

Hydrogen sulphide in a fattening pig barn operated with in-house acidification

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Topic

- ▶ In-house acidification using sulphuric acid (H_2SO_4) is a promising option for ammonia emission abatement since an emission reduction over the entire manure cascade including housing, manure storage, manure application can be achieved
- ▶ The emission reduction is due to $\text{NH}_4^+ \leftarrow \text{NH}_{3,L} + \text{H}^+$ at a pH < 6
- ▶ Addition of sulphur with the acid to slurry gives rise to concern for enhanced formation of hydrogen sulphide (H_2S) in livestock housings

Objectives

- ▶ Determination of H_2S concentrations in a fattening pig barn with 400 places in 16 pens littered with straw pellets with partly slatted floor and forced ventilation before and after installation of an in-house acidification
- ▶ Evaluation for exceedance of critical exposure limits (e.g. threshold of 10 ppm over 15 min)

Materials and methods

- ▶ Inhouse acidification
 - ▶ Addition of 96% H_2SO_4 to a 32 m³ process tank adjacent to the pig barn until target pH of 5.5
 - ▶ Flushing of the channels in the barn at 8h00 and 16h00 with the acidified slurry for 5 min
 - ▶ Use of acid: 15.6 kg 96% H_2SO_4 per m³ slurry
- ▶ H_2S concentrations in the barn were measured with portable gas detectors "PAC 6500 and Multiwarn II" from Dräger and with electrochemical sensors (range of 0.1 - 100 ppm) during four measurement campaigns
- ▶ One measurement campaign was conducted before the acidification was operative and three campaigns with acidification in summer and winter with and without ventilation of the slurry channels (see picture at the right side)
- ▶ The number of measurement periods was 5 for the measurement without acidification and 6 to 14 for the measurement with acidification
- ▶ The duration of a measurement period was 10 to 104 min

Results

- ▶ A pH of 5.5 was achieved in approx. 50% of all measurements by sensors in the process tank (<5% of all values \geq pH 6.0)
- ▶ H_2S was exclusively detected when channels were flushed. Outside of periods with flushing, H_2S concentrations were below detection limit of 0.1 ppm
- ▶ The maximum 15-min mean value was 20.2 ppm and obtained before acidification was operative
- ▶ With slurry acidification, no exceedance of the 15 min threshold of 10 ppm occurred; the maximum H_2S concentration was 4.8 ppm
- ▶ Overall, the average H_2S concentrations with slurry acidification (0.14 ppm) were lower than without acidification (1.44 ppm)
- ▶ The mean values of measured H_2S concentrations in winter (0.16 ppm) were higher than in summer (0.06 ppm) due to higher barn ventilation rates in summer
- ▶ The use of the ventilation system in slurry channels reduced H_2S concentrations to 0.16 ppm compared to 0.30 ppm without ventilation



Aerial picture of the pig barn with the inhouse acidification



Exhaust duct for channel ventilation

Conclusions

- ▶ Slurry acidification did not enhance H_2S concentrations in the indoor air of the investigated pig barn which is in line with previous studies
- ▶ The low H_2S concentration with acidification can be explained by the inhibition of sulphate reduction by microorganisms at a pH of approx. 5.5

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