

Assessment of Odour Reduction through Waste Air Treatment Systems

Waste air treatment systems are used in animal husbandry to abate odour emissions from forced-ventilated stables. In this paper the odour reducing effect of an acid scrubber-biofilter combination with a biotrickling filter is evaluated with the aid of a large number of randomly selected panellists. The results show that both techniques are suited for reducing odour intensity and hedonic odour tone as well. In general, the panellists judged the two-stage, the more complex technique, more favourably than the biotrickling filter.

Dr. rer. nat. Jochen Hahne is a member of the scientific staff of the Institute of Technology and Biosystemtechnology at the Bundesforschungsanstalt für Landwirtschaft (FAL), Bundesallee 50, 38116 Braunschweig; e-mail: jochen.hahne@fal.de

Keywords

Waste air, odour, waste air treatment, animal husbandry

Literature

[1] DIN EN 13725: 2003-07: Bestimmung der Geruchsstoffkonzentration mit dynamischer Olfaktometrie. Beuth Verlag GmbH, 10772 Berlin

For the reduction of odour emissions from animal husbandry facilities, waste air treatment systems are increasingly used. Due to the waste air composition and the comparatively high volume flows primarily biofilters, waste gas scrubbers and combined systems come into operation. The odour reduction of a waste gas treatment system is measured by olfactometry which is described in EN 13725 [1]. Following results show, how a major number of randomly selected persons evaluate the efficiency of an acidic scrubber / biofilter combination and a biotrickling filter in the range of pig keeping.

Test description and methods

Odour samples were continuously pumped with different lines to an odour measuring device, which was located outside of the waste gas treatment system. The measuring device was started 24 hours before sampling. Panellists should evaluate the raw gas, the scrubber outlet and the biofilter outlet from the acidic scrubber / biofilter combination (Fig. 1, measurement 1 and 2). The testing of the biotrickling filter was carried out by an evaluation of the raw and outlet gas (measurement 3). At first panellists were asked for the relative odour intensity whereas a scaling with the classifications „very intensive“, „intensive“, „moderate“ and „imperceptible or hardly imperceptible“ was allowed. Afterwards the panellists were asked for their evaluation of the hedonic odour tone during measurements 1 and 3, which has to be clas-

sified as „very unpleasant“, „unpleasant“, „neutral“ and „pleasant“. Additionally the panellists were asked for the kind of smell during measurement 3.

The biotrickling filter was identical in design with the acidic scrubber, whereas water without pH control was used as scrubber liquid. Furthermore both scrubber units were completely separated by stopping the pump 3. Both test options were operated over several weeks under constant conditions before sampling. Essential operation parameters are summarised in Table 1. There was neither an exchange of washing liquid nor of biofilter material.

Results

The relative odour intensity evaluation of the two stage process with a 3 years old biofilter material during measurement 1 with 83 panellists showed that the raw gas from a conventional pig stable was felt as „intensive“ or „very intensive“ by 74.7 % of the panellists (Fig. 2). The scrubber outlet was classified as „moderate“ and the biofilter outlet as „imperceptible or hardly perceptible“ by the majority of panellists (67.5 % and 87.9 % respectively). In terms of the hedonic odour tone the survey showed that the raw gas was felt as „unpleasant“ or „very unpleasant“ by 91.8 % of the panellists. Also the scrubber outlet was classified as „unpleasant“ (69.8%). In contrast 97.2 % of the panellists assessed the biofilter outlet as „neutral“ or „pleasant“. A repeated measurement after two years under nearly comparable condi-

Table 1: Operation parameters of the waste gas treatment systems during odour valuation

Measurement No	SGL [m ³ /m ³ h]	BGL	Composition of scrubber liquid *					
			PH S1	PH S2	NH ₄ -N S1 [g/kg]	NH ₄ -N S2 [g/kg]	NO ₃ -N S1 [g/kg]	NO ₃ -N S2 [g/kg]
1	2214	110	3.11	1.16	15.3	0.51	0.07	0.01
2	1956	100	2.97	1.05	10.2	0.04	0.003	0.002
3	1346	-	6.28	5.84	4.62	0.55	1.34	0.21

SGL: scrubber gas load, BGL: biofilter gas load, S1: unit 1, S2: unit 2

* Nitrite nitrogen was only detectable at measurement 3 with 0.32 g/kg in unit 2. The low nitrate nitrogen concentrations at measurements 1 and 2 resulted from nitrate inputs by fresh water.

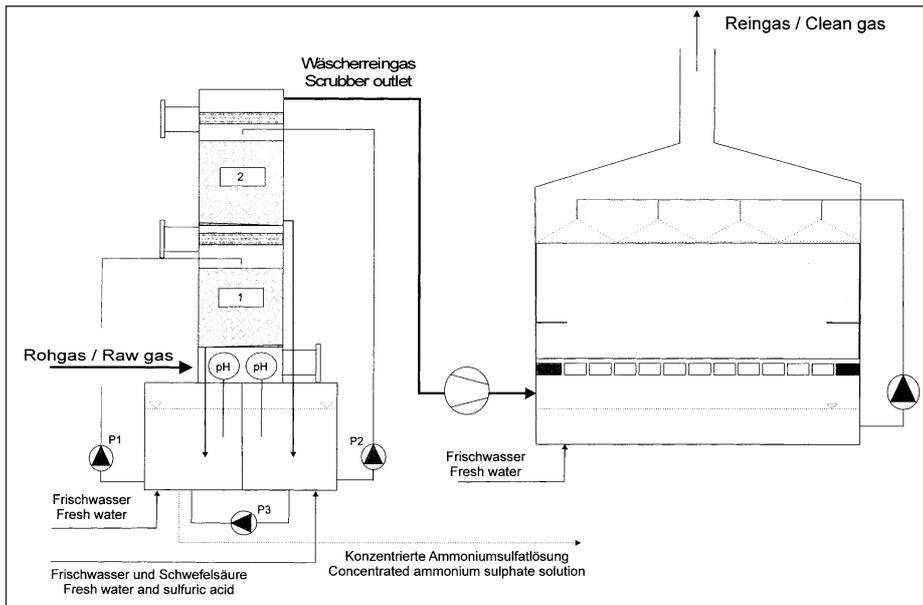


Fig. 1: Flow chart of the two-stage FAL waste gas treatment system for stable waste gas cleaning

ons with 152 panellists (measurement 2) showed similar results for the raw gas. 90.8 % of the panellists classified it as „intensive“ or „very intensive“. The scrubber outlet was evaluated very inconsistently. 22.4 % of the respondents evaluated the scrubber outlet as „intensive“, 33.6 % as „moderate“ and 26.3 % as „hardly perceptible“. The biofilter outlet was classified as „moderate“ by the majority (59.2 %). Merely 23.7 % and thus considerable less panellists in comparison to the former measurement classified the biofilter outlet as „imperceptible or hardly perceptible“. The biofilter material (0.5 m shredded root wood and 0.5 m bark mulch on top) was five years in use at that time. For the measurement 3 the acidic scrubber was reconstructed to a bio-

trickling filter several weeks before sampling. 96.2 % of the 133 respondents evaluated the raw gas odour intensity as „intensive“ or „very intensive“ (Fig. 3). Thus the raw gas was classified similarly at all measurements. In terms of the hedonic odour tone the results showed that 91 % of the panellists classified the raw gas as „unpleasant“ or „very unpleasant“. They described the kind of smell as „pig stable“ or „animal house“. The respondents evaluated the outlet of the biotrickling filter as „intensive“ (42.1 %) or „moderate“ (52.6 %). Merely 2.3 % of the panellists classified the outlet as „imperceptible or hardly imperceptible“. The hedonic odour tone of the outlet was evaluated by the majority as „unpleasant“ (60.2 %). 3.8 % of the respondents classified it even as „very unpleasant“.

22.6 % of the panellists evaluated the outlet as „neutral“ and 10.5 % as „pleasant“. The panellists replied the question on the kind of the smell with „sewage plant“ (44.4 %), and „animal house“ (36.1 %). 19.5 % of the respondents had with „sulphurous“, „as bread“, „garlic“ or „maize silage“ very different impressions.

Conclusions

Waste air from conventional piggeries was predominantly evaluated as „intensive“ or even „very intensive“ in terms of odour intensity by randomly selected persons (75 to 96 % of the respondents). More than 90 % classified the hedonic odour tone as „unpleasant“ or „very unpleasant“. The use of waste air treatment systems resulted in a noticeable reduction of the odour intensity and in an improvement of the hedonic odour tone as well. In comparison to the biotrickling filter the two stage and more complex process of acidic scrubbing and subsequent biofiltration tended to result in a stronger reduction of odour intensity and in a more obvious improvement of the hedonic odour tone.

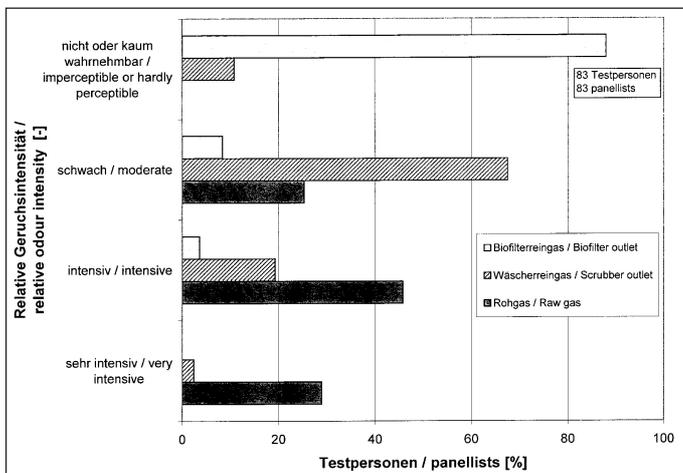


Fig. 2: Assessment of odour intensity of the two-stage waste gas treatment system at different measuring points (measurement 1: biofilter material three years in use)

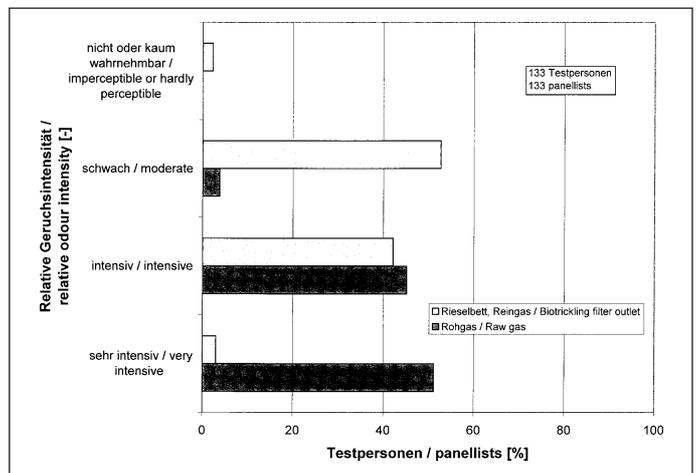


Fig. 3: Assessment of odour intensity of raw and outlet gas from a biotrickling filter for stable waste gas cleaning