AltraSens

OdourVector™

Continuously Monitoring Odour Measurement System

‚Electronic Nose'

Applications for odour measurements:

- On-line odour monitoring and timely counteractive measures help to prevent nuisance odour
- Documentation for residents and authorities
- Extended lifetime for odour filters
- Assisting R&D projects for the development of innovative measures to reduce nuisance odour
- Increasing the accuracy and significance of olfactometric reports

How does continuous odour measurement work?

The human sense of smell reacts to a relatively small part of the volatile compounds in the air, known as the odour compounds. Pleasant odours are often associated with fresh food, unpleasant odours in contrast are associated with food which has gone off or foul water and generally indicate a dangerous situation. There is a complex relationship between odour compounds and smell which cannot be described by analytic measurements only.

The method of ‚Technical-Sensory Odour Measurement' uses special gas sensors to monitor the odour compounds. From the sensor signals the odours and smells in the atmosphere can be projected. Similar gas compositions can be identified using a mathematical evaluation method. In a calibration phase olfactometric data (i.e. data from a human sensory panel) can be used to correlate the sensor data with the human sense of smell. After successfully calibrating the measurement system the stand-alone instrument can monitor the quality and intensity of odours and smells continuously.

Technical odour measurement – a technological and methodical problem

The expression ‚Electronic Nose' is used for a variety of measurement systems which aim to mimic the human sense of smell. However, an electronic nose cannot be compared to a human nose in the sense that: receptor cells = gas sensors and olfactory system in the brain = computer programme.

From many years of experience with „Electronic Noses" the following conclusions can be drawn:

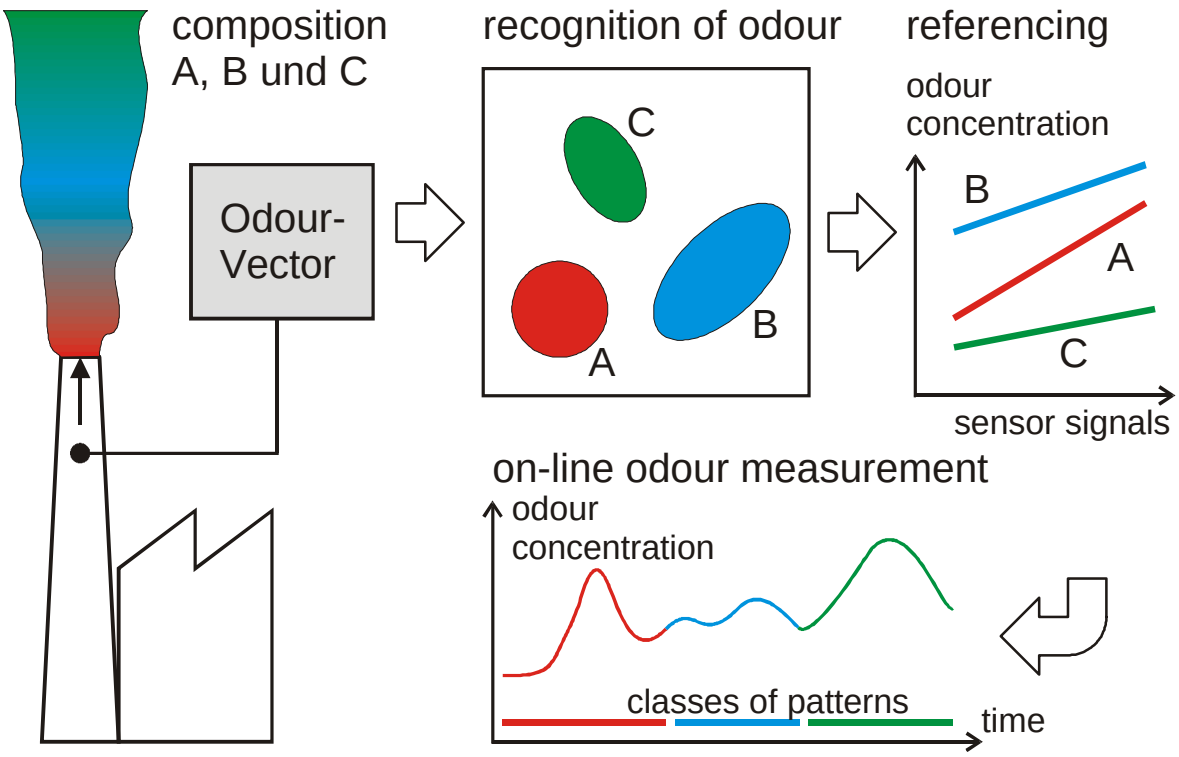
- Gas sensors detect odourless gases as well.
- Gas sensors change their characteristics with time (by drift and ageing).
- Too simple data evaluation methods produce wrong ‚pseudo-results'.

This leads to the following criteria for odour measurement systems:

- The chemical measurement must be tuned the range of odour compounds.
- A high stability of the chemical sensors is required (to maintain the calibration information and allow quantitation of the odour emissions).
- A strict method must be applied to the odour measurement. This method must be adjusted to the special conditions of the respective application.

The measurement system OdourVector™

The measurement system OdourVector is the result of many years of research in cooperation with partners from industry and universities and meets the above criteria for odour measurements. It uses mass sensitive gas sensors which favour the higher molecular odour compounds. The measurement principle is a reversible physical-chemical absorption reaction which minimises ageing and drift problems often experienced with other sensor technologies. An integrated thermal desorption unit enhances the sensitivity and improves the chemical imaging of gas atmospheres. The TD unit also allows a partial separation of the gas components. The data evaluation method complies to the special conditions of odour measurements, too. Olfactometric reference data from sensory panels are used to calibrate the system and to associate the sensor signals to the various odour patterns resulting in a reliable prediction of odour emissions.



Technical-sensory odour measurement using the measurement system OdourVector™.

Applications

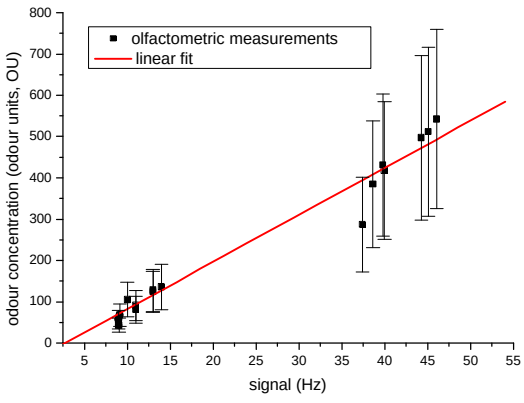
Odour filter monitoring

Odourous emissions from an industrial plant are usually filtered, e.g. by using charcoal filters. Odour Vector was used to comply with the limits of concentration and to allow a better service management of the filters. The measurement system continuously monitors the emissions unsupervised and reports filter failures and breakthroughs.

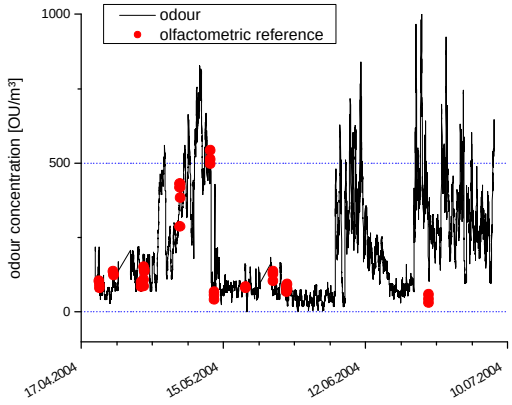
The filter material can now be used near to the filter breakthrough point. Therefore, the continuous monitoring helps to extend the lifetime of the odour filters. As the system response is recorded it can be used as documentation of the present emission situation. This can be used in a complaints procedure with authorities and residents.

Olfactory polluted emissions

Filter unit to reduce odour emissions



Correlation between sensor signals and odour units.



Odour prediction and measurements

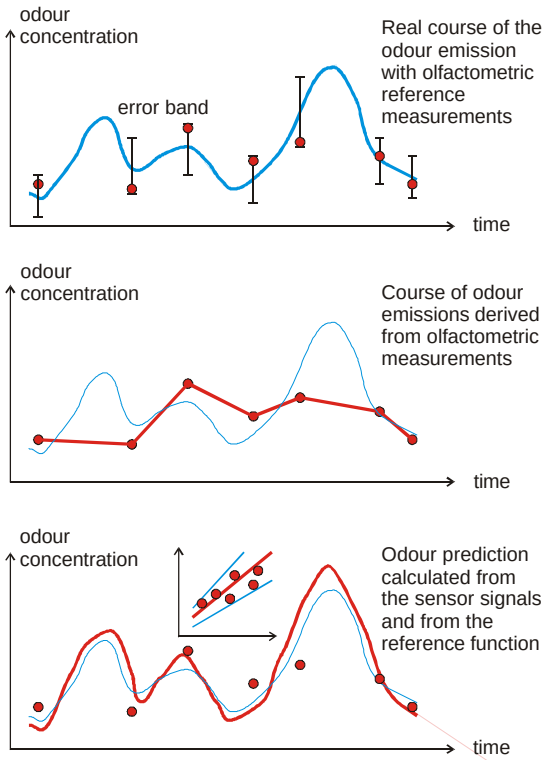
Sensor assisted olfactometry

In order to assess odour emissions it is extremely helpful to have a complete course of odour emissions over a representative period of time. The full emission characteristics can be monitored by using OdourVector, whereas olfactometry can only deliver spot samples from the course of emissions.

Taking into account that there usually is a 50% error on those spot samples, the picture of the emission characteristics from olfactometry is very imprecise and does not give a meaningful result of what causes the odour emissions.

However, a combined analyses of odour emissions using both, continuous data from OdourVector and reference data from olfactometry, provides a precise prediction of those emissions.

OdourVector has a GSM data modem interface and can be remote controlled.



Data can be transferred in real time from remote locations via the widely available mobile networks as well as via email. The operator can prompt the stand-alone instrument to send an email message with the logged data files or change the parameter settings of the instrument if measurement conditions have changed. This also reduces the costs for servicing and operating the instrument.

Via a potential-free switching output OdourVector can trigger a sampling procedure for an olfactometric measurement depending on the signal levels of the sensors. The trigger level can be adjusted via the GSM modem interface. This optimises the timing of the olfactometric sampling (e.g., only sample when emissions are high).

Further applications and projects

OdourVector has already been used for numerous projects and applications:

- Monitoring odour emissions from a sewage canal.
- Dosage of odour supressing additives in a sewage canal.
- Long term monitoring of emissions from a biological sewage treatment plant.
- Monitoring industrial emissions from a metal processing plant.
- Recycling of biofilters
- Monitoring the efficiency of odour filters in a waste incineration plant.

AltraSens and five technologies GmbH

The technology of the OdourVector™ is a result from a long-term co-operation between university and industry. Some of the research was funded by the German Federal Ministry of Education and Research.

AltraSens is a spin-off from the University of Bonn and offers services and technology in the field of odour measurement together with **five technologies GmbH**, a Munich based company.

The initiator of AltraSens, Priv.-Doz. Dr. rer.nat. Peter Boeker, is also leading a research group at the University of Bonn and is presently working on a project to improve the fundamental understanding of ‚technical-sensory odour measurement' (OdourMon). This work is funded by the German Research Foundation (DFG).

The aim of this R&D project is to develop the fundamentals for a future directive for ‚Technical-Sensory Olfactometry' following the present directive for olfactometry.

More information: www.altrasens.de

More information on the technology and applications can be found on the internet. A number of papers explaining the fundamentals of technical-sensory olfactometry can be downloaded as pdf-files from www.altrasens.de.

Technical background

The measurement system OdourVector comprises a gas conditioning unit, a pre-concentration device, the measuring cell and a signal evaluation unit.

Six gas sensors are used in the measuring cell which are integrated on a mass sensitive transducer (quartz microbalance). Inside the instrument is a pre-concentration unit (thermal desorption) which is optimised for the sensors and enhances the sensitivity of the system by several orders of magnitude. A partial separation of low, medium and high volatile compounds in the desorption process increases the selectivity of the system.

All functions and circuits are controlled by a central microcontroller which is also responsible for the internal data evaluation. A pattern recognition functionality is implemented in the data evaluation algorithms for the identification of reference classes from the signal pattern of a measurement. Calibration functions can be assigned to each of the reference classes. After the recognition of an odour pattern a quantification process can be started. An analogue output (0...10V) is used to transmit the odour concentration to a central control system.

OdourVector can be used as a stand-alone unit, but can also be connected with a PC. If a PC is connected all raw data are stored each second.

For remote control operation a GSM data modem is used to record the data and send the logged data file via email attachment to a selected email address. All parameters of OdourVector can be accessed via the modem, therefore the system can be configured by remote control with the same functionality as a direct PC connection.

OdourVector continuously monitors the level of the sensor signals. If the level is over a set limit (e.g., the signal of a certain sensor element has exceeded a certain level more than 5 times) the instrument can trigger an external device (e.g. an olfactometry sampling system). At the same time the GSM modem prompts a text message to a selected mobile number to insure a timely collection of the sample.