Research Institute of Agricultural Engineering

Prague – Czech Republic

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The Department of Agroecology

Reduction of ammonia concentration in intensive animals breeding by biotechnological agents.

Large farms with high concenntration of animals.

- 1,4 million cattle
- 1,7 million pigs
- 21,5 million poultry

210 000 broilers in 3 halls – 20 t NH_3

16 000 pigs – 70 t NH_3

202 000 laying hens – 40 t NH_3

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1999: The Gothenburg protocol

obliged the Czech Republic to reduce the ammonia emissions from livestock housing by 20% to the year 2010.

- Modifications of technologies
- Modifications of slurry and manure management
- Application of biotechnological agents

The biotechnological agents

- *Agents drafted on the principle of adsorption*
- *Agents utilizing specific ability to bind chemically certain emitted gaseous (liquid) compound*
- *Agents utilizing enzymatic activity*
- *Agents acting by odours overlap*
- *Biological agents*

They can be added to a feeding, to a drinking water or they can be applied to the manure.

The database of verified agents

The assignment of our authorized laboratory:

to confirm the effectiveness of agents before recording into the database of verified agents

The measurement of ammonia emissions

- from the housing with applied agent

X

- from the identical housing without agent

The methodology of ammonia emission measurement:

$$m = c \cdot \Phi$$

m	emission mass flow	($mg.s^{-1}$)
c	concentration	($mg.m^{-3}$)
Φ	air flow rate	($m^3.s^{-1}$)

The specific production emission is calculated per year and animal.

$$SPE = m \cdot 3600 \cdot 24 \cdot 365 \cdot n^{-1} \cdot 10^{-6}$$

SPE	specific production emission	($kg.year^{-1}.animal^{-1}$)
m	emission mass flow	($mg.s^{-1}$)
n	number of animals	

The measurement of ammonia concentration:

- The Photoacustic Multigas Monitor INNOVA 1312, 1412
- Multipoint Sampler INNOVA 1309

- High accuracy
- High stability
- High sampling rate
- Small dimensions
- Up to 12 sampling points

The measurement of ammonia concentration:

The sampling points are placed in the outlet air streams,

usually in the outlet shafts with electric fans.

The 24-hour measurement is necessary because of including all activities during all the day (feeding, manipulating with manure etc.).

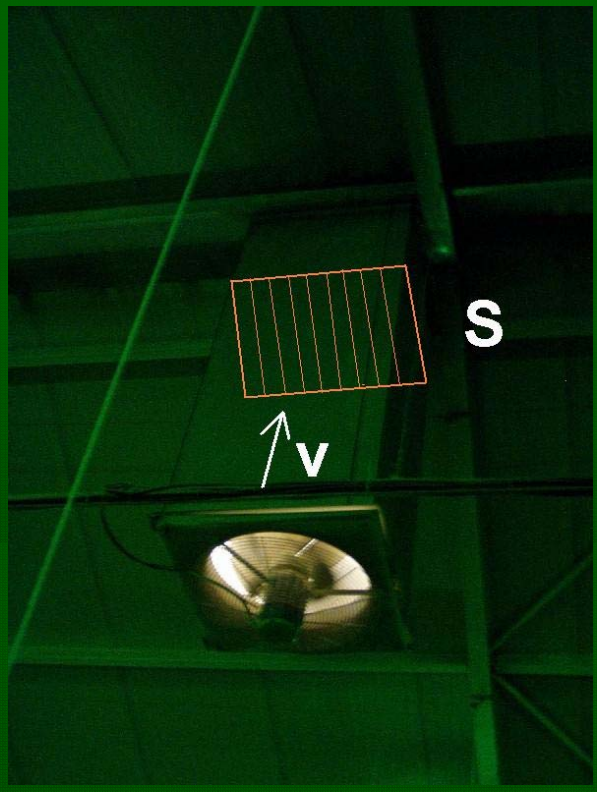
The air flow determination:

1. The controled ventilation

$$m = c \cdot \Phi$$

$$\Phi = v \cdot S$$

Φ	air flow rate	$(m^3.s^{-1})$
v	air velocity	$(m.s^{-1})$
S	shaft cross-section	(m^2)



The automatic control of ventilation must be switch of during all the measurement.

The ventilation must be adjusted manually according to external temperature and the requirement of animals.

The air flow determination:

2. The naturally ventilated building

- CO_2 – balance method
- Tracer gas measurement (SF_6, Krypton 85)

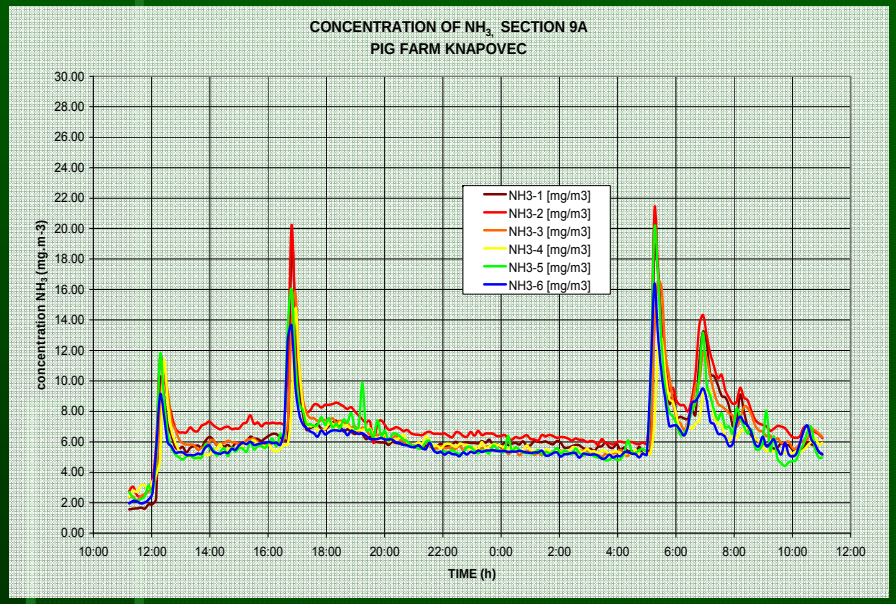
$$\Phi = m/c$$

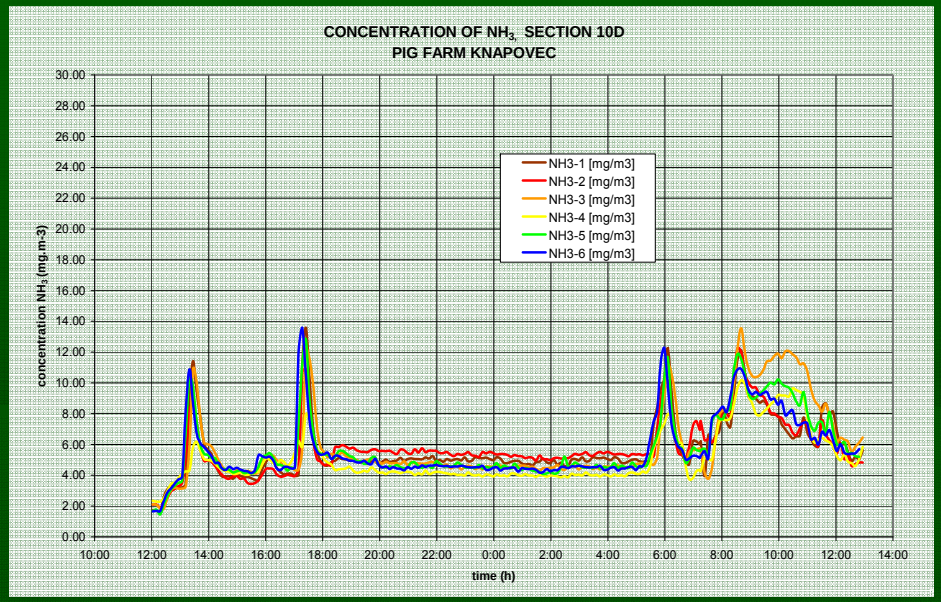
Φ	air flow	$(m^3.s^{-1})$
m	mass flow rate	$(kg.s^{-1})$
c	concentration	$(kg.m^{-3})$

The agent CARBOVET M applied in the pig housing:

Hall 9A (reference hall):
328 pigs, weight=70kg

Hall 10D with agent:
323 pigs, weight=82kg





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Hall 9A (reference hall):

SPE NH_3 = 3.25 kg.year^{-1}.animal^{-1}

Hall 10D with agent:

SPE NH_3 = 2.48 kg.year^{-1}.animal^{-1}

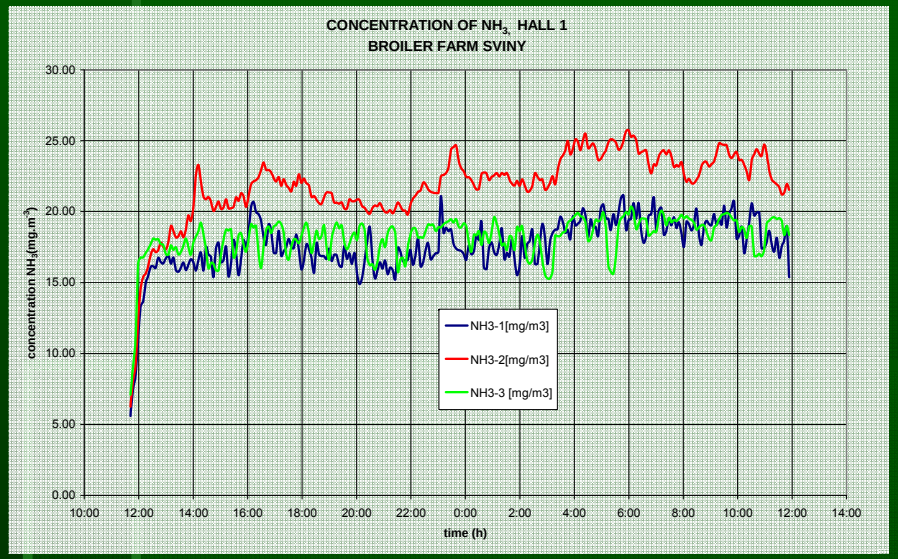
The biotechnological agent decreased the ammonia emission

from the pig housing by 24%.

The agent Xylanase + Phytase applied in a broiler breeding:

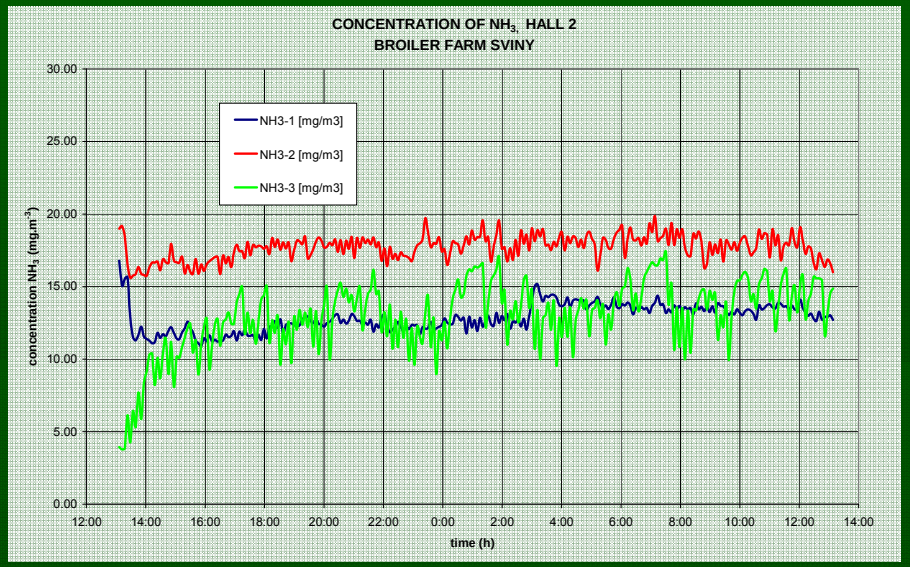
Hall 1 (reference hall):

38 500 broilers, weight=1.07kg



Hall 2 with agent:

38 500 broilers, weight=1.06kg



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Hall 1 (reference hall):

SPE NH_3 = 0.099 kg.year^{-1}.animal^{-1}

Hall 2 with agent:

SPE NH_3 = 0.074 kg.year^{-1}.animal^{-1}

The biotechnological agent decreased the ammonia emission from the broiler housing by 25%.

Conclusion

- The use of agents in the livestock production is one of the cheapest ways of decreasing the ammonia emissions, polluting our environment.
- The lower ammonia concentration inside the stable improves the welfare of animals (reduction of lung disease, reduction of mortality, increase of efficiency)
- The agents have another benefits for farmers

The list of the verified agents is available on our website

http://www.vuzt.cz/zp/pripravky.htm .

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Thank you for your attention

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Third Meeting of the COST LivAGE Project

Prague, March 1-2, 2018

PRELIMINARY PROGRAM

Meeting venue: Institute of Thermomechanics AS CR, v.v.i.

Dolejškova 1402/5 Prague 18200 Czech Republic

http://livage.it.cas.cz/im/im/

Thursday, March 1, 2018

8.00 – 9.00 *REGISTRATION*

09.00 – 12.30 **MC meeting**

Meeting agenda:

- Information from cost association.
- Status of the action (web, WGs, STSM, ITC conference, disseminations);
- Topics for discussion:
  - STSM process and further action in 1st GP (till April 30, 2018);
  - ITC conference grant – any needs/relocation;
  - TS (training schools) in GP 1 & future;
  - Our strategy & goals for GP1 and GP2. WG's goal and estimated outcomes (WG's leader working proposal and expected outcomes)
  - Dissemination strategy.

10:30 – 10:50 COFFEE BREAK

- Practical issues:
  - Decide the dates (possible program) for the next networking events – (in GP1 & GP2) timeline for finalizing the date, locations; invitations issue in e-cost… all have to response in due time!
  - A general rule on timing on invitation response
  - Budget & networking strategy
  - New members/partners
- OB

12.30- 13.30 *LUNCH*

13.30 – 15.30 **Working groups meetings (in parallel)**

15.30-15.45 *COFFEE BREAK*

15.45 – 17.45 **Working groups meetings (in parallel)**

19.00 - … *DINNER (please register in Doodle if you plan to join)*

Friday, March 2, 2018

Open Conference

"2nd Conference on Ammonia and Greenhouse Gases Emissions from Animal Production Buildings"

08.00 - 08.30 *REGISTRATION*

08.30 – 10:00 **KEYNOTE PRESENTATION** *moderator, Guoqiang Zhang*

08:30 – 08:55	Measurement of ammonia and greenhouse gas emissions from animal buildings, by Dr Ji-Qin Ni, PU, USA
09:00 – 09:25	Toward a quantitative understanding of ammonia volatilization from animal slurry, by Dr Sasha D. Hafner, AU, Denmark
09:30 – 10:00	Challenges of Inventory Preparation: Activity Data, Emission Factors and Models by Dr Barbara Amon, ATB, Germany

10:00 – 10:30 *COFFEE BREAK*

10:30 – 11:45 General session 1, Monitoring gaseous emissions from farming animal buildings
Moderator ***Mélynda Hassouna***

10:30 – 10:50	Test protocol of Vera (Verification of Environmental Technologies for Agricultural Production) by Dr Nico Ogink, WUR, The Netherlands
10:50 – 11:05	Application of the dual tracer ratio method to quantify emissions from naturally ventilated dairy housings, by Schrade et al.,
11:05 – 11:20	Measurement and reporting of emission rates from intensive animal production units in Ireland and Australia, by Fogarty et al.
11:20 – 11:35	Reduction of ammonia emissions from livestock housing by biotechnological agents, by Češpiva and Zabloudillová, Research Institute of Agricultural Engineering, Czech Republic
11:35 – 11:45	Questions & Discussion

11:45 – 14:10 General session 2, Reduction technologies of farming animal building emission
Moderator: ***Kamila Kočí***

11:45 - 12:00	Agricultural emissions and their environmental impacts: going beyond the animal-building scale using life cycle assessment, by Michael Corson, France
12:00 – 12:15	Feeding strategies aimed to reduce environmental impact in dairy ewes and cattle, by Marcello Mele, Italy
12:15 – 12:30	Farm scale strategies for reducing the environmental footprint in intensive livestock production, Thomas Bartzanas, CERTH, Greece

12:30 – 13:30 LUNCH BREAK

13:30 – 13:45 Danish regulations on ammonia emission from animal housing and options to meet the requirements" by Bjarne Bjerg, University of Copenhagen, Denmark

13:45 – 14:00 Integrated ventilation techniques and exhaust air purification for effective reduction of emission from farm animal houses, By Guoqiang Zhang, Aarhus University, Denmark

14:00 – 14:10 Questions & Discussion

14:10 – 16:00 General Session 3, Modelling ammonia and GHG emissions from animal buildings

Moderator: ***André Aarnink,*** *WUR, The Netherlands*

14:10 – 14:25 Development of ventilation based strategies to reduce ammonia emissions from pig fattening houses: an integrated approach, by Peter Demeyer, ILVO, Belgium (as continues of Session II)

14:25 – 14:40 Modelling the transport of gases to improve emission measurements, by David Janke, ATB, Potsdam, Germany

14:40 – 14:55 Modelling the effects of nutritional measures on ammonia emission from houses for growing pigs, by André Aarnink, Wageningen University and Research, the Netherlands

14:55 – 15:25 *COFFEE BREAK*

15:25 – 15:40 Development of VR simulator to educate environmental distribution of swine house such as gas, temperature, humidity, and dusts. By R.W. Kim and In-Bok Lee, SNU, Korea

15:40 - 15:55 CFD methods to model emissions from livestock housing, by Bjerne Bjerg, University of Copenhagen, Denmark

15:55 – 16:10 CFD modeling of livestock odor dispersion on complex topography, by In-Bok Lee and R.W. Kim, SNU, Korea

16:10 – 16:20 Questions & discussion

16:20 – 16:50 General **DISCUSSIONS**