Pablo Meissner and Herman Van den Weghe, Vechta

Methane Emissions

Comparing Two Litterless Pig Fattening Housing Systems

In conventional pig fattening houses, considerable methane emissions are released through the fermentation of carbon in organic matter. In an experimental house with a flushing manure removal facility and sequential biological treatment, the excreta were removed from the house daily. Compared to an identical house compartment without a flushing device, methane emissions were reduced up to 90%.

Prof. Dr. Ir. Herman Van den Weghe is the director of the Research Centre for Animal Production and Technology of the University of Göttingen, Universitätsstr. 7, D-49377 Vechta, holding the chair for process engineering. M. sc. agr. Pablo Meissner is a scientist working at the same institute, e-mail: *pablo.meissner@agr.uni-goettingen.de*.

Keywords

Methane, emissions, flushing gutters, slatted floor, fattening pigs

After carbon dioxide, methane is considered the most important anthropogenic greenhouse gas. World-wide, it causes ~ ~ 15% of the anthropogenic greenhouse effect. Even though rice paddies and the anaerobic digestion processes of ruminants are the most significant anthropogenic methane sources, methane emissions from animal excrement should not be underestimated [1, 2]. During slurry storage in the stall area, carbonaceous organic substances as well as anaerobic conditions combined with the prevalent temperatures unavoidably cause methane emissions. The question arises to what extent methane emissions from litterless fattening pig housing can be reduced in the stall area by flushing out the excrement produced daily.

Material and Methods

Two identical compartments of a fattening pig house with a fully slatted floor (120 animals per compartment) were studied comparatively with regard to their methane emission behaviour. One compartment was equipped with flushing gutters (*Fig. 1*). The second compartment, which featured conventional housing and intermediate slurry storage in the stall, was considered a reference compartment. In order to guarantee the comparability of the two compartments, the stalled-up animals were identical with regard to age, genetic origin, and production-technical treatment. For the determination of methane emissions, methane concentrations in the exhaust air were measured with the aid of a photo-acoustic system (multi-gas monitor 1302, company Innova, DK). The air volume flows in both stall compartments were determined on-line, using calibrated measuring fans (FMS 45, company Fancom, NL).

The slurry flushed out daily was treated mechanically and biologically using a treatment plant described in [3] (*Fig. 2*). In the first process step, the flushed-out slurry was mechanically separated in a funnel-shaped sedimentation tank. The liquid phase thus gained was used for other flushing processes without water supply. 40% of the thin fraction produced underwent discontinuous biological treatment in a gassed stirring tank (batch operation). In the reaction container, primarily the nitrification of ammonium nitrogen as well as the breakdown of carbon and odour-intensive organic compounds

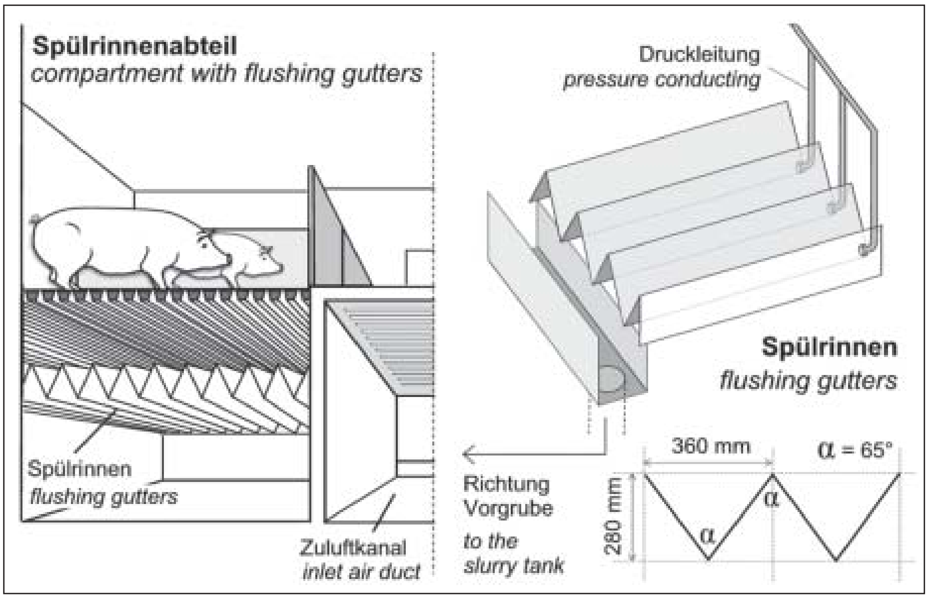

Fig. 1: Cross section of the compartment with flushing gutters

took place. After biological treatment, the tailings were mixed with the untreated thin fraction in another tank. This biologically stable mixture was used for the daily flushing (once or twice) of the flushing gutters. The treatment plant as well as the operation of the flushing demanuring system in the stall were controlled automatically.

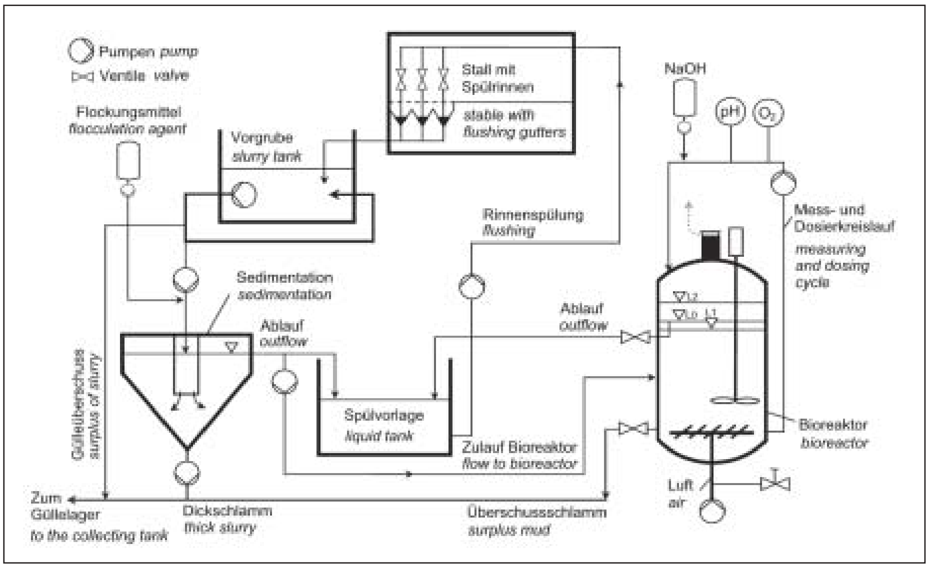

Fig. 2: Flow chart of the experimental facility[3]

Results and Discussion

In order to be able to evaluate the effect of flushing intensity on methane emissions, three fattening periods in different seasons were, carried out which differed with regard to flushing intensity. In the first trial (winter conditions, measuring period 12 weeks), flushing was done once a day. In the second trial (summer, measuring period 12 weeks) and the third trial (winter, measuring period 12 weeks), the flushing rhythm was 12 hours.

In all three fattening periods, significant differences in the methane mass flows (*Fig. 3*) manifested themselves between the flushing gutter and the reference compartment. Independent of flushing intensity, methane emissions in the winter half year were very similar, reaching values of 3.5 to 5.3 g per animal place (AP) and day (d) in the flushing gutter compartment and 26.8 to 28.7 g per animal place and day in the reference compartment. The corresponding average reduction rates ranged between 80 and 88%. In the summer half year, the loads produced increased enormously in both stall systems as a result of the higher temperatures. This confirms earlier studies [1]. The loads increased to an average of 16.7 g AP^{-1} d^{-1} in the flushing gutter compartment and 67.6 g AP^{-1} d^{-1} in the reference compartment. This corresponds to an increase of 380% in the flushing gutter compartment and 244% in the reference compartment. In the summer trial, the average reduction rate between the two compartments amounted to ~ 75%. Flushing intensity was shown not to have any significant influence on the reduction of methane formation.

Conclusion

The use of a flushing gutter system enables methane emissions from the stall area to be kept at a very low level. However, this does not solve the problems. The flushing out of the slurry only shifts the emission potential to the nearest storage container. A sustainable reduction of methane emissions can only be achieved if the flushed-out slurry is treated actively (e.g. anaerobic fermentation for biogas production).

Literature

Books are identified with •

[1] *Husted, S.*: Seasonal Variation in Methane Emissions from Stored Slurry and Solid Manures. J. Environ. Qual. 23 (1994), pp. 585-592

[2] *Ahlgrimm, H.-J. und J. Breford*: Methanemissionen aus der Schweinemast. Landbauforschung Völkenrode, 1998, H. 1, S. 26-34

[3] • *Kiuntke, M.*: Entwicklung und Einsatz einer Spülentmistugsanlage im Praxismaßstab in der einstreulosen Mastschweinehaltung zur Reduzierung gasförmiger Emissionen. VDI-MEG-Schriftenreihe Forschungsbericht Agrartechnik Nr. 395, Dissertation, Göttingen, 2002, 198 S.

Fig. 3: Methane emissions (Mean of daily averages (n=84), rate of reduction and standard deviation [in bars])