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Measurement of smell emissions

Application of olfactormetry and chemical sensor arrays in a comparison of feeding pig housing

Here documented are the results from the comparison of different housing systems for feeding pigs using olfactometry and chemical sensor arrays. In a long-term comparison of a conventional insulated house and two different types of naturally-ventilated trial units on the same farm, statements regarding odour emissions from the different house types could be made. A reduction in odour emission potential from the naturally-ventilated units could be demonstrated during all three trial periods compared with that for the conventional insulated part-slatted house with forced ventilation.

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This work was financed by the BML and the BStMLuU.

A refereed paper for LANDTECHNIK, the full-length version of which can be accessed under LANDTECHNIK-NET.com

Keywords

Emission, odour, monitoring, housing systems, fattening pigs, chemical sensor array

Literature details are available from the publishers under LT 01114 or via Internet at http://www.landwirtschaftsverlag.com/landtech/local/fliteratur.htm.

As rural settlements become more densely populated an increasing number of inhabitants feel themselves afflicted by odours, especially those from farm animal production. Presented here is odour monitoring through chemical sensor array and olfactometry.

Trial farm

Because of the multi-factorial influences on emissions, comparing systems in pig feeding between several farms is very difficult. In this case, therefore, direct comparisons were made between a conventional insulated house with slatted flooring (kW) with 52 animals, a naturally-ventilated house with loafing kennels and part-slatted flooring (AKt) and a naturally-ventilated house with loafing kennels and littered dunging area (AKe), each with 64 animals, all situated on the same commercial farm.

Method

A practice-proven system developed for long-term measurement of exhaust air flow from naturally-ventilated outdoor climate housing is described in detail in the full-length paper (see LANDTECHNIK-NET) and in [1]. This method allows the exhaust air flow to be assessed with the help of measuring fans and this system was also used for measuring exhaust air flow in the conventional forced-ventilation insulated house.

Using olfactometry [2, 3] (Olfactometer from Mannebeck, TO4) the odour concentrations were determined in GE/m^3 at the different sampling points in the naturally-ventilated trial unit exhaust air and in the conventional insulated house during three trials each lasting eight to 10 days in April 1999 (G1), August 1999 (G2) and January 2000 (G3).

Results

During all three trial periods the average odour concentrations from the naturally-ventilated trial compartments lay clearly under those of the conventional insulated houses. These results are fully depicted in graphic form in the full-length version of this report (see LANDTECHNIK-NET). The odour concentrations are also summarised in *table 1*. During the August measurements (G2), the odour concentrations in both naturally-ventilated trial compartments were roughly the same as during the April measurements. The August odour concentrations in the conventional insulated house, however, were only just under half the value of those during the April trial whilst nonetheless still two to three times higher as those from the naturally-ventilated trial compartments. The smaller odour concentration in the conventional insulated house at summer was caused by the higher exhaust air flow during the sampling in August. In the winter sampling, odour concentrations in both the naturally-ventilated trail compartments were clearly under the level of the concentrations measured in the conventional insulated house. The concentrations in the naturally-ventila-

Table 1: Number of animals, animal weights and air flow during odour measurement at the olfactometer (T04)

	Conventional insulated house (kW)			Naturally-ventilated house part-slatted (AKt)			Naturally-ventilated house littered (AKe)		
	Odour concentration GE/m^3	Σ Animal live-weight kg	ø Exhaust air flow m^3/h	Odour concentration GE/m^3	Σ Animal live-weight kg	ø Exhaust air flow m^3/h	Odour concentration GE/m^3	Σ Animal live-weight kg	ø Exhaust air flow m^3/h
G1	364.7	4227	4000	73.8	5620	8300	82.8	5770	8400
G2	197.4	3591	5000	71.71	4008	7900	65.57	4202	7700
G3	220.8	3844	3000	32.2	4908	5400	27.96	4928	5000

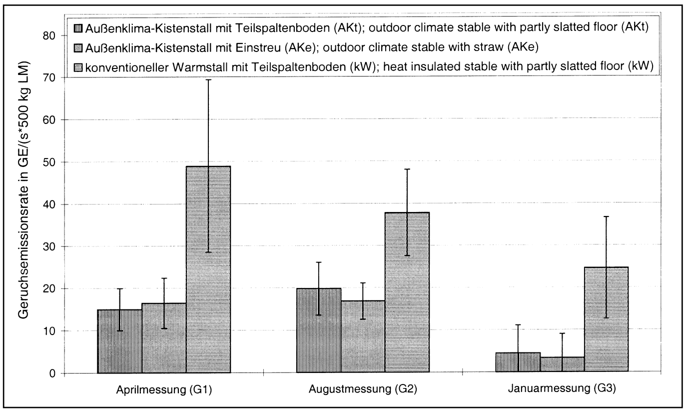

Fig. 1: Odour emission rate in OU/(s•500 kg LW) with according standard deviation of the mean during the respective measuring periods

ted trial compartments during the winter were also only about half as high as during both other trial periods which could be attributed to the low average outer and interior temperatures during that period of – 4.0 °C and 5.6 °C respectively.

The two naturally-ventilated trial compartments differed from one another hardly at all as far as odour concentrations were concerned, but the difference was very clear between them and the insulated house.

In the trial period G2 (August 1999) a continuous monitoring by chemical sensor array was carried out (as described in [4]) in addition to the olfactometric measurements. The sensor measurements took place in all three sampling points within the different housing types so that samples could be taken hourly from the same house compartment. These sensor readings were calibrated according to the olfactometrical odour concentrations whereby the sensor humming signal was able to be recalculated into odour concentrations.

The continuous measurements gave, in agreement with the olfactometrically recorded measurements, continuously higher odour concentrations in the insulated house compared with the two naturally-ventilated trail compartments. It was also shown that the variability of the concentrations in the area of the naturally-ventilated compartments was greater than that in the insulated housing. The recording of such dynamically timed results was not possible with the up-until-now non-continuous olfactometry technique.

In order to improve the comparability of the results, the concentrations were multiplied with the exhaust air volume flow and the resultant odour emission flow standardised per 500 kg animal liveweight. The end results for trial periods G1 to G3 are presented in *figure 1*. The necessary animal weights and exhaust air flows required for calculating these odour emission rates are included in *table 1*. The lower total liveweight in the conventional insulated house was because of the low stocking rate in this compartment.

Regarding the standardised odour emission rates (fig. 1), the picture shown is the same as that already shown by the concentrations. The amounts for both naturally-ventilated trial compartments are very similar and no clear tendency can be determined as to which naturally-ventilated housing system had the higher odour emission per 500 kg lw. This impression was strengthened by observation of the standard deviations within the average values, which are a measurement for the variations of the odour emission rates during the respective measurement periods. The standard deviations of both naturally-ventilated houses overlapped one another, whilst the average value of the odour emission rate of the conventional insulated house clearly differed from these. The relatively large standard deviation made it additionally clear in all cases that the odour emission rate is subject to larger variations.

On average, the continuous measurement by chemical sensor array (*fig. 2*) showed, in agreement with olfactometry, higher odour emission rates from the insulated house than from the naturally-ventilated trial compartments. This method also enabled the recording of the measurement value time dynamics. Clearly noticeable was a high variability of the values in the area of the naturally-ventilated trial units, which could be attributed to the influences of the temperatures and the volume flow. Here, the usefulness of continuous measuring was emphasised. As indicated above, odour emission rate variations over the day could not be shown with olfactometry.

Classifying the results

As already reported in [4] the suitability of the chemical sensor array technique for measuring of odours from farm units could be documented here too. It was, however, only thanks to repeated olfactometric measurements carried-out by a team of well trained testers that made an evaluation of the different housing systems possible. The suitability of the chemical sensor array technique was clearly shown [3, 4]. Thus this technique can be used directly in the future for the long-term monitoring and for evaluation of systems.

The measured odour emission rates for the conventional insulated house of 48.9 (G1), 37.8 (G2) and 24.6 (G3) GE/(s•500 kg lw) lie, in large, at the same level as the results from [5, 6, 7, 8] and [9] in [10] with part slatted floors, and with a full slatted ones from 52 GE/(s•500 kg lw) as well as 39 to 78 GE/(s•500 kg lw). Compared with the conventional insulated house (kW) the naturally-ventilated trial compartments lay in summer with an average 18.3 GE/(s•500 kg lw) lower than the conventional insulated house by the factor 2 and in winter by the factor 7.

The absolute peak of the measured emission rates can only serve as orientation values because of the limited representativeness of the chosen investigation periods. It is possible, however, to use the figures for a comparison of investigated systems within the same farm manager-influence and surrounding condition. In the naturally-ventilated trial compartments with part-slatted flooring and with littered flooring these trials showed a reduction in odour emission potential compared with the conventional insulated part-slatted housing with forced ventilation during all three trial periods.

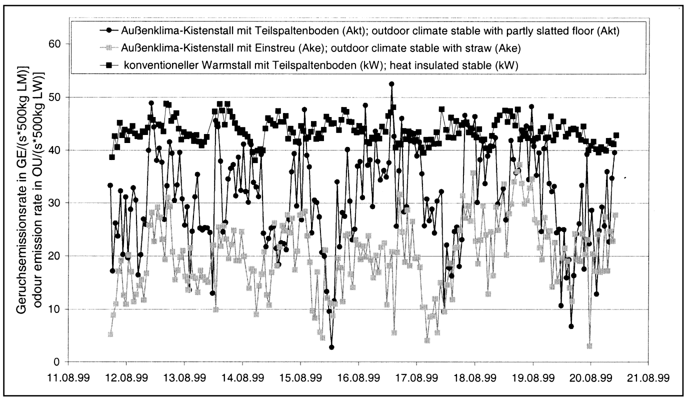

Fig. 2: Odour-monitoring using an olfactometrically calibrated chemical sensor array