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Emission of nitrous acid (HNO_2) and other nitrogen (N) compounds from biotrickling filters treating exhaust air of pig houses

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Air scrubbers are used for removal of ammonia (NH_3) and other compounds from exhaust air of mechanically ventilated animal houses. In single-stage biotrickling filters, and multi-stage scrubbers (combining a water spray section with biotrickling), ammonia is converted to nitrite (NO_2^-) and nitrate (NO_3^-), and discharged with the waste water. In some cases an additional denitrification step is used. Such systems normally operate at near-neutral pH (6.5-7.5). A field survey was carried out to investigate effects of pH on emissions of a range of nitrogen compounds. Samples of inlet and outlet air of biotrickling filters were taken at 15 farm locations and analysed for NH_3 (gas detection tubes), nitrous oxide (N_2O) (gas chromotography) and nitrogen oxides or NO_y (chemiluminescence NO_x analyser). Results show that systems running at normal pH (n=3) had an average NH_3 removal of 65% and low production of N_2O and NO_y. Systems with added denitrification (n=4) had relatively high N_2O emissions, equalling 14% of all NH_3-N removed. Systems operating at low pH (< 6.5) (n=6) showed very high NO_y emissions, equalling 61% of all NH_3-N removed. This appears to be caused by evaporation of nitrous acid (HNO_2), which is a volatile compound. This reduced the apparent N-removal of the scrubber system from 100% (as based on NH_3 only), to a net N-removal of 36%, if all N compounds are taken into account. Systems with high pH (> 7.5) (n=2) showed low NH_3 removal (22%) and relatively high N_2O production (71% of all NH_3-N removed), but the net N-removal was only slightly lower (19%). As scrubber performance (N-removal) is commonly estimated based on NH_3 measurements only, the emission of other nitrogen compounds might often remain unnoticed. It is concluded that it is important to prevent low pH conditions in biotrickling filters, as the net N-removal can be drastically affected.

Keywords:
biotickling filter, animal house, nitrous acid (HNO_2), nitrous oxide (N_2O), ammonia (NH_3)