficient independent odour samples with an adequate number of replicates, to reach a meaningful conclusion on the validity of the manufacturer's claim.
In datasets available to the WG41 members, we see that the uncertainty in the IOMS data is still Larger than that in n=1 olfactometry, by a factor of approx. 1,5. This means that a relatively limited number of samples and replicates will be sufficient.
When IOMS results improve, the design of the validation test programme will need to become more ambitious and extensive too, in order to confirm the manufacturer's claim.
Through mathematical simulations, members of WG41 have developed the underpinning that is fit for purpose to design the optimum approach, balancing the resources required with the relevance and meaningfulness of the validation outcome.
In the end the purpose of the standard WG41 is developing is to provide a well-founded validation for applications of IOMS instruments, when the intention is to use these instruments in the verification and enforcement of license conditions and air quality endpoints for odour exposure.

Indicate preference of kind of presentation

- ■ Oral Communication
- ☐ Poster

Indicate topic of your work for the conference:

- ■ Policy and associated regulations for odour and air quality.
- ☐ Odour/VOC measurement, monitoring&sensor technologies.
- ☐ Odour/VOC perception, impact, formation and dispersion.
- ☐ GHG emissions particulate matter and industrial emissions.
- ☐ Source characterization and odour/VOC mapping.
- ☐ Odour/VOC abatement, mitigation and neutralization.
- ☐ Odour/VOC from waste water, sewer systems and livestock.
- ☐ Air emissions and sustainable solutions for waste handling
- ☐ Community engagement, social media and citizen action.
- ☐ Other (suggest a new topic):

The scientific committee may change the session where authors propose to include their works.