

# VERA VERIFICATION STATEMENT

VERIFICATION OF ENVIRONMENTAL TECHNOLOGIES  
FOR AGRICULTURAL PRODUCTION

It is hereby stated that

TECHNOLOGY

## JH Forsuring NH4+

MANUFACTURED BY

### JH Agro A/S

has been tested according to the VERA Test Protocol for  
Livestock Housing and Management Systems (Version 2, 2011).

The following main results have been documented through the test:

#### **Verified environmental efficiency**

Ammonia emission reduction efficiency at 64 % when applied in finishing pig units.  
The acidification system has no verified reducing effects on odour emissions.

#### **Verified operational stability**

The JH Forsuring NH4+ acidification system has demonstrated  
a satisfactory operational stability.

08 Sept 2016



Iris Beckert, Head of the International VERA Secretariat



VERA Verification no 006.

This VERA Verification Statement is only valid when including the full document. This is page 1 of 9.  
A copy of all valid VERA statements can be found on [www.vera-verification.eu](http://www.vera-verification.eu)

## EXEMPTION OF LIABILITY

The VERA Secretariat does not endorse, certify or approve technologies. VERA verifications are based on an evaluation of the technology performance under specific, predetermined criteria and the appropriate quality assurance procedures.

VERA as a representative for the Danish EPA, the German Federal Ministry of Food and Agriculture and the Dutch Ministry of Infrastructure and Environment makes no expressed or implied warranties as to the performance of the technology and does not certify that a technology will always operate as verified.

The end user is solely responsible for complying with any and all applicable federal, state, and local requirements. Further the end user must be aware that the countries involved in VERA are having different legal requirements which will influence the status and use of this verification statement in each country.

## THE VERA ORGANISATION

VERA – Verification of Environmental Technologies for Agricultural Production – is a multinational organisation for testing and verification of environmental technologies for agricultural production. VERA is established as a cooperation between the Danish Environmental Protection Agency, the Dutch Ministry of Infrastructure and Environment and the German Federal Ministry of Food and Agriculture.

The purpose of VERA is to enhance a well-functioning market for environmental technologies to increase the environmental protection of agricultural production by substantially accelerating the acceptance and use of improved and cost-effective environmental technologies.

VERA verifies the performance of technologies which are tested according to pre-defined test protocols. A VERA Verification Statement secures validated documentation for the environmental efficiency and operational stability of the technology and is an important step in introducing the technology to the market. Based on information from the test reports, the VERA Verification Statement gives a general and short description of the technology, its principle of operation and the main results and conclusions from the VERA test.

## APPLICANT DATA

Technology type	The acidification system is a batch treatment system where the slurry is removed from the animal house and acidified to a pH of 5.5 and afterwards pumped back to the facility.
Applied for	Reduction of ammonia emissions from pig houses
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Test institute	Pig Research Centre, Danish Agriculture and Food Council, Axeltorv 3, 1609 Copenhagen V, Denmark



## TECHNOLOGY DESCRIPTION

The “JH Forsuring NH4+” acidification system from JH Agro A/S applies concentrated sulphuric acid (96 %) to the manure which lowers the pH of the manure and thereby reduces the emission of ammonia from the manure. The treatment of manure by the “JH Forsuring NH4+” acidification system from JH Agro A/S is performed by flushing the manure once a day from the manure pits inside a pig house to an external process tank where sulphuric acid (96 %) is added under continuous stirring until the pH reaches 5.5. The slurry going in and out of the process tank is measured by flow gauges. The control system is programmed for every section for a defined minimum and maximum quantity of slurry. When the maximum quantity of slurry going out of a section into the process tank is reached, the slurry will be acidified and the difference between minimum and maximum will be pumped to storage. These quantities are measured in m<sup>3</sup> and can be set individually from section to section and farm to farm.

All processes such as stirring, pumping, addition of sulphuric acid and measurement of pH values are controlled automatically via a control unit and the values logged.

## TEST DESIGN

The “JH Forsuring NH4+” acidification system was tested in Denmark by the Danish Pig Research Centre who carried out a case-control test in accordance with the VERA test protocol at two commercial growing/finishing pig production facilities. At both test sites, the test was carried out with two “case (slurry acidification) units” and two “control (untreated) units”.

Table 1: Mean and standard deviation of basic parameters of test setup

	Location A		Location B	
	Control	Case	Control	Case
Number of pigs	190 ± 5	191 ± 5	666 ± 33	674 ± 66
Weight of pigs [kg]	76 ± 18	76 ± 18	66 ± 10	66 ± 18
Floor space [m <sup>2</sup> /pig]	0.74	0.74	0.67	0.67
Air volume at max. ventilation [m <sup>3</sup> /pig · h]	119	118	99 <sup>[1]</sup>	102 <sup>[1]</sup>
Height of manure in slurry channels [cm]	36 ± 15	31 ± 7	26 ± 8	25 ± 2
pH of manure	7.4 ± 0.12	5.7 ± 0.23	7.1 ± 0.30	5.5 ± 0.38
Total-N of manure [kg/t]	3.0 ± 0.78	4.0 ± 0.52	3.9 ± 0.89	4.5 ± 0.47

<sup>[1]</sup> = With supplemental air inlets open

The floor in the pens at both test sites consisted of 1/3 drained floor (= concrete slatted floor with max. 10% opening area) and 2/3 slatted flooring. At both test sites the manure was collected in a shallow (50 or 60 cm) pit underneath the floor. The manure pits were emptied by vacuum flushing. The pigs at test site A and B were fed liquid feed according to a norm. At both test sites the indoor climate was controlled by low pressure forced ventilation with wall inlets (site A) or diffuse air inlet through the ceiling (site B) and exhaust outlets mounted in the ceiling.

The measurements were distributed over the production cycle with an animal weight ranging from 19 kg to 100 kg.

In a preliminary test, the “JH Forsuring NH<sub>4</sub><sup>+</sup>” acidification system was tested at test site A from November 2010 to November 2011. The ammonia emission from the four batches of pigs was measured continuously using electrochemical sensors which are a deviation from the VERA test protocol and thus, were not considered in the evaluation of this verification.

To fulfil the VERA test protocol requirements, supplementary ammonia emission measurements in compliance with the test protocol were performed on 32 measuring days and additional odour measurements on 5 days between June 2012 and May 2013. Odour measurements were taken on eight days in the summer period between July 2010 and October 2010. Since two control units and two experimental units were used during the first test period, only two odour samples were collected in each unit. In the second test period with one control and one experimental unit, three odour samples were collected in each unit on each measurement day.

At test site B the “JH Forsuring NH<sub>4</sub><sup>+</sup>” acidification system was tested in the period from April 2012 to April 2013. Measurements of the ammonia emission in compliance with the test protocol were performed on 48 days between April 2012 and February 2013. Odour measurements were taken on nine days in the summer period and on five days during the rest of the year. On ten measurement days, odour samples were taken in two control units and two experimental units, and therefore only two odour samples were collected in each unit on each measurement day. On four measurement days during the summer period, odour samples were taken in one control and one experimental unit, with three odour samples in each unit.

Measurement of ventilation rates was carried out at test location B using Dynamic Air®, a proprietary flow sensor system developed by SKOV A/S. This method is not approved by the VERA test protocol for livestock housing and management systems (version 2, 2011). However, the test institute carried out an onsite performance test of the novel method using a calibrated fan wheel anemometer covering the outlet in accordance with table 5a of the aforementioned VERA protocol as reference method.

Since the technology was focused on manure treatment no effect on the dust emission was expected, thus dust was excluded in the test.



# TEST RESULTS

## ENVIRONMENTAL EFFICIENCY

### AMMONIA

The ammonia emission from the pig units provided with the “JH Forsuring NH4+” acidification system (experimental units) was on average reduced by 64 % compared to the emission from the control units without the system. The measured ammonia emissions based on animal place and year with (experimental unit) and without (control unit) “JH Forsuring NH4+” are presented in table 2.

Table 2: The ammonia emission measured with INNOVA and a multipoint sampler in the exhaust air from the control and experimental units.

Site	Number of measurement days	Control unit [kg NH <sub>3</sub> / year*animal place]	Experimental unit [kg NH <sub>3</sub> / year*animal place]	Reduction rate due to the technology [%]
A	32	1.5	0.6***	62.7
B	48	2.0	0.7***	66.0

\*\*\* = statistically significant difference  $p < 0.001$  relative to the emission from the control unit

### ODOUR

Odour emissions with (experimental unit) and without (control unit) “JH Forsuring NH4+” are presented in table 3.

Table 3: The odour emission measured in the exhaust air from the control and experimental units.

Site	Measurement period	Number of odour samples	Control unit [OUE/s/1000 kg animal]	Experimental unit [OUE/s/1000 kg animal]	Reduction rate due to the technology [%]
A	During the year	47	97	69***	29
A	Summer <sup>[2]</sup>	20	80	59***	26
B	During the year	52	99	92 <sup>[NS]</sup>	--
B	Summer <sup>[2]</sup>	32	112	98 <sup>[NS]</sup>	--

\*\*\* = statistically significant difference  $p < 0.001$  relative to the emission from the control unit

[NS] = no statistically significant difference ( $p > 0.05$ ) relative to the emission from the control unit

<sup>[2]</sup> = measured on days with an outdoor temperature of more than 16 °C

At test site A the use of the “JH Forsuring NH4+” acidification system in the experimental unit resulted in a 29% lower odour emission compared with the control unit. On days with an outdoor temperature of more than 16 °C, the average odour emission from the experimental units was 26 % lower compared to the control unit.

At test site B the odour emission from the experimental units was not significantly lower compared with the control units, neither during the year nor on days with an outdoor temperature of more than 16 °C.

According to the VERA test protocol the results from the lowest effect should be considered to represent

the system effect in cases where farm interactions occur. Thus, the technology cannot be ascribed an odour reducing effect.

## OPERATIONAL STABILITY

The test proved that the acidification system had satisfying operational stability. The “JH Forsuring NH4+” acidification system is delivered with a complete user manual, which describes relevant directions for system operation, maintenance and safety.

Although the acidification system is equipped with an automatic control and logging system, service and maintenance shall be carried out in accordance with the instructions from JH Agro A/S. The “JH Forsuring NH4+” acidification system shall be inspected at least every 6 months.

Particularly, the following issues shall be observed regularly as described in the user manual:

- > pH level: the user shall monitor and register the pH level
- > Control and remedy alarms
- > Use of sulphuric acid: the user shall monitor and register the amount of sulphuric acid used per kg ammonia
- > Control of sulphuric acid leftovers in tank
- > Control of fluids via viewing window placed on the external hull of the tank

Repair work was carried out on the acidification system by JH Agro A/S on three days during the test period at location A and on five days on location B which took 9 hours in total. Since the “JH Forsuring NH4+” acidification system only runs once a day, none of the problems was so serious that the acidification systems were inoperative. During the emission measurements the system uptime was 99 %, at test location A even 100 %.

An accumulation of manure in the slurry channels or any other negative effect on the performance of the slurry channel system was not observed.

## IDENTIFIED SIDE EFFECTS

An increased hydrogen sulphide concentration was observed when the daily flushing of the manure took place during treatment of the manure. The higher H<sub>2</sub>S levels lasted less than 1 hour per day. To prevent any risks for the user, the stirring of the slurry is done outside the animal house in the process tank which is equipped with decals warning against H<sub>2</sub>S.

However, the total hydrogen sulphide emission per hour and pig was significantly lower in the experimental units with the acidification system in place than in the control units.



## ADDITIONAL RESULTS

During the test periods the consumption of sulphuric acid varied between 5.8 (test site B) and 7.1 (test site A) kg per produced pig at the two test locations. The total electricity consumption of the acidification system reached around 1.5 kWh per produced pig.

## ADDITIONAL INFORMATION

In order to prevent corrosion in the manure channels the manufacturer JH Agro A/S suggests a concrete quality corresponding to a moderate environmental class (DS/EN 206 + DS 2426).

## TEST INSTITUTE

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# VALIDITY AND TERMS OF USE

## VALIDITY

This VERA Verification Statement is only valid for the specific verified product/technology and the tested animal category. There is no time limit for the validity of this VERA Verification Statement as long as the product/technology stays unmodified.

The International VERA Secretariat can, however, at any time invalidate the VERA Verification Statement if it is found to be misused or if significant modifications have been made to the product/technology that are estimated to have a negative effect on the environmental efficiency or operational stability. In regard to the latter the International VERA Secretariat can require that a new VERA test should be performed.

## TERMS OF USE

The use of this VERA Verification Statement must be in compliance with these terms:

- > JH Agro A/S must inform the International VERA Secretariat if any modifications are applied to the technology that can significantly influence the environmental efficiency and/or the operational stability.
- > This verification cannot be considered as an endorsement, approval, authorization or warranty of any kind, and the performance parameters provided cannot be extended to other applications or to other technologies.
- > JH Agro A/S agrees not to use this VERA Verification Statement, the test reports, or to refer to those, for any other technology than the one specified in the statement.
- > The VERA Verification Statement will be made available for public access at the VERA website: [www.vera-verification.eu](http://www.vera-verification.eu)
- > All other information obtained or produced during the verification process is considered confidential and will not be made available for others than the part owning the intellectual property rights.

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