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AGRICULTURAL TECHNOLOGY RESEARCH INSTITUTE . AUTHORIZED EMISSION MEASUREMENT

**REPORT NO. E001A/12 - AUTORIZED MEASUREMENT OF AMMONIA  
EMISSION**

**AGPI, a.s.  
Vrcovická ulice  
397 01 Pisek**

**Lety piggery  
House 11**

***Ing. Miroslav Češpiva  
Ing. Petra Zabloudilová***

**Report no.** *E001A/12*

**Client** *BioAktiv CZ s.r.o.(GmbH)  
Bořivojova 878/35  
130 00 Praha 3, Žižkov  
ID no.(IČ): 24845957*

**Source** *AGPI, a.s.  
Vrcovická ulice  
397 01 Písek  
Lety piggery  
House 11  
ID no.: 00112836*

**Organized by** *Agricultural Technology Research Institute  
(Výzkumný ústav zemědělské techniky)  
Drnovská 507  
161 01 Praha 6 – Ruzyně  
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**Responsible** *Ing. Miroslav Češpiva / - / (Unterschrift)  
Round stamp:  
AGRICULTURAL TECHNOLOGY RESEARCH INSTITUTE  
AUTHORIZED EMISSION MEASUREMENT*

**Drawn up by** *Ing. Miroslav Češpiva*

**Measurement period** *Feb. 21-22, 2012*

**Made out on** *March 26, 2012*

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## 2. Background

Single measurement of ammonia emission using a continuous measuring system was commissioned by BioAktiv CZ s.r.o. for the period from Feb. 21 – 22, 2011 and carried out by a crew from the Agricultural Technology Research Institute, Praha 6 – Ruzyně after authorization was given on Feb. 3, 2004 – file no. 4796/740/03 - by the Czech Ministry of the Environment pursuant to § 15 para. 1 of law no. 86/2002 law gazette.

## 3. Purpose

This was to make authorized measurements of NH<sub>3</sub> emissions resulting from pig farming and to determine specific reference quantities (temperature, pressure, relative humidity).

## 4. Source of contamination

Measurements took place in fattening house 11 of the Lety piggery which is a masonry structure with partly slatted floors and concrete bedding. Ad-lib dry feeding uses troughs with automatic refill.

The longer sidewall of house 11 accommodates seven exhaust fans in openings with cross sections of 45 x 45 cm. Outside air is sucked in through slots in the ceiling arranged on the opposite side of the building. The animals' gaseous metabolites gradually accumulate in the intake air. For the number of animals in the house during the measurements, and their age and average weight see table **T01**.

**T01.** *Animals kept in house 11*

House no.	Size (m) Length x Width x Height	No. of animals reported	Type	Age	Average wt. (kg)
11	05 x 8.5 x 2.5	464	Fattening pigs	145 days	79

## 5. Measuring method

Ammonia concentration was measured with an INNOVA 1312 gas analyzer using the opto-acoustic IR procedure, in conjunction with an INNOVA 1309 multipoint sampler. The unit converts the readings to normal state conditions with continuous automatic storage. The temperature and relative humidity of the air mixture were measured continuously and recorded by a COMMETER L3120 unit. Air pressure was also measured continuously and recorded by a COMMETER D4141 instrument. Ventilation parameters were measured with a TESTO 445 anemometer.

Air sampling probes were installed upstream of the exhaust fans in the house. Ventilation data was measured/determined in keeping with ČSN 12 4070 (equivalent to ST SEV 5882-87).

As required by the quality manual, the gas analyzer was tested with a calibration gas (a mix of ammonia and synthetic air – concentration 50 ppm) before measurements started. During measurement the air flow in the houses was stabilized and ventilation set to manual operation. Fan performance was adjusted to 60% throughout the measuring period. Uncertainties were defined in terms of the documents of the Czech Accreditation Institute (ČIA) – European Cooperation for Accreditation EA 4/02.

### List of instruments

**Gas analyzer** 1312 A Photoacoustic Multi-gas Monitor, Manufacturer no. 0028-002.

Manufacturer INNOVA Air Tech Instruments, Denmark,

Measuring range for  $\text{NH}_3$  0.2 -15,000  $\text{mg}\cdot\text{m}^{-3}$ , Operating temperature +5 to +40 °C,

Zero point temperature dependence for  $\text{NH}_3$  0.02  $\text{mg}\cdot\text{m}^{-3}/^\circ\text{C}$ ,

Zero point fluctuation for  $\text{NH}_3 \pm 0.2 \text{ mg}\cdot\text{m}^{-3}$ ,

Temperature dependence of the  $\text{NH}_3$  check point 0.3 % of the measuring value /°C,

Check point fluctuation for  $\text{NH}_3 \pm 2.5$  % of reading

**Sampling point changeover** 1309 D Multipoint Sampler, Manufacturer no. 177-002,

Manufacturer INNOVA Air Tech Instruments, Denmark

**Temperature/humidity measuring instrument with data logger** COMMETER L3120,

Manufacturer no. 01070176, Manufacturer COMET SYSTEM, s.r.o., Czech Republic,

Temperature measuring range -30 to +70 °C, Uncertainty  $\pm 0.4$  °C,

Relative humidity measuring range 0 to 100% relative humidity, Uncertainty  $\pm 2.5$  % relative humidity

**Pressure gauge with data logger** COMMETER D4141, Manufacturer no. 03910485,

Manufacturer COMET SYSTEM, s.r.o., Czech Republic,

Measuring range 800 to 1,100 hPa, Uncertainty  $\pm 2$  hPa,

**Anemometer** TESTO 445, Manufacturer no. 00463417/011,

Uncertainty with anemometer probe  $\pm 1.5\%$  of reading,

Manufacturer TESTO, Germany.

The instruments conform to ČSN EN ISO/IEC 17 025.6.

### **Measurement procedure** *in House no. 11*

Measuring equipment was installed at 12.30 p.m. on Feb. 21, 2012 and ventilation set to manual operation with only fans V1, V2 and V3 running during measurement at 60% performance. Concentration readings were continuously and automatically recorded.

The sensor for temperature and relative humidity measurement was arranged next to fan no. 2 (see Fig.1). The flow rate of the air mixture was measured using an anemometer conforming to ČSN 12 4070 at 8 points along 2 vertical straight lines arranged one above the other. Reading and storage of readings started at 12.40 on Feb. 21, 2012. The interval

for storing readings from individual sampling points was set at 4 mins. The system worked continuously and without problems until 12.40 p.m. on Feb. 22, 2012.

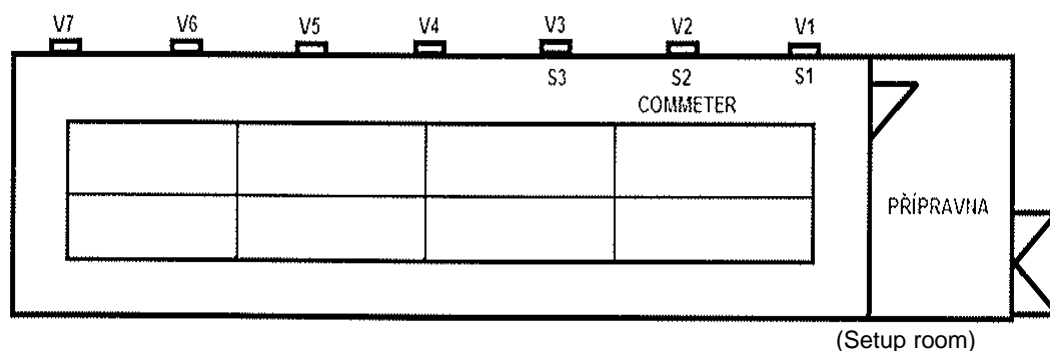


Fig. 1. Arrangement of probes in house 11

## 7. Measuring results

Due to a stable climate it was possible to set ventilation to manual operation throughout the measurement period. Readings for the air mixture flow rate are shown in Table T02.

**T02:** *Measured and calculated flow rates for fans in house 11*

Fan no.	1	2	3
Probe no.	1	2	3
Air duct cross section (m <sup>2</sup> )	0.20	0.20	0.20
Average speed (m.s <sup>-1</sup> )	1.74	1.96	1.38
Air mixture flow rate (m <sup>3</sup> .s <sup>-1</sup> )	0.35	0.40	0.28

During measurements the air mixture temperature in house 11 varied between **20.0 and 23.2 °C** (average **22.1 °C**), while relative humidity fluctuated between **55 and 89 %** (average relative humidity **62.4 %**) and air pressure between **972 and 974 hPa** (average **972.7 hPa**).

For variations in temperature, relative humidity and pressure of the air mixture in house 11 during measurements see Fig. 2.

**Temperature, relative humidity and pressure of the air mixture in house 11, Lety piggery, Feb. 21.-22, 2012**

**TEPLOTA, REL. VLHKOST A TLAK VZDUŠINY  
FARMA CHOVU PRASAT LETY, HALA 11, 21. - 22. 2. 2012**

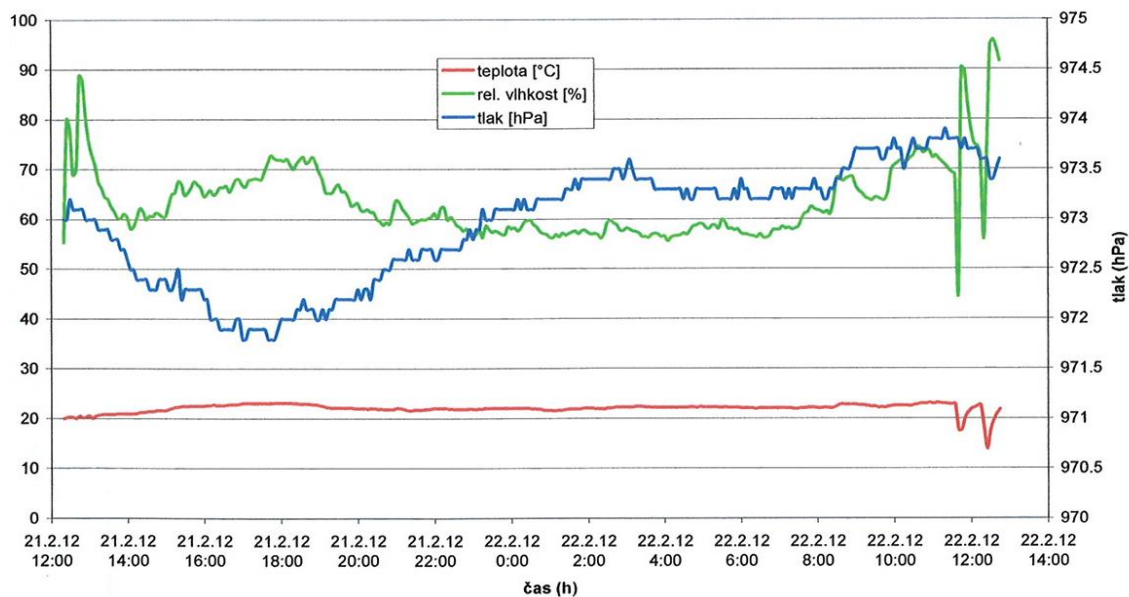


Fig. 2: relative humidity, temperature and pressure of the air mixture in house 11

Table T03 shows ammonia concentrations for all three sampling points throughout the measurement period. Concentration readings are for a temperature of 0 °C, a pressure of 101.3 hPa and dry air.

**T03:** NH<sub>3</sub> concentration readings for individual sampling points in house 11

	Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )		Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )
21.2.12 12:40	9.18	11.62	11.69		21.2.12 15:56	29.79	25.23
21.2.12 12:43	9.29	10.88	11.88		21.2.12 16:00	30.27	25.42
21.2.12 12:47	11.71	13.12	9.41		21.2.12 16:03	30.19	26.97
21.2.12 12:50	11.33	13.80	13.14		21.2.12 16:07	32.03	26.13
21.2.12 12:54	14.75	14.95	14.38		21.2.12 16:10	29.11	27.40
21.2.12 12:57	15.00	15.77	15.83		21.2.12 16:14	30.43	27.35
21.2.12 13:01	16.52	16.94	16.28		21.2.12 16:17	30.39	26.66
21.2.12 13:04	17.08	16.59	15.63		21.2.12 16:21	30.44	26.32
21.2.12 13:08	17.09	15.88	15.34		21.2.12 16:24	30.27	26.20
21.2.12 13:11	17.35	16.35	15.77		21.2.12 16:28	31.06	25.56
21.2.12 13:15	17.81	16.89	16.17		21.2.12 16:31	30.84	25.74
21.2.12 13:19	19.08	17.61	17.22		21.2.12 16:35	29.78	25.77
21.2.12 13:22	19.89	18.00	17.81		21.2.12 16:38	30.23	25.77
21.2.12 13:26	21.63	20.56	22.58		21.2.12 16:42	30.59	25.21
21.2.12 13:29	26.00	33.19	29.50		21.2.12 16:45	32.77	27.30
21.2.12 13:33	28.44	26.35	26.02		21.2.12 16:49	30.38	25.57
21.2.12 13:36	26.72	24.29	24.09		21.2.12 16:52	31.22	26.19
21.2.12 13:40	25.94	23.60	22.90		21.2.12 16:56	30.64	27.63
21.2.12 13:43	25.59	23.00	22.81		21.2.12 16:59	31.72	29.43
21.2.12 13:47	25.60	22.71	23.07		21.2.12 17:03	32.45	28.13
21.2.12 13:50	25.39	23.10	22.02		21.2.12 17:06	32.59	27.03
21.2.12 13:54	25.54	24.47	21.34		21.2.12 17:10	33.20	27.54
21.2.12 13:57	24.99	23.15	21.49		21.2.12 17:13	32.76	27.92
21.2.12 14:01	23.92	22.69	20.53		21.2.12 17:17	33.06	27.54
21.2.12 14:04	24.97	24.50	22.15		21.2.12 17:20	33.20	26.98
21.2.12 14:08	26.23	24.38	22.57		21.2.12 17:24	33.05	27.60
21.2.12 14:11	27.09	22.76	21.26		21.2.12 17:27	32.90	27.08
21.2.12 14:15	26.77	22.63	21.98		21.2.12 17:31	32.46	27.10
21.2.12 14:18	27.23	23.28	21.23		21.2.12 17:34	33.74	26.96
21.2.12 14:22	26.91	23.05	21.33		21.2.12 17:38	34.74	27.64
21.2.12 14:25	26.76	22.95	21.52		21.2.12 17:41	33.42	27.72
21.2.12 14:29	27.47	23.28	21.94		21.2.12 17:45	33.42	27.65
21.2.12 14:32	26.61	23.23	21.06		21.2.12 17:48	34.15	29.19
21.2.12 14:36	27.06	23.88	20.59		21.2.12 17:52	35.60	28.15
21.2.12 14:39	26.42	23.39	21.53		21.2.12 17:55	34.55	28.22
21.2.12 14:43	26.72	22.72	20.54		21.2.12 17:59	32.86	28.19
21.2.12 14:46	26.65	22.77	20.34		21.2.12 18:02	34.12	27.98
21.2.12 14:50	27.25	24.24	21.02		21.2.12 18:06	34.22	27.34
21.2.12 14:53	27.91	24.25	20.28		21.2.12 18:09	34.52	28.85
21.2.12 14:57	26.53	24.05	20.24		21.2.12 18:13	34.12	28.31
21.2.12 15:00	29.26	24.37	22.17		21.2.12 18:16	32.06	28.80
21.2.12 15:04	28.29	24.26	22.30		21.2.12 18:20	33.42	29.53
21.2.12 15:07	28.84	25.15	23.39		21.2.12 18:23	34.52	30.44
21.2.12 15:11	29.61	24.61	22.10		21.2.12 18:27	35.06	28.96
21.2.12 15:14	29.14	24.66	22.51		21.2.12 18:30	35.75	30.52
21.2.12 15:18	29.34	23.95	21.94		21.2.12 18:34	36.81	30.05
21.2.12 15:21	30.99	24.99	22.45		21.2.12 18:37	36.38	30.67
21.2.12 15:25	29.92	25.07	22.31		21.2.12 18:41	36.37	29.97
21.2.12 15:28	30.66	25.84	21.42		21.2.12 18:44	37.15	29.71
21.2.12 15:32	31.09	25.66	22.86		21.2.12 18:48	34.14	28.56
21.2.12 15:35	29.37	25.70	21.92		21.2.12 18:51	33.87	28.18
21.2.12 15:39	30.45	24.55	21.77		21.2.12 18:55	35.88	28.26
21.2.12 15:42	31.13	26.22	22.58		21.2.12 18:58	33.32	28.07
21.2.12 15:46	31.08	25.87	22.63		21.2.12 19:02	33.93	27.77
21.2.12 15:49	31.59	25.22	22.24		21.2.12 19:06	34.83	28.66
21.2.12 15:53	30.83	25.92	21.25		21.2.12 19:09	34.05	27.41

T03: NH<sub>3</sub> concentration readings for individual sampling points in house 11 - continued

	Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )		Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )
21.2.12 19:13	33.15	27.49	23.97	21.2.1222:29	25.21	21.65	18.35
21.2.12 19:16	33.54	26.88	23.28	21.2.12 22:32	24.94	20.89	18.24
21.2.12 19:20	32.71	27.05	23.47	21.2.1222:36	26.39	21.29	18.58
21.2.12 19:23	33.66	26.42	23.46	21.2.1222:39	25.83	20.82	17.96
21.2.12 19:27	32.92	26.89	23.88	21.2.1222:43	25.14	20.37	17.49
21.2.12 19:30	32.65	26.04	23.39	21.2.12 22:46	25.36	19.69	16.66
21.2.12 19:34	32.17	25.72	22.85	21.2.1222:50	24.79	20.24	17.17
21.2.12 19:37	32.18	25.62	23.35	21.2.1222:53	24.64	20.95	17.54
21.2.12 19:41	32.57	25.92	23.11	21.2.1222:57	24.67	20.33	18.03
21.2.12 19:44	31.93	25.83	21.94	21.2.1223:00	24.45	19.23	17.19
21.2.12 19:48	32.57	26.89	22.18	21.2.1223:04	24.80	19.49	17.56
21.2.12 19:51	31.75	24.58	22.29	21.2.12 23:07	24.91	20.39	17.60
21.2.12 19:55	31.47	27.02	22.71	21.2.1223:11	24.52	20.92	17.80
21.2.12 19:58	32.05	25.86	22.78	21.2.1223:14	24.90	20.29	17.21
21.2.12 20:02	31.11	26.08	22.82	21.2.1223:18	24.09	20.94	17.19
21.2.12 20:05	30.70	24.63	22.08	21.2.1223:21	25.63	20.98	18.02
21.2.1220:09	30.39	26.00	22.34	21.2.12 23:25	25.00	20.59	17.83
21.2.12 20:12	30.42	25.31	22.94	21.2.1223:28	24.46	20.10	18.09
21.2.12 20:16	30.62	25.23	21.96	21.2.1223:32	24.13	21.27	18.44
21.2.12 20:19	30.28	25.44	21.51	21.2.12 23:35	24.12	21.26	18.16
21.2.1220:23	29.02	24.28	21.16	21.2.1223:39	24.58	20.29	18.78
21.2.12 20:26	29.96	24.33	20.81	21.2.12 23:42	25.64	21.55	18.65
21.2.12 20:30	28.21	23.51	20.60	21.2.1223:46	24.97	20.65	19.34
21.2.12 20:33	28.07	23.65	20.65	21.2.1223:49	24.73	21.71	19.69
21.2.12 20:37	29.34	24.90	22.33	21.2.12 23:53	26.66	20.95	19.75
21.2.12 20:40	29.16	24.55	21.52	21.2.1223:56	25.26	21.46	19.66
21.2.12 20:44	29.35	24.02	20.70	22.2.12 0:00	25.55	20.85	18.83
21.2.12 20:47	30.22	23.68	25.10	22.2.12 0:03	25.64	20.60	18.77
21.2.1220:51	29.40	25.02	21.10	22.2.12 0:07	25.22	21.01	18.53
21.2.12 20:54	29.84	23.99	20.58	22.2.120:10	25.30	21.86	18.60
21.2.1220:58	29.26	23.37	20.66	22.2.120:14	26.68	20.88	18.40
21.2.12 21:01	28.93	24.35	20.21	22.2.120:17	25.20	19.84	17.82
21.2.1221:05	28.69	22.83	19.24	22.2.12 0:21	26.53	20.30	17.73
21.2.1221:08	27.00	21.74	18.77	22.2.12 0:24	25.84	20.63	17.92
21.2.1221:12	27.46	23.20	19.68	22.2.120:28	25.27	20.33	17.71
21.2.1221:15	27.78	22.77	19.79	22.2.12 0:31	25.82	21.01	17.86
21.2.12 21:19	27.42	22.29	19.06	22.2.12 0:35	24.91	20.42	17.30
21.2.1221:22	26.99	22.36	19.88	22.2.12 0:38	24.87	20.63	17.35
21.2.1221:26	27.63	22.61	19.52	22.2.12 0:42	25.02	20.55	17.15
21.2.12 21:29	27.29	23.18	19.90	22.2.12 0:45	25.23	20.32	17.01
21.2.12 21:33	28.09	23.69	19.84	22.2.12 0:49	24.75	20.73	17.50
21.2.1221:36	28.20	24.14	19.54	22.2.12 0:53	24.68	20.50	17.38
21.2.1221:40	27.85	23.35	20.07	22.2.12 0:56	24.58	19.45	16.87
21.2.1221:43	28.29	23.73	20.30	22.2.12 1:00	23.79	21.52	17.32
21.2.1221:47	27.18	22.58	19.74	22.2.12 1:03	23.52	20.04	16.73
21.2.1221:50	27.33	22.25	20.39	22.2.12 1:07	23.87	20.34	17.40
21.2.1221:54	27.38	22.37	21.94	22.2.12 1:10	23.39	19.78	16.58
21.2.1221:57	27.97	23.03	19.76	22.2.12 1:14	24.31	19.22	17.10
21.2.1222:01	27.65	22.63	19.24	22.2.12 1:17	22.75	19.72	17.19
21.2.1222:04	28.08	23.69	21.08	22.2.12 1:21	23.49	19.45	16.77
21.2.1222:08	28.18	23.10	20.24	22.2.12 1:24	23.96	20.49	17.59
21.2.12 22:11	27.56	21.83	20.20	22.2.12 1:28	24.30	21.30	17.57
21.2.1222:15	27.39	23.00	19.64	22.2.12 1:31	23.96	20.66	17.41
21.2.12 22:38	28.43	22.84	19.54	22.2.12 1:35	24.90	21.12	17.62
21.2.12 22:22	26.83	22.02	18.63	22.2.12 1:38	24.26	20.22	17.45
21.2.12 22:25	27.54	21.87	18.61	22.2.12 1:42	24.80	19.83	16.70



**T03: NH<sub>3</sub> concentration readings for individual sampling points in house 11 - continued**

	Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )		Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )
22.2.12 1:45	23.51	19.55	17.11	22.2.12 4:58	23.09	20.03	21.29
22.2.12 1:49	24.81	19.27	17.02	22.2.12 5:02	23.60	20.44	19.65
22.2.12 1:52	24.43	19.57	17.87	22.2.12 5:05	22.93	20.15	19.53
22.2.12 1:56	24.16	19.91	17.28	22.2.12 5:09	23.29	20.09	21.53
22.2.12 1:59	24.53	20.70	17.91	22.2.12 5:12	22.59	19.85	21.04
22.2.12 2:03	24.48	19.81	17.09	22.2.125:16	22.71	20.04	19.63
22.2.12 2:06	24.32	20.21	18.08	22.2.125:19	22.11	20.10	20.07
22.2.122:10	25.03	20.69	17.86	22.2.12 5:23	22.72	19.97	20.89
22.2.122:13	23.97	19.88	17.78	22.2.125:26	22.21	18.63	22.45
22.2.122:17	24.23	20.96	18.18	22.2.125:30	22.73	19.10	22.07
22.2.12 2:20	24.87	21.09	18.42	22.2.12 5:33	22.12	19.84	20.41
22.2.122:24	24.05	20.10	18.25	22.2.12 5:37	21.93	20.43	20.94
22.2.12 2:27	24.84	19.95	18.08	22.2.12 5:40	22.39	20.50	21.75
22.2.122:31	24.99	19.80	17.76	22.2.12 5:44	23.07	22.26	21.05
22.2.12 2:34	24.63	20.04	18.09	22.2.12 5:47	22.01	21.61	21.44
22.2.12 2:38	24.07	19.74	17.39	22.2.125:51	23.29	21.26	20.47
22.2.12 2:41	24.05	19.93	17.77	22.2.12 5:54	23.26	21.07	22.03
22.2.12 2:45	24.06	19.97	17.43	22.2.12 5:58	22.71	20.97	21.80
22.2.12 2:48	24.84	21.14	17.85	22.2.126:01	23.61	20.98	21.47
22.2.12 2:52	24.93	20.06	17.56	22.2.12 6:05	23.40	22.33	20.60
22.2.12 2:55	24.70	19.81	18.00	22.2.12 6:09	24.13	20.78	18.51
22.2.12 2:59	24.42	21.84	18.24	22.2.126:12	23.30	21.21	20.67
22.2.12 3:02	24.18	20.26	18.02	22.2.12 6:16	23.96	20.98	19.95
22.2.12 3:06	24.55	19.30	18.02	22.2.12 6:19	23.88	21.67	18.14
22.2.12 3:09	23.35	20.08	18.34	22.2.126:23	24.09	20.54	19.21
22.2.123:13	24.60	19.63	17.88	22.2.12 6:26	23.31	20.85	18.13
22.2.12 3:16	23.43	19.95	17.85	22.2.12 6:30	23.61	20.49	18.98
22.2.12 3:20	23.91	19.74	17.87	22.2.12 6:33	22.71	20.48	18.94
22.2.12 3:23	24.29	19.31	17.30	22.2.12 6:37	22.97	20.33	19.70
22.2.12 3:27	24.00	19.33	17.25	22.2.12 6:40	23.23	19.83	23.19
22.2.12 3:30	23.37	20.02	18.11	22.2.12 6:44	23.77	19.98	20.38
22.2.12 3:34	24.62	20.60	17.95	22.2.12 6:47	23.34	21.00	19.43
22.2.12 3:37	23.86	20.45	18.46	22.2.12 6:51	22.89	21.13	20.79
22.2.12 3:41	23.92	19.88	18.39	22.2.12 6:54	23.43	20.23	22.86
22.2.12 3:44	23.38	20.66	18.96	22.2.52 6:58	23.88	21.1 1	21.33
22.2.12 3:45	23.38	20.79	19.14	22.2.127:01	24.47	20.95	21.1 1
22.2.12 3:48	22.96	20.84	21.36	22.2.12 7:05	24.13	22.14	20.81
22.2.12 3:52	23.78	21.10	20.95	22.2.12 7:08	24.14	22.25	19.95
22.2.12 3:55	22.90	21.16	21.69	22.2.12 7:12	23.70	21.40	21.21
22.2.12 3:59	22.79	20.89	21.88	22.2.127:15	24.66	21.70	21.05
22.2.124:02	22.25	20.68	21.10	22.2.127:19	24.11	21.24	21.45
22.2.12 4:06	21.96	19.85	22.52	22.2.12 7:22	24.36	22.05	19.00
22.2.12 4:09	22.27	20.08	23.13	22.2.12 7:26	24.54	21.96	20.27
22.2.12 4:13	22.20	20.60	24.61	22.2.12 7:29	24.25	22.27	21.90
22.2.124:16	22.38	20.31	23.18	22.2.12 7:33	24.88	22.62	21.02
22.2.12 4:20	23.21	20.75	21.60	22.2.12 7:36	24.89	22.31	21.07
22.2.12 4:23	23.01	20.49	20.14	22.2.12 7:40	24.28	22.75	20.10
22.2.12 4:27	22.39	20.78	20.27	22.2.12 7:43	24.26	22.70	18.83
22.2.124:30	22.90	22.48	21.38	22.2.12 7:47	24.64	23.09	19.98
22.2.12 4:34	22.65	23.76	20.28	22.2.12 7:50	24.95	22.96	21.77
22.2.124:37	22.83	22.28	20.52	22.2.12 7:54	25.02	22.79	23.63
22.2.12 4:41	22.89	22.52	20.05	22.2.12 7:57	25.26	23.76	23.16
22.2.124:44	23.37	22.22	19.53	22.2.12 8:01	24.71	22.56	23.87
22.2.124:48	23.25	21.20	20.69	22.2.12 8:04	25.45	22.68	23.30
22.2.12 4:51	23.55	20.94	20.52	22.2.12 8:08	25.19	22.39	23.02
22.2.12 4:55	22.90	20.91	22.31	22.2.12 8:11	26.00	23.93	22.15

**T03: NH<sub>3</sub> concentration readings for individual sampling points in house 11 - continued**

	Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )		Probe 1 (mg.m <sup>-3</sup> )	Probe 2 (mg.m <sup>-3</sup> )	Probe 3 (mg.m <sup>-3</sup> )
22.2.12 8:15	25.85	24.23	19.85	22.2.12 11:31	32.72	30.87	24.42
22.2.12 8:38	24.89	25.41	20.92	22.2.12 11:34	33.27	29.48	24.11
22.2.12 8:22	25.50	24.30	24.46	22.2.12 11:36	33.07	29.24	24.51
22.2.32 8:25	26.34	24.96	24.55	22.2.12 11:40	32.89	29.93	24.74
22.2.12 8:29	26.75	23.83	21.95	22.2.12 11:44	33.26	30.39	24.66
22.2.12 8:32	26.73	23.98	21.82	22.2.12 11:51	32.89	29.40	24.51
22.2.12 8:36	26.75	24.17	20.88	22.2.12 11:54	33.69	30.22	24.59
22.2.12 8:39	26.56	24.06	25.48	22.2.12 11:58	33.14	30.16	24.41
22.2.12 8:43	26.38	23.71	24.38	22.2.12 12:01	32.99	30.29	24.78
22.2.12 8:46	27.06	24.10	23.66	22.2.12 12:05	33.21	30.01	24.81
22.2.12 8:50	26.54	24.01	21.85	22.2.12 12:08	33.20	30.89	24.30
22.2.12 8:53	26.69	22.99	21.65	22.2.12 12:12	34.24	29.81	24.34
22.2.12 8:57	26.70	23.96	21.99	22.2.12 12:15	34.05	30.22	23.89
22.2.129:00	26.85	23.97	20.88	22.2.12 12:19	33.72	29.77	24.74
22.2.12 9:04	28.20	26.83	21.27	22.2.12 12:22	33.23	29.68	24.93
22.2.12 9:07	28.35	26.22	20.80	22.2.12 12:26	33.51	31.24	24.65
22.2.12 9:11	28.01	26.24	21.59	22.2.12 12:29	32.81	31.22	24.42
22.2.129:14	28.00	26.39	21.72	22.2.12 12:33	32.49	30.69	23.99
22.2.12 9:18	28.03	26.27	21.83	22.2.12 12:36	32.65	30.50	24.16
22.2.12 9:21	27.81	26.12	22.17	22.2.12 12:40	32.22	30.02	24.06
22.2.12 9:25	27.73	26.14	21.78				
22.2.12 9:28	27.99	25.98	21.65				
22.2.12 9:32	28.48	26.71	22.16				
22.2.12 9:35	28.25	26.53	22.33				
22.2.12 9:39	28.51	26.86	22.38				
22.2.12 9:42	29.02	26.88	22.69				
22.2.12 9:46	28.76	26.93	22.33				
22.2.12 9:49	28.92	26.72	22.87				
22.2.12 9:53	29.20	27.13	22.93				
22.2.12 9:56	29.60	27.22	22.60				
22.2.12 10:00	30.19	27.57	22.58				
22.2.12 10:03	30.10	28.02	22.30				
22.2.12 10:07	29.76	28.20	22.34				
22.2.12 10:10	29.54	27.73	22.64				
22.2.12 10:14	29.75	27.50	22.27				
22.2.12 10:17	29.94	27.69	22.01				
22.2.12 10:21	29.79	27.93	21.42				
22.2.12 10:24	29.58	28.43	21.81				
22.2.12 10:28	29.62	27.74	22.66				
22.2.12 10:31	30.00	27.13	22.27				
22.2.12 10:35	30.78	29.11	22.68				
22.2.12 10:38	30.78	29.00	23.08				
22.2.12 10:42	30.93	29.23	23.14				
22.2.12 10:45	30.86	29.26	23.14				
22.2.12 10:49	30.92	29.39	23.36				
22.2.12 10:52	31.41	28.66	23.38				
22.2.12 10:56	31.17	29.29	23.16				
22.2.12 10:59	31.42	28.92	23.77				
22.2.12 11:03	31.51	29.48	24.01				
22.2.12 11:06	31.95	30.55	24.68				
22.2.12 11:10	31.44	30.05	24.25				
22.2.12 11:13	31.77	30.07	24.18				
22.2.12 11:17	31.56	30.01	24.72				
22.2.12 11:20	31.86	29.69	24.91				
22.2.12 11:24	33.02	30.54	24.35				
22.2.12 11:27	32.95	30.80	24.34				

Fig. 3 is a diagram of the fluctuations during NH<sub>3</sub> concentration measurement in house 11 with allowance made for all readings. For all concentrations observed at individual sampling points see Table T03.

**Ammonia concentration**  
**Lety piggery, house 11, Feb. 21-22, 2012**

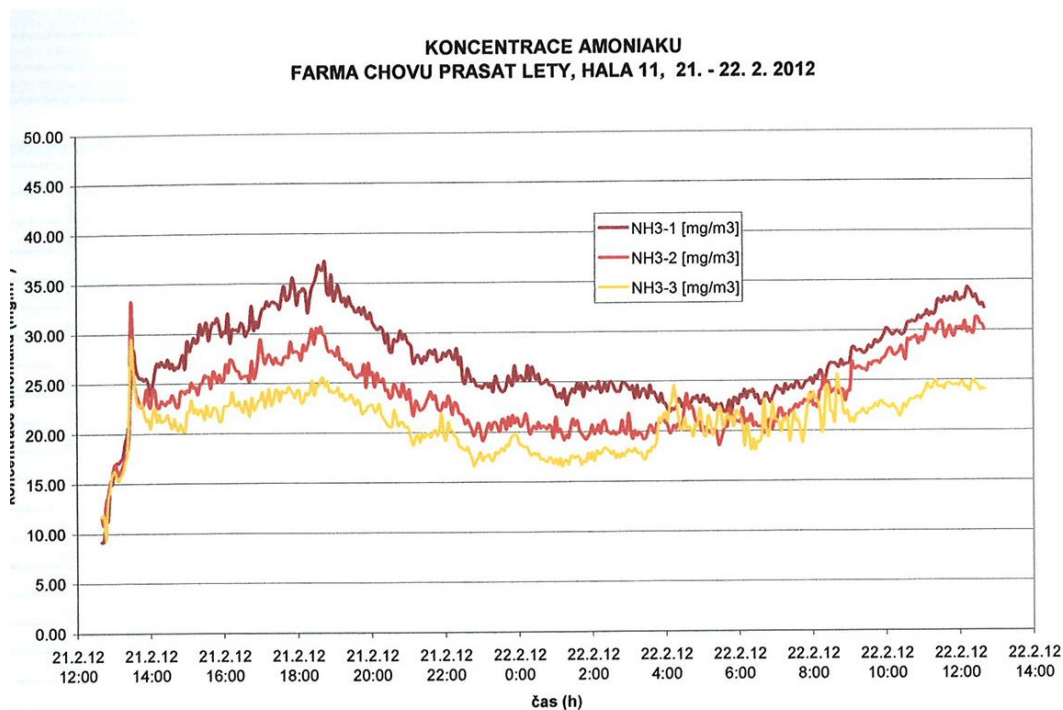


Fig. 3: Variation of NH<sub>3</sub> concentration at sampling points in house 11

The concentration readings served to calculate mean half-hour measurement intervals which are given in Table T04, p. 12 of the report.

Final values measured and calculated in keeping with the quality manual are shown in Table T05, p. 13 of the report.

During measurements in **house 11** made over **24 hours** the inside air NH<sub>3</sub> concentration fluctuated between **9.18 and 37.15 mg.m<sup>-3</sup>**. **There was no reading above 50 mg.m<sup>-3</sup>**. The average flow rate for ventilation was **3,698 m<sup>3</sup>.h<sup>-1</sup>**.

## 8. Evaluation of results

**T04:** Overall results for house 11 compared with emission limits (factors)

Contaminant		NH <sub>3</sub>		
Emission limit		50 mg.m <sup>-3</sup>		
Concentration relative to temperature 0°C. pressure 103.3 hPa. dry air				
Time interval no.	Time	Average NH <sub>3</sub> concentration (mg.m <sup>-3</sup> )		
		Probe 1	Probe 2	Probe 3
i	21.2.12 13:10	13.93	14.59	13.94
2	21.2.12 13:40	22.00	21.27	20.74
3	21.2.12 14:10	25.53	23.44	22.01
4	21.2.12 14:40	26.86	23.28	21.50
5	21.2.12 15:10	27.75	23.98	21.39
6	21.2.12 15:40	29.94	25.02	22.27
7	21.2.12 16:10	30.65	25.89	22.31
8	21.2.12 16:40	30.31	26.20	22.85
9	21.2.12 17:10	31.58	26.98	23.00
10	21.2.12 17:40	33.25	27.41	23.83
11	21.2.12 18:10	34.16	28.09	23.97
12	21.2.12 18:40	34.90	29.61	24.50
13	21.2.12 19:10	34.99	28.73	24.58
14	21.2.12 19:40	32.96	26.54	23.44
15	21.2.12 20:10	31.67	25.84	22.56
16	21.2.12 20:40	29.55	24.72	21.58
17	21.2.12 21:10	28.93	23.67	20.36
18	21.2.12 21:40	27.57	22.93	19.60
19	21.2.12 22:10	27.75	22.86	20.30
20	21.2.12 22:40	26.83	21.93	19.00
21	21.2.12 23:10	24.91	20.24	17.50
22	21.2.12 23:40	24.64	20.70	17.91
23	22.2.12 0:10	25.36	21.09	19.06
24	22.2.12 0:40	25.57	20.69	17.92
25	22.2.12 1:10	24.37	20.39	17.13
26	22.2.12 1:40	23.92	20.23	17.27
27	22.2.12 2:10	24.43	19.98	17.44
28	22.2.12 2:40	24.47	20.22	17.96
29	22.2.12 3:10	24.31	20.21	17.86
30	22.2.12 3:40	23.93	19.90	17.94
31	22.2.12 4:10	22.96	20.59	20.91
32	22.2.12 4:40	22.67	21.41	21.52
33	22.2.12 5:10	23.17	21.08	20.56
34	22.2.12 5:40	22.48	19.85	21.08
35	22.2.12 6:10	22.98	21.22	21.01
36	22.2.12 6:40	23.52	20.71	19.54
37	22.2.12 7:10	23.63	20.89	20.95
38	22.2.12 7:40	24.38	22.05	20.70
39	22.2.12 8:10	24.98	22.96	21.98
40	22.2.12 8:40	26.06	24.13	22.51
41	22.2.12 9:10	27.13	24.61	22.36
42	22.2.12 9:40	28.12	26.34	21.82
43	22.2.12 10:10	29.36	27.33	22.57
44	22.2.12 10:40	30.07	28.15	22.40
45	22.2.12 11:10	31.24	29.38	23.60
46	22.2.12 11:40	32.45	30.07	24.45
47	22.2.12 12:10	33.14	30.01	24.58
48	22.2.12 12:40	33.21	30.40	24.35
Average mass concentration (mg.m <sup>-3</sup> )		26.95	23.38	20.83

**T05:** Overall results for house 11 compared with emission limits (factors) - continued

Qty.	Unit	Total			Uncertainty
Average air mixture temperature	(°C)				
Average relative humidity of air mixture	(%)				
Average air pressure	(hPa)				
Sampling point		Probe 1	Probe 2	Probe 3	
No. of fans		1	2	3	
Pipe cross section	(m <sup>2</sup> )	0.20	0.20	0.20	
Air flow rate	(m <sup>3</sup> .s <sup>-1</sup> )	0.35	0.40	0.28	1.03 ± 0.021
Average mass concentration	(mg.m <sup>-3</sup> )	26.95	23.38	20.83	
Contaminant mass flow	(mg.s <sup>-1</sup> )	9.50	9.26	5.80	24.56 ± 0.491
<b>Specific production emission</b>	(kg.pig <sup>-1</sup> .yr. <sup>-1</sup> )	<b>1.6693</b>			<b>± 0.034</b>
Emission factor. fattening pigs (acc. to NV 615/2006 Law Gazette)	(kg.pig <sup>-1</sup> .yr. <sup>-1</sup> )	House			3.2
		Manure			2

## 9. Quantities and symbols used

**T06:** *List of quantities. units and their symbols*

<b>Quantity</b>	<b>Unit</b>	<b>Symbol</b>
Temperature	° Celsius	°C
Relative humidity	percent	%
Air pressure	Hektopascal	hPa
Flow rate	cubic meters per second	$\text{m}^3 \cdot \text{s}^{-1}$
Mass concentration	Milligrams per cubic meter	$\text{mg} \cdot \text{m}^{-3}$
Contaminant mass flow	Milligrams per second	$\text{mg} \cdot \text{s}^{-1}$
Specific production emission	Kilograms per pig per year	$\text{kg} \cdot \text{pig}^{-1} \cdot \text{yr}^{-1}$
Emission factor	Kilograms per pig per year	$\text{kg} \cdot \text{pig}^{-1} \cdot \text{yr}^{-1}$

## 10. Bibliography

ČSN 12 4070 separators. measuring procedures  
Government ordinance no. 615/2006 Law Gazette  
Law no. 86/2002 Law Gazette as amended  
Document EA 4/02. Description of measuring uncertainties  
Quality manual for measuring crew, Agricultural Technology Research Institute, public  
research establishment (VÚZT, v.v.i.). Prague 2010