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Using slurry additives to reduce emissions

Slurry additives offer the advantages of supplementary application within conventional production systems. Main aims are the reduction of odour and ammonia emissions. Statistically supported differences between treated and untreated slurry manure up until now have only been able to be confirmed in a very few cases. Quantifying additive-caused material changes within slurries enabled conclusions to be drawn regarding emissions of pollutant gases.

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Keywords

Emission reduction, liquid manure additives, ammonia

Ammonia occurs in livestock housing through bacterial and enzymes decomposition of compounds containing nitrogen, mainly excrement. Regarded as sources of the nitrogen-containing decomposition products of excrement are, above all, undigested and microbial synthesised protein and urea. Urea is the main source of NH3 production in livestock housing [1].

The basis, therefore, for applying slurry additives is the influencing of microbial activity with the aim of encouraging a certain germ flora or the inhibiting of undesirable microbial activities.

Measuring conditions and methods

The measuring conditions were already extensively described by the authors in LANDTECHNIK 6/2000.

Testing the efficiency of slurry additives under practical conditions took place between 13.01 and 30.05.2000 in two trial series, i.e., under typical winter and early summer conditions.

Trial locations were two piglet-rearing compartments at the Agrargenossenschaft Barnstädt in the Querfurt district.

Tested was a mineral mixture based on limestone and sand (97.5% CaCO3 and SiO2) and a liquid 80% lactic acid additive. In each case, the materials were applied in the respective pig compartments through the slatted flooring.

In table 1 the additive amounts and volumes of slurry during the trial periods are collated.

There was a control compartment for each trial where no additives were applied and where the gas concentrations of ammonia, nitrous oxide, carbon dioxide and methane were continually recorded and compared with those in the application compartments. Gas measurement was by a multigas monitor from Brüel & Kjaer.

Fig. 1 shows the location of measurement points whereby the animal inhalation zone, exhaust air concentrations, concentrations of exterior and intake air, were all taken account of as background information.

In order to inhibit condensation within the PTFU gas pipelines, pipeline packages were formed, insulated and fitted with electric heating cables. The temperature level within the pipeline packets was adjusted to the livestock housing compartment temperature.

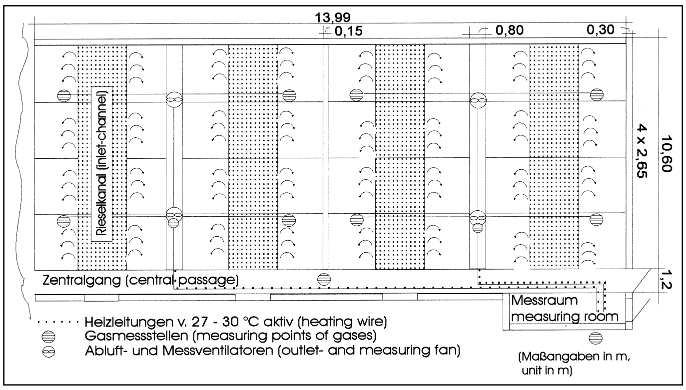

Fig. 1: Position of gas measuring points in the piglet rearing compartment

Table 1: Dosages of liquid manure additives

Slurry manure-additive	Period of-use	Slurry production/ Compartment and month Control (m³)	Variant (m³)	Application amount (g or l) *manufacturer's figurs. **calculated from laboratory trails
Stone meall	13.1 .to 14.3. 2000	16,5	16,9	1x400 g/week* 5x200 g/week*
Lactic acid (80 %)	30.3 to 30.5. 2000	14,6	16,0	50 l/week**

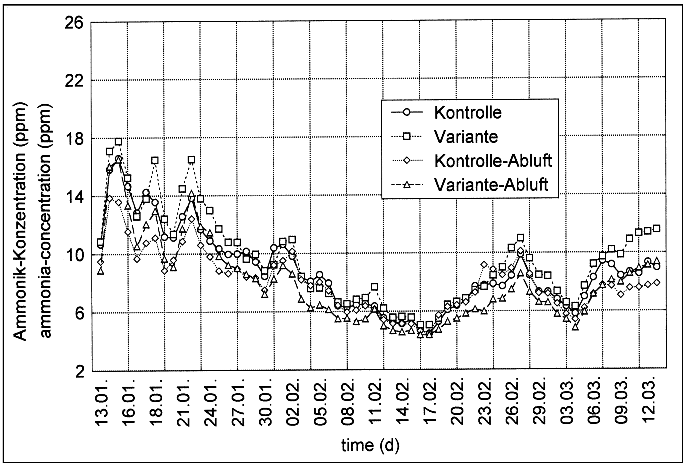

Fig. 2: Mean ammonia concentration in air when adding mineral powder

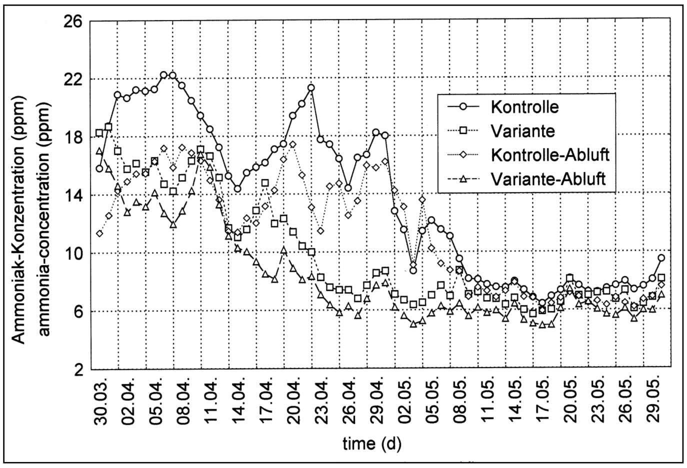

Fig. 3: Mean ammonia concentration in air when adding lactic acid

In the following report only the ammonia concentrations are addressed.

Results

Development of the ammonia concentrations in both trial series is presented in figs. 2 and 3. It can be seen that only in the second trial series was the Pig Production Act of 1994 [2] threshold value of 20 ppm slightly exceeded. Furthermore, a strongly decreasing level of concentrations during the rearing period could be noted. This, however, could not be attributed to the effect of additives alone. More responsible for this effect were the low temperature requirements of the pigs and, with that, the associated higher air exchange rates.

Comparisons of average concentrations produced statistically supported differences not only within, but also between, the compartments.

Stone meal

From fig. 1 indicates that, because of the generally low ammonia concentrations, no conclusions were able on the emission-reducing effect of stone meal.

The pH analyses (6.9 and 6.7) and ammonia and total nitrogen contents (NT = 2195.08 and 2531.30 mg N/ 100g DM) also confirmed these results. Average dry matter content of the slurry was 5.6%.

Lactic acid

Lactic acid application results differed widely. Ammonia concentrations between control and the variants in the first two thirds of the trial periods differed from one another very clearly. The same applied to the exhaust air concentrations. A clear reduction in concentration, caused by high air exchange rates, appeared only in the final third period. pH comparisons showed a reduction in the trial variants of about 2.5 compared to control.

Presented in table 2 are average ammonia emissions, calculated on the basis of exhaust air concentrations and exhaust air volume flow, for the trial period. Although the exhaust air volume flow in the lactic acid variants was around 1000 m3/h higher than the control, the ammonia emission could be decreased by 11%.

Conclusions

High pH values in the alkaline zone and high slurry temperatures strongly influenced the ammonia desorption rate.

The application of lactic acid as slurry additive and the associated decrease in pH meant important changes in ammonia emissions could be achieved. Similar investigations by other authors have led to the same conclusions [3, 4, 5].

Important for success is a graduated application of the additive to guarantee a continuous decrease in pH over a long period.

It should also be mentioned that adding lactic acid to slurry causes a reaction associated with strong foam creation which in turn has a hygienic effect. Where there's a substantial reduction of floating crust it can be assumed that there's been a homogenising effect. Rheological investigations are required here. In total, the practical application supporting the already existing laboratory results. Application is therefore advisable so long as, according to [6], no detrimental effects from the acidified slurry can be found for plants or soil. Further work should lead to increasing precision of application so that costs can be reduced.

Regarding the stone meal additive, there are different points of view whereby the biochemical association requires further clarification. It could be shown in laboratory trials up until now that applying mineral additives (carrier material CaCO3) tends to push pH into the base zone and thus increase the desorption rate of ammonia.

Table 2: Ammonia emissions in the piglet rearing compartments

Trail-period	Controlle NH_3 g/h	Variante NH_3 g/h
13.1 to 14.3. 2000	8,7	9,6
30.3. to 30.5. 2000	32,8	29,1

Literature

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