

VERA VERIFICATION STATEMENT

VERIFICATION OF ENVIRONMENTAL TECHNOLOGIES FOR AGRICULTURAL PRODUCTION

It is hereby stated that

Technology: SyreN

Manufactured by: BioCover a/s

has been tested according to the VERA test protocol for
Gaseous Emissions from Land Applied Manure version 1, December 2010.

The following main results have been documented through the test:

Verified environmental efficiency:

Ammonia emission reduction efficiency at 49 % when applied on cattle slurry

Ammonia emission reduction efficiency at 37 % when applied on pig slurry

No effect on odour emission reduction efficiency

Verified operational stability:

The SyreN technology has demonstrated a satisfactory operational stability

This VERA Verification Statement is only valid when including the full document. This is page 1 of 9.
VERA Verification Statement no 002.

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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, Agriculture and Consumer Protection and the Dutch Ministry of Infrastructure and Environment make no expressed or implied warranties as to the performance of the technology and do not certify that a technology will always operate as verified.

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The VERA Organisation

VERA – Verification of Environmental Technologies for Agricultural Production – is an international organisation for test and verification of environmental technologies for agricultural production. VERA is established as a co-operation between the Danish Environmental Protection Agency, the Dutch Ministry of Infrastructure and Environment and the German Federal Ministry of Food, Agriculture and Consumer Protection.

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 by carrying out tests 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 the introduction of 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	Acidification of cattle and pig slurry during land application of slurry
Applied for	Reduction of ammonia emissions during land application of slurry
Technology name	SyreN
Company	BioCover a/s
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Test institute	Aarhus University, Faculty of Agricultural Sciences Faculty in collaboration with AgroTech A/S (Institute for Agri Technology and Food Innovation).

Technology Description

During land application of slurry, the SyreN technology continuously acidifies the slurry by mixing concentrated sulphuric acid with slurry. By lowering slurry pH, the potential for ammonia emission is significantly reduced compared to land application of untreated slurry. The SyreN technology was during this test applied to slurry spread with a standard trailing hose slurry application system with a distance between each hose of 30 centimetres. This type of standard trailing hose system was furthermore used as the reference system.

During operation of the SyreN technology, the sulphuric acid is transported and stored in an approved container mounted in front of the tractor or between the tractor and the slurry spreader which was at the rear end equipped with a spreading bar with trail hoses. The liquid manure was applied on the soil through the hoses trailing on the soil surface. The sulphuric acid is with the SyreN technology pumped through pipes from the acid container on the tractor to the outlet of the tank on the manure spreader where the liquid manure is mixed with the acid in a static mixer before the slurry is pumped into the device used to apply the acidified slurry on the soil. The system continuously controls the rate of acid being mixed with slurry by online pH measurement of acidified slurry. The technology is applicable during seasons for slurry application.

The SyreN technology includes an online data handling system, which store the following data: pH in the untreated slurry, pH in the acidified slurry and acid consumption per m³ slurry. The data handling system continuously measures the amount/volume of spread slurry and the SyreN technology automatically and continuously adjusts the rate and the amount of acid added to the slurry according to the target slurry pH.

Test Design

The SyreN technology was tested in June 2010 according to the instructions in the VERA Test Protocol for Measurement of Gaseous Emissions from Land Applied Manure (Version 1, December 2009). The environmental efficiency of SyreN was tested with a standard trailing hose slurry application system without the SyreN technology as the reference system. The SyreN system was tested in experiments where cattle slurry from a dairy cow and pig production was applied to at forage grass field at Research Centre Foulum, near Viborg, Denmark. The soil type was sandy loam.

Ammonia emission was measured during field scale test in 36*36 m field plots. Five reference plots, four acidified pig slurry and three acidified cattle slurry plots. The experiments were carried out at in early May and mid -June, which in Denmark give the temperature intervals demanded in the test protocol



Odour was measured on four plots in the same fields where ammonia emission from 6 plots were measured. Odour was measured after application of acidified slurry on two plots and of untreated slurry to two plots. The plots were 12*30 m and were situated 200 metres from the nearest ammonia plot. Odour concentration was measured 20 minutes after cattle slurry application. The experiment was carried out on two measuring days on 2nd of June and 15th of June 2010.

Test Results

Environmental Efficiency

Cattle slurry

Unacidified and acidified cattle slurry was applied to grass field plots (36*36 m²) the 2nd of June (1 trial) and 15th (2 trials) of June 2010 after grass cutting. Ammonia emission was measured with the standard micrometeorological method (6 measuring intervals over 6 days). Fluxes was measured using space shuttles. Odor emission was measured from two plots (12*30 m²) with and without acidified slurry on the same dates (olfactometry - samples collected after 20 min).

The 2nd of June 2.3 Ltr acid was added per ton slurry giving a pH at 6.4 and in the two trials 15th of June 2.9 Ltr acid was added per ton slurry giving a pH at 6.4-6.5.

In total 3 trials testing the effect of acid addition to cattle slurry at application was carried out. The measurements provided an average estimate of the reduction in ammonia emission at 49% (Standard Deviation 11%, max 61 and min 34%).

The ammonia emission was with application of the SyreN technology on cattle slurry on average reduced with 49 % compared to ammonia emissions from the untreated slurry.

Acidification had no significant effect on odor emission.

Pig slurry

Unacidified and acidified pig slurry was applied to winter wheat field plots (36*36 m²) the 4th of May (2 trials) and 18th of May (2 trials) 2010. The ammonia emission was measured with the standard micrometeorological method (6 measuring intervals over 6 days). Fluxes was measured using space shuttles.

In the 4th of May trial 1.9 and 2.1 Ltr acid was added per ton slurry giving a pH at 6.1 in both trials and in the two trials 18th of May 2.2 and 2.9 Ltr acid was added per ton slurry giving a pH at 6.7 and 6.6.

In the tests in May the addition of acid reduced ammonia emission from applied pig slurry with in average 37% (SD 12%, Max 52% min 18%).

Effect on odor emission from pig slurry was not measured, since the VERA test protocol do

not demand odor measurements.

The ammonia emission was with application of the SyreN technology on pig slurry on average reduced with 37 % compared to ammonia emissions from the untreated slurry.



Operational Stability

The test proved that the system had a satisfying operational stability. SyreN is delivered with a complete user manual, which describes relevant management of the system, maintenance and security. The acid supply to the slurry is controlled by continuous pH measurement and addition of acid to slurry can be adjusted to give a pH at or below a fixed target pH prior application to the soil, which is set and controlled online. The actual acid consumption, therefore, depends on the initial slurry pH and target pH, and will consequently vary between slurries.

The functionality and operational stability of the SyreN system can be controlled by relevant authorities by checking the online pH log file of the applied slurry.

Identified Side Effects

None observed.

Additional Results

None observed.

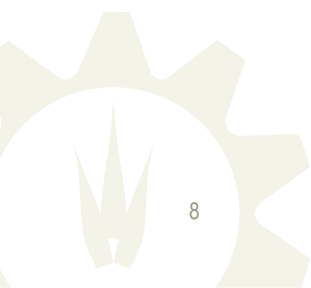
Additional Information

Procedures for handling and transportation of concentrated acids are described in the user manual.

Test Organisation

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Validity and Terms of Use

Validity

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