

TWO-AIRSPACE BUILDING DESIGN FOR REDUCING ODOUR AND GAS EMISSIONS FROM GROWER – FINISHER BARNs

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Air quality in the barn and in its vicinity

Odour and gas emissions from swine operations can be a nuisance to nearby residents. In Canada, most pig barns have outside manure storage resulting in two odour sources on the production sites: the building and the manure storage facility. By keeping the manure inside the building, the nuisance sources would be reduced to only one. A two-air-space building concept where pigs would dung in an enclosed dunging area (EDA) above the slats could result in an improvement of the barn air quality as odours and gases from dunging and the manure itself would be contained inside the EDA. By extracting part of the ventilation rate through the EDA and treating this air with a biofilter, the overall emissions from a swine operation could be reduced.

Objectives

The objectives of the project were:

- To construct an EDA that will:
 - be consistently used by the pigs.
 - minimise odour/gas transfer to the pig/worker airspace.
- To observe the pig behaviour in a pen equipped with an EDA.
- To design and test four types of opening for the EDA:
 - no door, solid door, strip curtain and air curtain.
- To construct and evaluate a two-air-space ventilation system.
- To investigate the use of biofiltration for odour removal from EDAs.
- To measure odour and gas emissions from a feeder barn provided with EDAs and biofilters.

This project was conducted at two locations: at Prairie Swine Centre (PSCI) for the engineering development of the EDA concept and pig behaviour analysis, and at the University of Alberta for the development of the biofilter and its implementation with the EDA. This article summarizes the work completed at PSCI.

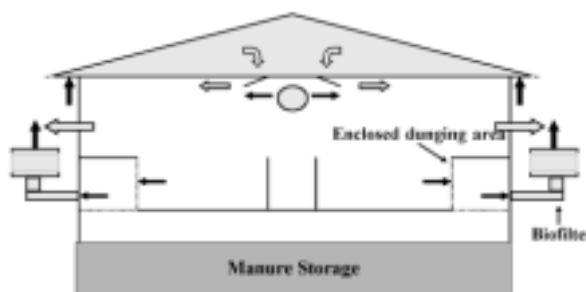
The development of the two-air-space concept

The EDA design was established through different steps to analyse the different components of the new concept and their impacts on the pigs.

- Air containment tests were performed in laboratory at the University of Saskatchewan to verify the potential of the EDAs for gas containment.
- Behavioural studies of the pigs using open EDAs were conducted at PSCI.
- Engineering modifications to the EDA design were implemented to help controlling pig dunging behaviour and to improve gas containment.

The most promising EDA was selected for thorough in-barn testing at PSCI and was equipped with:

- a full strip curtain on the whole width of the pen that reduced gas containment but greatly improved pig usage of the EDA and cleanliness of the pens;
- bars that were laid on the slats and intermittent water sprinkling used for a few days to discourage pigs from sleeping in the EDA.



Schematic of the two-air-space building design

The most promising design featured a full strip curtain, bars on the slats and intermittent water sprinkling.

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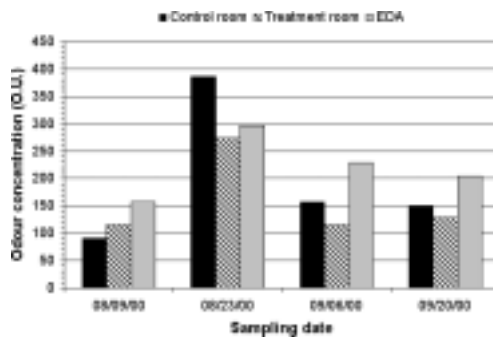
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The EDA design implemented at PSCI and tested with full strip curtains

Results

The following figures show the impact of the two-air-space concept on odour threshold and ammonia concentrations for both a conventional grower-finisher room (control room) and a similar room equipped with EDAs (treatment room). Air samples were taken in the middle of the rooms and also directly inside the EDA. Over the four sampling periods, odour threshold measurements showed a 20% reduction in the treatment room compared to the control room and no consistent differences were measured in the EDA. The ammonia concentration was reduced by 40% in the treatment room compared to the control room. However,



Odour concentration measured with the full curtain EDA (PSCI)

the concentration in the EDA was more than double what was measured in the treatment room which demonstrated that a good gas containment could be provided by the two-air-space concept. No consistent differences were observed for the hedonic tone of the odour and the carbon dioxide concentrations.

Conclusions

Odour and ammonia concentrations were reduced using the full curtain EDA that was developed for the two-air-space building design:

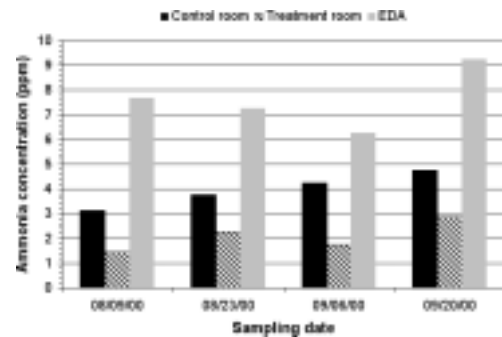
- Reductions of 20 and 40% were measured for odour threshold and ammonia, respectively;
- No difference were observed on the hedonic tone and the carbon dioxide concentrations.

Further steps have to be completed for this project:

- A full data analysis of the pig behaviour and odour and gas measurements based on the results obtained at PSCI;
- The experiment with a room equipped with EDAs and biofilters at the University of Alberta.

Acknowledgements

Canada Alberta Hog Industry Development Fund, Alberta Agriculture Research Institute and strategic program funding provided by SaskPork, Alberta Pork, Manitoba Pork and Saskatchewan Agriculture and Development Fund.



Ammonia concentration measured with the full curtain EDA (PSCI)