

How to measure odor emissions?

Olfactometry: sensory technique for measuring odors.

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Olfactometry is a laboratory technique that uses the smell of trained people to quantify odors in gas emissions and ambient air. It is basically a quantitative method to measure the intensity of odors in the air that replaces the instrumental chemical sensors with a very particular neurochemical sensor, smell.

Is it a subjective method?

The application of olfactometry to determine odor units is a standardized method to quantify the degree of intensity of odors in a gas sample. There are two reference standards for carrying out this sensory analysis: the ASTM Method E 679 method and the UNE-EN 13725 standard. The first is the worldwide reference standard and the second is a European standard that includes many recommendations from the ASTM standard, but with additional requirements. In general terms, the two standards are based on the known *Forced-choice dynamic olfactometry procedure*, using three nozzles for sensory evaluation, the sample with odors comes out of one nozzle and clean air comes out of the other two nozzles, which are used as reference targets.

The measurement of odor units is carried out in the following way:

- A panel of qualified evaluators is chosen. They must meet certain requirements or preliminary tests to be part of the panel.
- A piece of equipment known as a dynamic olfactometer is used, which is responsible for mixing or diluting the sample with clean air and sending it to the nozzles where the sensory analysis is performed.
- The evaluators are carrying out odor detection and identification tests. The procedure consists of sending the gas sample through one nozzle, and sending clean air through the other two. The sample is sent randomly to one of the three nozzles, so the panelist does not know which nozzle the sample is going to come out of. The concentration at the beginning is such that all the panelists identify the nozzle through which the odorous sample comes out by smell. In each round, the dilution of the odor-bearing sample with clean air is increased; as dilutions increase, it becomes EROM difficult for testers to identify the nozzle from which the odorous sample is exiting. The dilution procedure is continued until the panelists no longer detect the odor at the nozzle from which the sample comes out. The reference dilution is the one at which only 50% of the panel

Definitions:

Smell: organoleptic property perceptible by the olfactory organ when it breathes in certain volatile substances.

Panel of Experts: The panel is made up of 8 people selected with very similar perception thresholds (those individuals who detect the calibration gas n-butanol at EROM concentrations and with a low standard deviation between their perceptions).

European Odour unit (OUE): That amount of odorant(s) that, when evaporated into 1 cubic metre of neutral gas at standard conditions, elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM), evaporated in one cubic metre of neutral gas at standard conditions.

European Reference Odour Mass (EROM): The accepted reference value for the European odour unit, equal to a defined mass of a certified reference material. One EROM is equivalent to 123 µg n-butanol (CAS 71-36-3). Evaporated in 1 cubic metre of neutral gas this produces a concentration of 0,040 pmol/mol.

could detect the odor and therefore correctly identified the nozzle through which the odorous sample came out.

- The calculation of odor units is performed, which is reported as uoE/m³.

According to the UNE-EN 13725 standard, an odor unit corresponds to the concentration of odors that have an odor intensity equivalent to 123 µg in a cubic meter of clean air. Evaluators must first undergo a standardization test with n-butanol, before being considered a competent evaluator to belong to a panel.

Image 1: Trained personnel measuring odor units



Source: St Croix Sensory.

Method applications.

This methodology is applied to evaluate the intensity of odor in gas samples that go through a duct or exit through a stack (gas emission). In this way, the method serves to evaluate the removal effectiveness of an odor control system, by taking a sample before and after the system, the effectiveness of odor removal of the system can be determined. Likewise, it can be used to evaluate dispersed sources of odors such as a landfill or a pigsty, and determine the effect on the surrounding ambient air.

Another important application of the odor unit measurement method in stack gas emissions results from its combination with gas dispersion models. A gas dispersion model results from the application of mathematical algorithms combined with meteorological information from the site, which allows knowing the way in which the gases that come out of a chimney or by a diffuse source are dispersed. Having the measurement of the gas flow, the concentration of odors (measured as odor units) and meteorological data, it is possible to determine the concentration of odors in each receiver or point of interest where the gases are directed, so that you obtain a map of concentrations of odor units in the surroundings of the industry or activity that emits odor emissions. With this procedure, it is possible to determine the sites and receptors (neighbors) for which concentrations of odor units are obtained above a defined standard, and who, therefore, are the ones who are or will be affected by the emissions of said activity.

It is important to mention that this tool can be used not only to evaluate an existing case where there are complaints, but also as a tool for forecasting the conditions that will arise when a certain industry or activity settles in a particular area.

Are there standards or reference values?

The measurement of odor units is not a subjective method, but rather a sensory method that allows obtaining values comparable to norms and standards. Although there are differences in the level of odors that each person can perceive (the response or annoyance to an intensity of odors in each person is different), there are levels of intensity of odors (odor units), at which it is ensured that the vast majority of people will not feel discomfort. Table 1 shows recommended values as standard to guarantee a nuisance-free environment for the population or locality.

Table 1. Odor impact criteria based on UK Environmental Agency guidance.

Offensiveness Scale	OIC	Example of Odor Source
Most offensive odors	1.5 ouE/m ³	Decaying animal or fish remains, septic effluent or sludge, biological landfill odors.
Moderately offensive odors	3.0 ouE/m ⁴	Intensive livestock rearing, fat frying (food processing), sugar beet processing, well-aerated green waste composting.
Less offensive odors	6.0 ouE/m ⁵	Brewery, confectionery, coffee roasting, bakery.

Source: Environment Agency UK 2011, Ref: LIT 5419. Environmental Permitting: H4 Odour Management. Available online: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296737/geho0411btqm-e-e.pdf.