

TECHNOLOGY SUMMARY

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Multi-pollutant Scrubbers for Removal of Ammonia, Odor, and Particulate Matter from Animal House Exhaust Air

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Species: Swine, Poultry
Use Area: Animal Housing
Technology Category: Scrubber
Air Mitigated Pollutants: Ammonia, Odor,
Particulate Matter

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System Summary:

In The Netherlands, Germany and Denmark packed-bed biotrickling filters and acid scrubbers for removal of ammonia from exhaust air of animal houses are off-the-shelf techniques for ammonia removal (70 - 95% average removal). At the moment a new generation of so-called "multi-pollutant scrubbers" is being developed and tested that not only removes ammonia but also aims for significant removal of odor and particulate matter (PM10 and PM2.5) from the air. Recently a 3-year research program has started that monitors and aims to improve the performance of five farm-scale multi-pollutant scrubber from different manufacturers. The preliminary results show that the average ammonia removal is relatively high (83%, n = 7) but that the average removal of odor (40%, n = 8) and particulate matter (PM10: 43%, n = 2; PM2.5: 42%, n = 2) needs to be improved further.

Applicability and Mitigating Mechanism: Limitations:

- Ammonia scrubbers consist of two types: either acid scrubbers or biotrickling filters
- Multi-pollutant air scrubbers usually consist of two or more scrubbing stages where subsequent removal of coarse dust, ammonia and odor takes place
- Scrubber are mainly applied in pig housings with central ventilation ducts; application in poultry housings are scarce because of high dust concentrations
- Already 10% of all exhaust air from pig houses The Netherlands is treated; this equals a treatment capacity of 79 million m³/hour
- Odor and dust removal is less effective than ammonia removal, at least for now
- High concentrations of coarse dust result in blockage of packing material and increased energy use (pressure drop)
- Costs are considered high, but multi-pollutant scrubbers provide an option for large scale livestock operations to remain in operation in areas nearby residential areas and sensitive ecosystems

Cost:

Investment and operational cost of scrubbers for newly built production facilities in €/ animal space.

	Acid scrubber	Biotrickling filter	Multi-pollutant scrubber (3-stage water/acid/biotrickling)
Investment costs	32.8	43.5	50.3
<i>Operational costs (year⁻¹)</i>			
Depreciation (10%)	2.6	3.4	4.2
Maintenance (3%)	1.5	1.8	2.0
Interest (6%)	0.8	1.0	1.2
Electricity use (€0.11 kWh ⁻¹)	3.3	3.8	3.7
Water use (€1.0 m ⁻³)	0.6	1.7	0.6
Chemical use (€0.6 L ⁻¹ H ₂ SO ₄ , 98%)	1.4	n/a ^[c]	0.7
Water discharge ^[b]	0.6	2.5	1.0
Total operational costs (year⁻¹)	10.8	14.3	13.5

^[a] The investment costs are based on a maximum ventilation capacity of 60 m³ animal place⁻¹ h⁻¹.

^[b] Water disposal costs are assumed of €10/m³ for discharge from acid scrubbing and €2/m³ for discharge from biotrickling or water scrubbing. For the multi-pollutant scrubber, discharge water from the biotrickling or water scrubbing step is reused in the acid scrubbing step. The systems do not include a denitrification unit which might significantly decrease water discharge costs.

^[c] n/a = not applicable.