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Monitoring of smell emissions in agriculture

Application of chemical sensor arrays

For those living in the vicinity of farms, smell pollution has become, for the most different reasons, an increasing problem. Because of the growing sensibilities of the population the identification of unwished-for smells can no longer be ignored. In this report, results from the comparison of different ventilation systems via multisensor-array have been documented. The great advantage of multisensor-array measurements compared with olifactometry is the continuous registration of values as opposed to the smaller number of sample probes used for olfactometric measurements.

Up until now the recorded emission patterns from different livestock housing systems were mostly based on the climate-relevant trace gases. Because of lack of measuring technology, smells were mostly not brought into such evaluations. Presented here are results of multisensor-array monitoring of smell emissions from different housing systems.

Material and methods

Olfactometry is the current technology for measurement of air pollution in units of smell – thus allowing assessment of its effect. More details about this are included in the VDI regulation 3881 [1 – 4]. Construction and function of multisensor-array systems were explained in detail in the previously published part 1 of this series [5,6].

The experiment was carried out on a farm in two departments of the same feeding pig building. The samples were taken from the exhaust air canals of both departments of the insulated building. The difference in the exhaust air systems: one department featured above-floor air extraction and the other under-floor extraction. During the continuous trial over eight days (8.9.1999 to 15.9.1999) the above-floor extraction department was changed-over to the same under-floor system as the other on 13.9.1999.

In this determination of odour substance concentration, consideration had to be made of the difference of average liveweight of pigs in the individual departments (Department 1 under-floor with around 50 kg/pig representing 19 animal units (GE); Dept.2 above-floor around 100 kg/pig representing 41 GE).

Monitoring in the feeding pig building

Parallel to the continuous measurements with multisensor-array, olfactometric measurements were also carried out. The results of these measurements are shown in fig. 1. A difference between the smell substance concentrations of the two departments over the total period is identifiable. Ten samples were taken from each department during the total trial period. On average two samples per day were analysed. Clearly visible is a fault in sampling during the period from 11.9.1999 to 13.9.1999. In this case, the main problems of olfactometry were very clear. On the one hand the human nose is capable of analysing smell samples via only a limited number of smell procedures, on the other, very high labour costs are involved in collecting a representative number of samples on a weekend. Further, there exists the problem of the dependency of the measurement value on the condition of the sampler (collective) on that day, which is the explanation for the exceptional result at the end of the measurement. The average smell substance concentration so recorded in department 2 was 204.5 GE/m^3. The concentration in the exhaust air canal of department 1 (with the smaller pigs) was a little less at 130.3 GE/m^3.

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The work was financed by the Bavarian State Ministry for Rural Development and Environmental Matters.

Refereed report for LANDTECHNIK, the full-length version of which can be accessed at LANDTECHNIK-NET.com

Keywords
Emission, odour, multisensor-array, monitoring

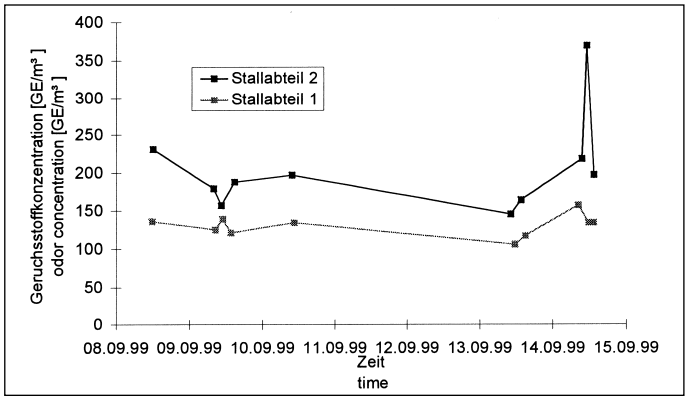

Fig. 1: Odor measurement on two compartments of a pig fattening stable using olfactometry

TTable 1: Comparing average odour concentrations partments of a pig fattening stable using with olfactometrics and with multisensor-array

Housing pens	Livesstock (adult units)	Odour concentration (adult units/m³)- olfactometric	Odour concentration (adult units/m³) Multisensor-multisensor-array
1	19	130,3	128,89
2	41	204,5	165,23

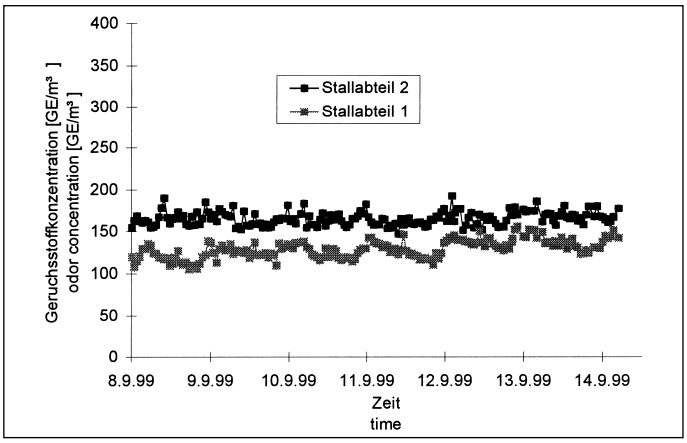

Fig. 2: Odor monitoring in two compartments of a pig fattening stable using with olfactometry and multisensor-array

In the following results the data from the olfactometry and the sensor measurements are brought together. The olfactometric measuring point, for which there are simultaneous multisensor-array measurements, serve then as the basis for a calibration of the multisensor-arrays.

According to information from the literature [7], the correlation between the olfactometrical smell units and the sensor signals can be produced over the sum of the sensor signals (total of maximum deflections of 18 sensors). With the data determined in this project there results a calibration line for the smell substance concentration as function of the sum of the sensor signals with the function Y=12.955X-2.93. The average quadratic deviation represents 0.9274; this graphic is presented in the full-length version of this report in LANDTECHNIC-NET.com.

With the help of this calibration it is now possible to calculate the continuously recorded sensor data on smell substance concentrations. Within these measurements a recording of interior air in one of the two departments of the pig building was taken every 20 minutes over a period of eight days. This meant data from each department was recorded every 40 minutes. It was thus possible to carry out a quantitative-continuous monitoring of both house departments. The smell monitoring reproduced in fig. 2 showed, over the total period and analogous to the olfactometric data, a higher concentration in department two where the larger pigs were kept. Through the continuous data recording via the multisensor-array, a daily pattern was able to be seen clearly, especially with the smaller animals. This was displayed through a rise in the smell substance concentration during the morning hours and a sinking of the concentration at night. Through the lesser nighttime value, which were not recorded by the olfactometric measuring, the average value of the sensor measurements was lower than the olfactometric ones. A summary of these values is shown in table 1.

As can be seen from figs. 1 and 2, the measurements carried out here failed to measure any change in the smell substance concentration caused by the adjustment in the exhaust air systems . For a final evaluation of the air exhaust systems, long-term measurements are currently being carried out. These more precise investigations over all seasons take account of further influence parameters such as the different ventilation rates and weight gains of the livestock. Only then will it be possible to evaluate the different ventilation rates with regard to smell emissions.

Conclusions

The results documented here show that farm smells can be evaluated with the help of multisensor-arrays. At the same time, data can be taken from several measurement points. This leads to the possibility of being able to observe daily patterns in closely-spaced periods but also offers at the same time the chance of continual monitoring of smells over a period of several weeks. The great advantage compared with olfactometry methods lies also in the system's non-dependence on the condition of the samplers on each day. In this way, it is just as possible to carry-out a comparison of livestock production systems as a smell monitoring comparison. This sort of monitoring can then also record influences which lie outside the normal working hours. In the full-length version of this article, reproduced in LANDTERCHNIK-NET.com, a comparison is presented of the emission rates of both house departments taking account of the different liveweights of the animals.

Literature

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Vorschau

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