



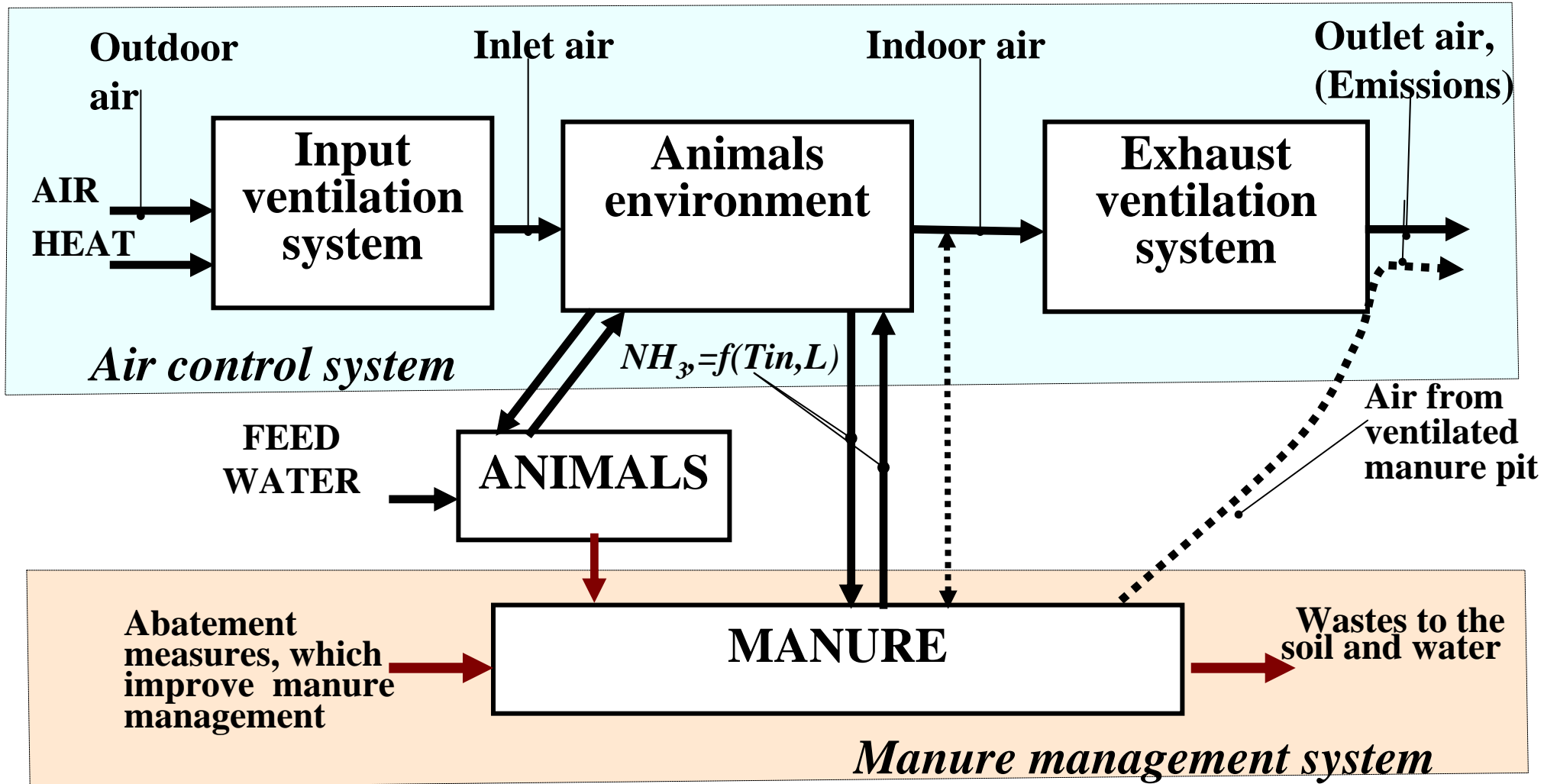
Livestock climate control systems as a potential ammonia abatement technique

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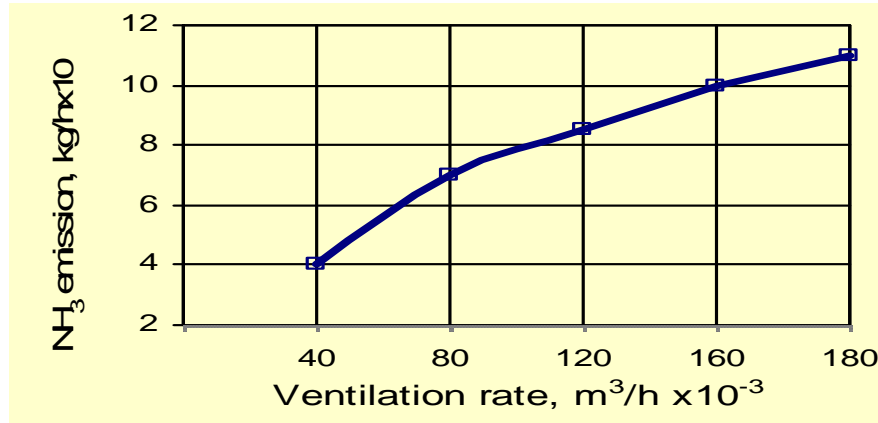
The place of climate control system in release and transportation of ammonia and other contaminants into the atmosphere as a result of interaction of two media – air and manure – in animal house



Data on the links between ammonia emissions, the ventilation rate and indoor temperature experimental data were found in the following literature: (Maximov, 2000, Gallman *et.al.*, 2005, Gustafsson *et.al.*, 2003, Jeppsson, 2003).

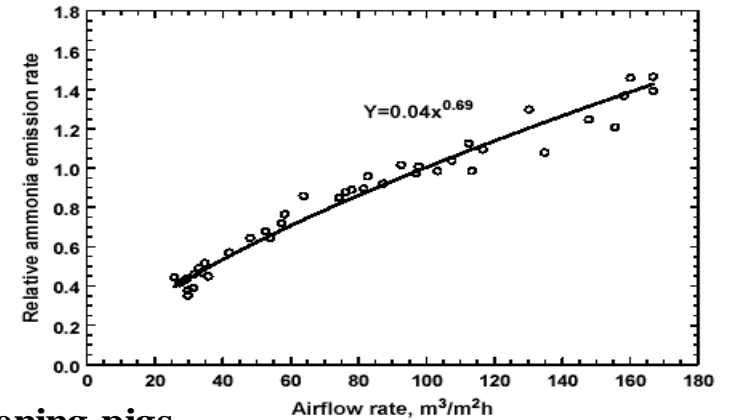
Ammonia emission –ventilation rate

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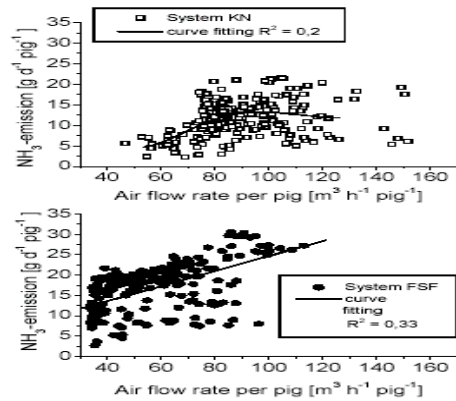
Fattening pigs

K.-H. Jeppsson



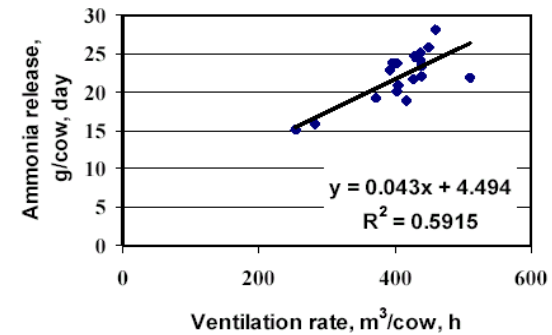
Fattening pigs

Eva Gallmann, Eberhard Hartung & Thomas Jungbluth



Fattening pigs

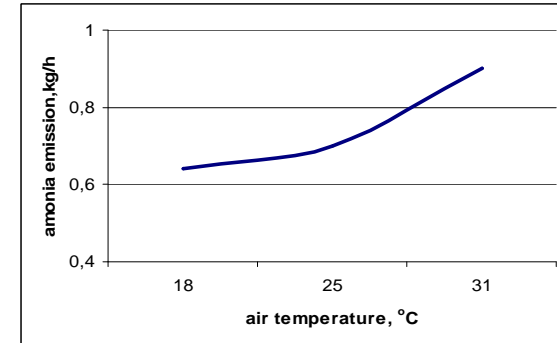
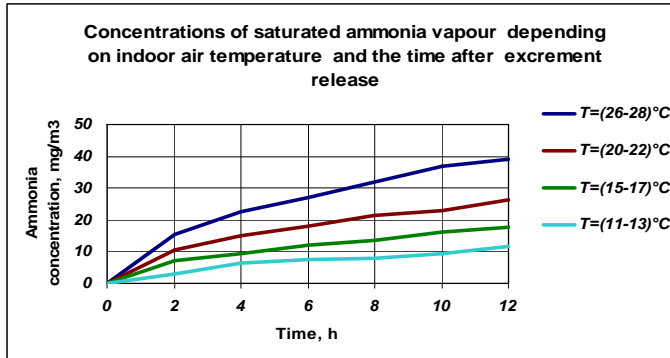
G. Gustafsson, K-H. Jeppsson, J. Hultgren, J-O. Sannö.



Tied Dairy Cattle

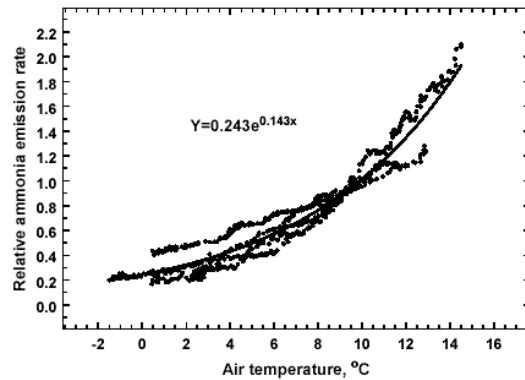
Ammonia emission –air temperature

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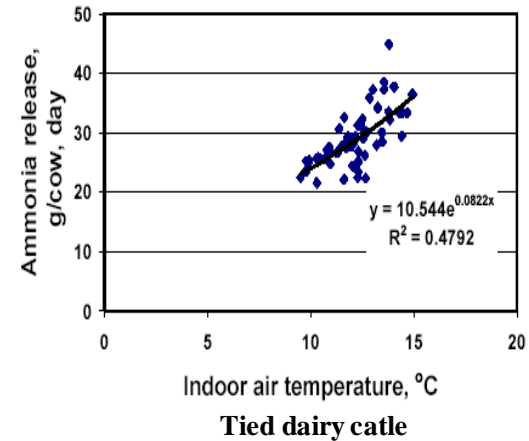
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Fattening pigs

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Tied dairy cattle

- **All these research results differed in trial aims, experimental techniques, methods of data handling, and further interpretation of results. But they show that there exists a correlation between the ventilation rate and hazardous emission, and between temperature and emission, and this correlation is strong.**
- **As for numerical evaluations, it is clear, that they are very specific. Our data show that the amount of ammonia emissions into the outdoor atmosphere might grow by up to 50% with the variation of ventilation rates, for the same feeding and manure removal system.**

- **Since the quantity and quality of the inlet air are adjusted in air control systems, this might be considered an ammonia abatement measure.**
- **Simulation of the operating modes of the climate control system installed in a dairy barn and a fattening pig house was used to identify the control methods for the ventilation rate and the indoor air temperature under varying outdoor climate conditions, the type and weight of animals**

Conclusion

To reduce ammonia emission from the animal house it is necessary to control the operation factors of the ventilating and heating system in order to keep the ventilation rate, indoor air temperature and air flow over the manure surface as low as possible. At the same time, the ventilation system must maintain an acceptable indoor air quality to comply with the animal welfare requirements.

- Investigation outcomes have shown that optimization of the livestock climate control system as ammonia emission abatement also can impact energy usage. Furthermore, the energy demand per product unit decreases, and as a result emissions become lower in a global sense.
- It is found that, in BREF recommendations concerning efficient use of energy by ventilating systems, exactly correspond to the demands for the ammonia emission abatement.

SUGGESTED ADDITION TO THE TEXT of Guidance Document EB.AIR/WG.5/2007/13

General operational measures to reduce ammonia emission in animal houses among others are:

(to paragraph 59)

- **lowering the indoor temperature as animal welfare and production allow**
- **reducing ventilation rate taking into account the minimum levels required for animal welfare reasons**
- **reducing air flow over the manure surface**

(new paragraph 69a)

69a. The ventilation system should be designed so that it has sufficient capacity to control the house temperature in warm summer months when the house is fully stocked with the heaviest animals, and to also have sufficient control to provide a minimum ventilation rate in colder winter months when the house is stocked with the lightest animals.

Significant reduction in power consumption and ammonia emission can be achieved by a combined system for controlling heating and ventilation systems that are optimally aligned to the requirements of the livestock.

Ventilation control strategy must restrict ventilation rate according to the actual animal weight, outdoor temperature and desired indoor climate

69. Other systems which could reduce NH₃ include increasing the depth of the under-floor manure pit further (1.2 m is suggested instead of 0.45 m) to maintain the slurry at a lower temperature, and mixing bedding straw with peat. The use of peat, however, is considered unsustainable in many countries

To encourage the introduction of emission abatement measures into engineering decision-making practice when designing new and reconstructing old farms we need

- calculation methods for permissible emissions from every pollutant source on the farm;
- environmentally friendly designing procedure for every particular object on the farm;
- harmonized standards on permissible indoor concentrations and permissible emissions

Developing simple methods for monitoring level of ammonia emission from animal houses (idea)

NH3 concentration:

*Constant * slope * actual CO2 concentration + (corrections due to air temperature, etc*

NH3 emission :

*NH3 concentration * Actual airflow rate*

StaldVent5 (Danish Institute of Agricultural Sciences, Bygholm)

Combination of *ammonia concentration, CO2 concentration, indoor temperature* actual indoor air, can be used as an emission level indicator
 Researches and developing models for each particular type of animal houses for monitoring , for simulation are needed

