

# Research Institute of Agricultural Engineering

## Prague – Czech Republic



The meeting about  
**Biotechnological additives**  
in agriculture production

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

Large farms with high concentration of  
animals.

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

210 000 broilers in 3 halls – 20 t NH<sub>3</sub>



16 000 pigs – 70 t NH<sub>3</sub>



202 000 laying hens – 40 t NH<sub>3</sub>



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## 1999: The Gothenburg protocol

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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## 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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## 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.



Research Institute of Agricultural Engineering  
Prague – Czech Republic



## 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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## The methodology of ammonia emission measurement:

$$m = c \cdot \Phi$$

m	emission mass flow	(mg.s <sup>-1</sup> )
c	concentration	(mg.m <sup>-3</sup> )
Φ	air flow rate	(m <sup>3</sup> .s <sup>-1</sup> )

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 <sup>-1</sup> .animal <sup>-1</sup> )
m	emission mass flow	(mg.s <sup>-1</sup> )
n	number of animals	



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## The measurement of ammonia concentration:

- The Photoacoustic Multigas Monitor INNOVA 1312, 1412
  - Multipoint Sampler INNOVA 1309
- High accuracy
  - High stability
  - High sampling rate
  - Small dimensions
  - Up to 12 sampling points



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## 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.).



Research Institute of Agricultural Engineering  
Prague – Czech Republic

# The air flow determination:

## 1. The controlled ventilation

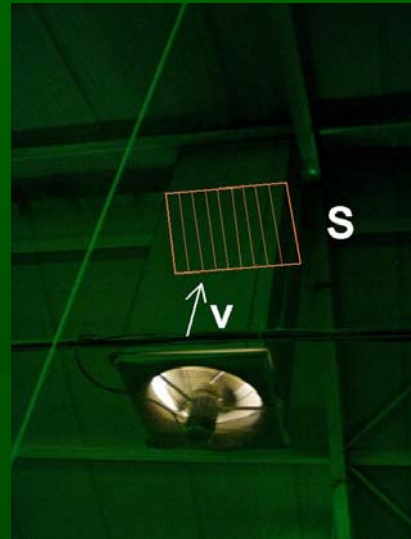
$$m = c \cdot \Phi$$

$$\Phi = v \cdot S$$

$\Phi$	air flow rate	$(\text{m}^3 \cdot \text{s}^{-1})$
$v$	air velocity	$(\text{m} \cdot \text{s}^{-1})$
$S$	shaft cross-section	$(\text{m}^2)$

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

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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

# The air flow determination:

## 2. The naturally ventilated building

- $\text{CO}_2$  – balance method
- Tracer gas measurement ( $\text{SF}_6$ , Krypton 85)

$$\Phi = m/c$$

$\Phi$	air flow	$(\text{m}^3 \cdot \text{s}^{-1})$
$m$	mass flow rate	$(\text{kg} \cdot \text{s}^{-1})$
$c$	concentration	$(\text{kg} \cdot \text{m}^{-3})$



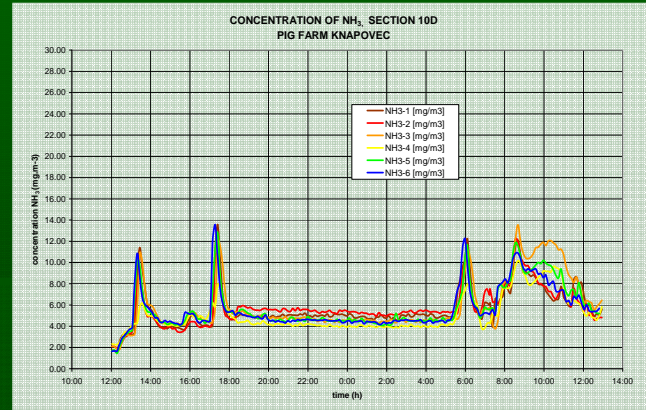
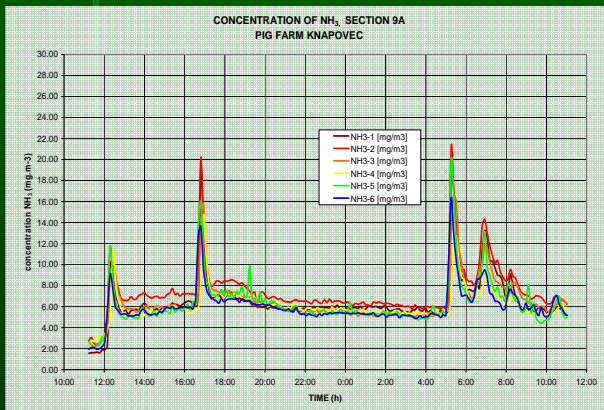
Research Institute of Agricultural Engineering  
Prague – Czech Republic



# 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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

Hall 9A (reference hall):

$$\text{SPE NH}_3 = 3.25 \text{ kg}\cdot\text{year}^{-1}\cdot\text{animal}^{-1}$$

Hall 10D with agent:

$$\text{SPE NH}_3 = 2.48 \text{ kg}\cdot\text{year}^{-1}\cdot\text{animal}^{-1}$$

The biotechnological agent decreased the ammonia  
emission

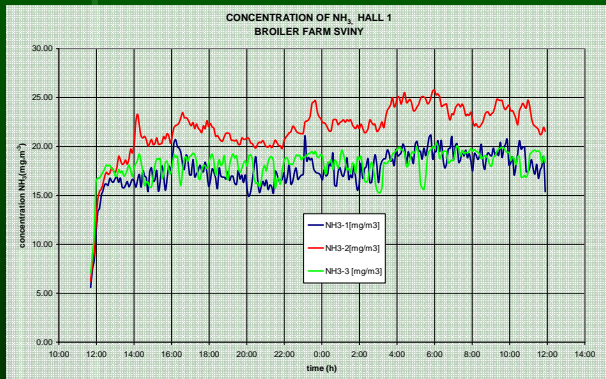
from the pig housing by 24%.



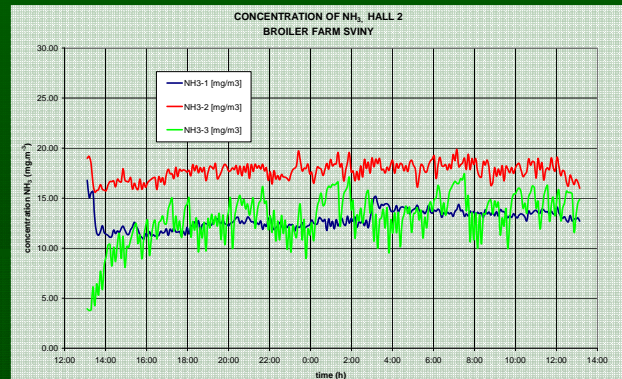
Research Institute of Agricultural Engineering  
Prague – Czech Republic

# 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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

Hall 1 (reference hall):

$$\text{SPE NH}_3 = 0.099 \text{ kg}\cdot\text{year}^{-1}\cdot\text{animal}^{-1}$$

Hall 2 with agent:

$$\text{SPE NH}_3 = 0.074 \text{ kg}\cdot\text{year}^{-1}\cdot\text{animal}^{-1}$$

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



Research Institute of Agricultural Engineering  
Prague – Czech Republic



# 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



Research Institute of Agricultural Engineering  
Prague – Czech Republic

# 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> .



Research Institute of Agricultural Engineering  
Prague – Czech Republic

# 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> .

Supported by long time development project of Research Institute of Agricultural Engineering no. RO0618.



Research Institute of Agricultural Engineering  
Prague – Czech Republic

## Thank you for your attention



# Research Institute of Agricultural Engineering Prague – Czech Republic

[miroslav.cespiva@vuzt.cz](mailto:miroslav.cespiva@vuzt.cz)



**vuzt**