

Test Report 6981

VEENHUIS MACHINES BV NUTRIFLOW 3.0

Ingredients in cattle manure,
in pig manure
and in liquid digestate



VEENHUIS MACHINES BV NUTRIFLOW 3.0

- ✓ Ingredients in cattle manure:
DM, N_{Total}, NH₄-N, K₂O
 - ✓ Ingredients pig manure:
DM, N_{Total}, K₂O
 - ✓ Ingredients in liquid digestate:
DM, N_{Total}, NH₄-N, K₂O
- DLG Test Report 6981



Overview

A test mark “DLG-APPROVED for single, value-determining criteria” is awarded for agricultural products which have successfully fulfilled a reduced usability testing conducted by the DLG according to independent and recognised evaluation criteria. The test is served to highlight particular innovations and key criteria of the test object. The test may contain criteria from the DLG test frame for total tests, or focus on other value-determining characteristics and properties of the subject of the test.

The minimum requirements, the test conditions and procedures, as well as the bases of evaluation of the test results are set in agreement with a DLG Experts group. They correspond to the recognised rules of technology as well as the science and agricultural knowledge and requirements. A successful test ends with the publication of a test report and the awarding of the test mark, which is valid for five years from the date of the award.

The DLG test for “Precision of NIR sensors for the determination of ingredients in passing liquid manure of animal origin and liquid digestate“ was carried out on the “**NUTRIFLOW 3.0**” of VEENHUIS MACHINES BV.

The measurements for determining the contents of ingredients were carried out in liquid cattle manure, liquid pig manure, and liquid digestate. In each manure type five different practice slurries were examined through the tested NIR sensor NUTRIFLOW 3.0 for their levels of dry matter content (DM in weight %), total nitrogen (N_{Total} in kg/m^3), ammonium nitrogen ($\text{NH}_4\text{-N}$ in kg/m^3) and potassium oxide (K_2O in kg/m^3). During the measurements each slurry sample was collected. The taken samples were analysed by a total of ten different accredited specialised laboratories, preferably with wet-chemical methods and threefold repetition. For each ingredient, the averages from the results of the laboratory analyses were calculated. For the evaluation, the differences between the value measured by the NIR Sensor and the mean value of the laboratories were determined as the relative measurement deviation. The precision of the sensor was examined at different flow rates too. Other criteria were not tested.



**VEENHUIS MACHINES BV
NUTRIFLOW 3.0**

- ✓ **Ingredients in cattle manure:**
DM, N_{Total} , $\text{NH}_4\text{-N}$, K_2O
- ✓ **Ingredients pig manure:**
DM, N_{Total} , K_2O
- ✓ **Ingredients in liquid digestate:**
DM, N_{Total} , $\text{NH}_4\text{-N}$, K_2O

DLG Test Report 6981

Assessment – Brief Summary

On the basis of the results the mobile NIR sensor “NUTRIFLOW 3.0” of VEENHUIS MACHINES BV is awarded the DLG test mark “DLG APPROVED in single criteria” in the measurement of ingredients in liquid cattle manure, liquid pig manure, and liquid digestate for the parameters listed in the following table 1.

Table 1:
Approved parameters

Manure type	Ingredient
Cattle Manure	Dry Matter (DM)
	Total nitrogen (N_{Total})
	Ammonium nitrogen ($\text{NH}_4\text{-N}$)
	Potassium oxide (K_2O)
Pig Manure	Dry Matter (DM)
	Total nitrogen (N_{Total})
	Potassium oxide (K_2O)
Liquid digestate	Dry Matter (DM)
	Total nitrogen (N_{Total})
	Ammonium nitrogen ($\text{NH}_4\text{-N}$)
	Potassium oxide (K_2O)

The Product

Applicant

VEENHUIS MACHINES BV
Almelosestraat 54,
8102 HE Raalte, Netherlands

Product:
NUTRIFLOW 3.0

Description and technical data

The NUTRIFLOW 3.0 measuring system is a NIR (NearInfraRed) measuring system developed for the compositional analysis of organic substances, such as animal farm fertiliser and digestates.

The NUTRIFLOW 3.0 is integrated into the existing pipe system of the pumping station or the manure tank truck. To ensure error-free functionality of the sensor, the installation positions specified by the manufacturer must be observed (refer to Fig. 2 for information on the NIR method).

During the NIR analysis, the manure flowing within the arrangement is irradiated by a sapphire window (5) with infra-red light (yellow beam) from an integrated light source (1). Parts of the light are absorbed by the sample and the rest of the light is reflected. The reflected portion is detected by an evaluation unit (2) and dispersed into its wavelength spectrum. The detected spectrum is then converted into electrical signals. The resulting data is processed in a microcomputer (4). The measured values are generated at short intervals by the data calculation in the stored calibration model, and can be displayed.

To compensate for the temperature-dependent shifts in the spectrum, the system runs regular white and dark referencing.

The measurement is performed continuously on the farm fertiliser

flowing past the sensor. Measuring values are output every second when in measuring mode. Depending upon the requirements, mean values for user-specific time intervals, or live values, are displayed in real time.

The manufacturer specifies the measurement ranges shown in Table 2 for the used calibration model.

Table 2:
Measuring range
NUTRIFLOW 3.0

Value	Range
DM in %	0,2 – 12,00
N _{Total} in kg/m ³	0,17 – 9,91
NH ₄ -N in kg/m ³	0,10 – 4,47
K ₂ O in kg/m ³	0,2 – 6,81

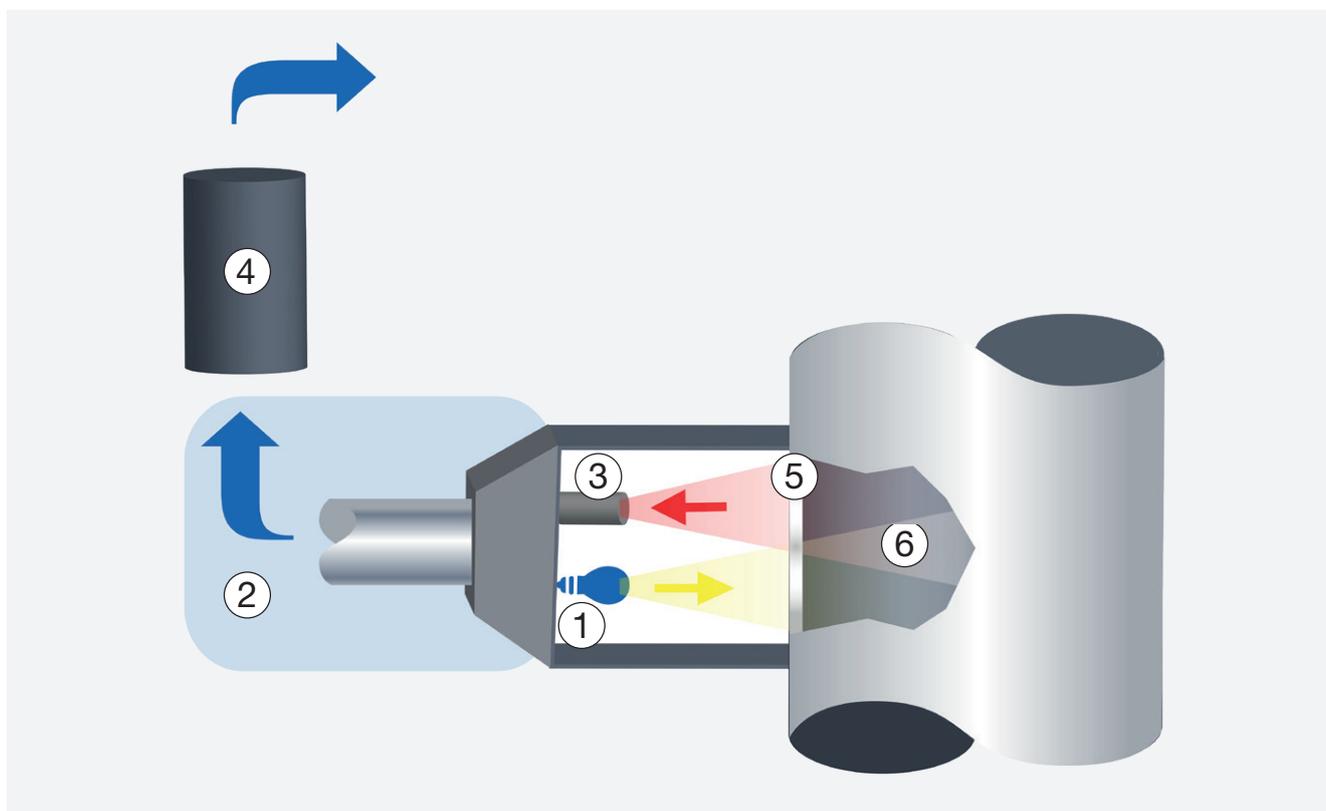


Figure 2:
Functional principle and system design of the NIR Sensor

The Method

The aim of the DLG Test „Precision of NIR sensors for the determination of ingredients in passing liquid manure of animal origin and liquid digestate“ is to examine the accuracies of mobile sensors in conjunction with appropriate calibration models in comparison to laboratory analysis with officially recognised methods.

A major advantage of NIR measuring technology compared to the conventional methods for the determination of ingredients in liquid manures through sampling and laboratory analysis, consist in the immediate availability of measurement results, and in the permanent measurement of the ingredients along the complete manure volume.

The scope in the DLG Test is limited on substrates, which are described as manure according to the Fertilizer Act (DüG), so on cattle manure, pig manure and liquid digestate.

The DLG test is available for the measurement of the following ingredients:

- Dry matter content (DM in % weight)
- Total Nitrogen amount (N_{Total} in kg/m^3)
- Ammonium nitrogen amount (NH_4N in kg/m^3)
- Phosphate content (Phosphorous Pentoxide; P_2O_5 in kg/m^3)
- Potassium content (Potassium Oxide; K_2O in kg/m^3)

In order to cover a wide range of applications, the test attempts to use a diverse spectrum for each type of substrate:

- Cattle manure: 4 % -9 % DM, where possible from dairy cows and fattened cattles
- Pig manure: 2 % -7 % DM, where possible from sow-keeping and fattened pigs
- Liquid digestate: 5 % -8 % DM

The DLG approval can be awarded for individual types of manure and individual ingredients. To get a DLG recognition, at least the requirements for the measurement of the total nitrogen content need to be met. When the requirements for the measurement of the total nitrogen content are fulfilled, other ingredients can be freely chosen.

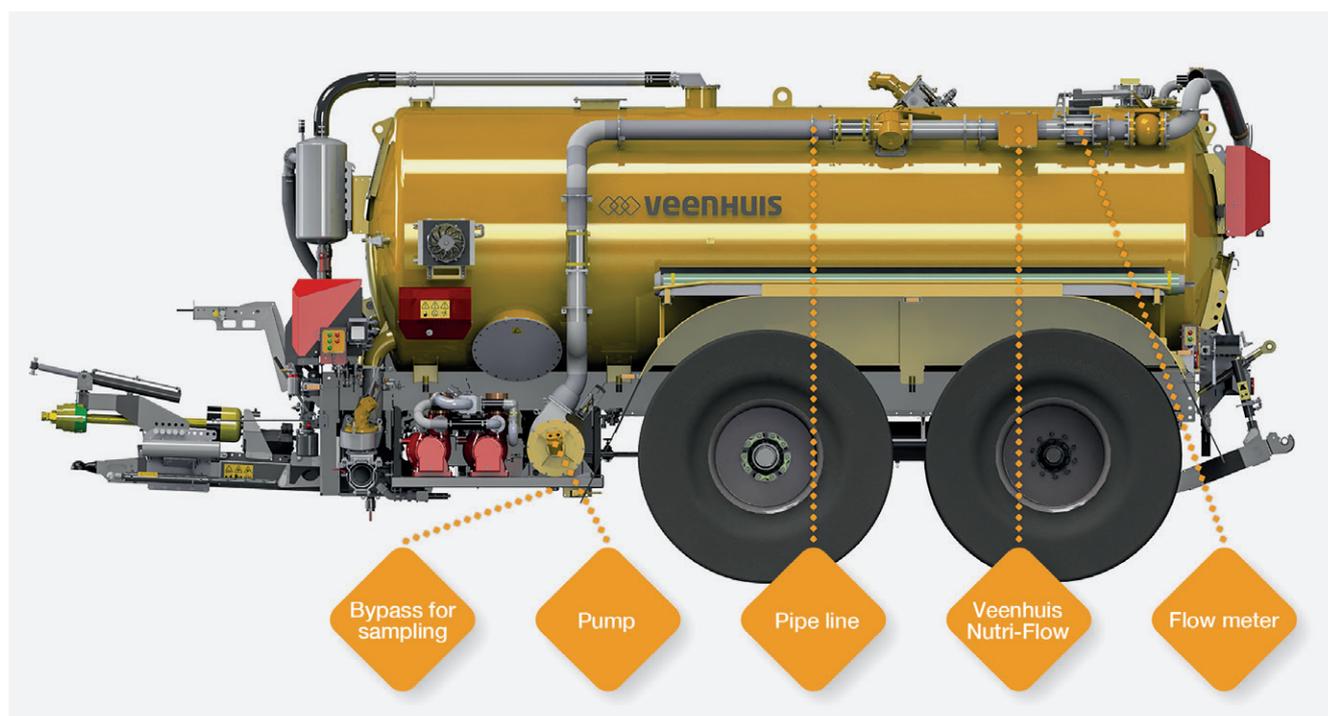


Figure 3:
Schematic structure of the DLG measuring system

The process

Depending on each type of manure (cattle manure, pig manure, liquid digestate) five individual samples that are as diverse as possible are measured and sampled on different farms. For this purpose, a subset of 3 m³ to 5 m³ is pumped from the previously stirred slurry storage in an intermediate tank.

At the intermediate tank, a pump and a common piping system are installed. On the piping system one or more sensors to be tested, a flow meter for the control of flow rates, and a bypass for sampling are attached (see figure 3).

In a preliminary phase the collected manure is intensively homogenised in the intermediate tank by continuous circulation in a closed circuit.

Following this preliminary phase, the measured values of the sensor are documented. Afterwards sub-samples for the reference analyses are then taken via the bypass while maintaining inflation around the closed circuit. In order to determine any possible influence on the sensor values, subsequently the flow velocity is varied and the measured values are re-documented.

The manure samples are clearly marked, frozen and stored frozen. Five suitable laboratories are commissioned with the reference analysis. Each laboratory receives at least three partial samples of each manure. The analyses in the laboratory must be carried out using officially recognised methods, preferably wet-chemical methods.

For each manure and each ingredient, the arithmetic mean value is calculated as a reference value from the laboratory results. The assessment of accuracy is based on the relative deviations from the sensor value in comparison with the reference value.

The Test Results in Detail

The trials were conducted jointly with the Chamber of Agriculture of North-Rhine Westphalia, Germany (Landwirtschaftskammer Nordrhein-Westfalen) in the administrative district of Kleve. Flow rates from 6 m³/min to 9 m³/min were set during the measurements. The different flow rates showed no influence on the measured values of the sensor. In table 3 the individual results are given.

Based on the obtained results, the mobile NIR Sensor “NUTRIFLOW 3.0” of VEENHUIS MACHINES BV is awarded the test mark “DLG-APPROVED in individual criteria” for the measurement of:

- Ingredients in cattle manure: DM, N_{Total}, NH₄-N, K₂O
- Ingredients in pig manure: DM, N_{Total}, K₂O
- Ingredients in liquid digestate: DM, N_{Total}, NH₄-N, K₂O

Table 3:

Individual results

Type designation	NUTRIFLOW 3.0	Evaluation*
Installation position (tilt)		
	90°	
Installation position		
	horizontal 6“ pipe	
Liquid Cattle manure		
	DM in % by weight	+
	N _{Total} in kg/m ³	○
	NH ₄ N in kg/m ³	+
	K ₂ O in kg/m ³	○
Liquid pig manure		
	DM in % by weight	++
	N _{Total} in kg/m ³	○
	NH ₄ -N in kg/m ³	-
	K ₂ O in kg/m ³	○
Liquid digestate		
	DM in % by weight	+
	N _{Total} in kg/m ³	○
	NH ₄ N in kg/m ³	○
	K ₂ O in kg/m ³	○

*** DLG-assesment scheme::**

- ++ = passed, very good (4/5 value pairs within a manure type ≤ 10 % and no > 20 % rel. deviation)
- + = passed, good (4/5 value pairs within a manure type ≤ 15 % and no > 25 % rel. deviation)
- = passed (3/5 value pairs within a manure type ≤ 25 % and no > 35 % rel. deviation))
- = failed

Summary

“NUTRIFLOW 3.0” of VEENHUIS MACHINES BV fulfilled the requirements for DLG approval in the accuracy of measurement of dry matter (DM), total nitrogen (N_{Total}), ammonium nitrogen (NH_4N), and potassium oxide (K_2O) in liquid cattle manure and in liquid digestate, as well as dry matter

(DM), total nitrogen (N_{Total}), and potassium oxide (K_2O) in liquid pig manure.

A major advantage of NIR measuring technology compared to the conventional methods for the determination of ingredients in liquid manures through sampling

and laboratory analysis, consist in the immediate availability of measurement results, and in the permanent measurement of the ingredients along the complete manure volume

More information

Testing agency

DLG TestService GmbH, Gross-Umstadt location
Chamber of Agriculture of North-Rhine Westphalia,
Germany (LWK Nordrhein-Westfalen)
Teaching and research Institute Riswick,
Elsenpass 5, 47533 Kleve, Germany
The tests are conducted on behalf of DLG e.V.

DLG test framework

DLG-APPROVED for single, value-determining
criteria "Precision of NIR sensors for the determina-
tion of ingredients in passing liquid manure of animal
origin and liquid digestate" (current as of 07/2017)

Department

Agriculture

Test engineer(s)

Dipl. Ing. agr. Georg Horst Schuchmann

Members of the competent

DLG Test Commission "Fertilising Technology"

Prof. Hans W. Griepentrog, University of Hohenheim
Prof. Nils Fölster, University of Osnabrück
Prof. Bernd Scheufler, University of Osnabrück
Dr. Harm Drücker, Chamber of Agriculture of
Lower Saxony
Dr. Horst Cielejewski, Chamber of Agriculture of
North Rhine-Westphalia
Dr. Fabian Lichti, State Institute of Agriculture Bavaria
Peter Seeger (farmer), Otzberg
Frank Reith (farmer), Groß-Umstadt
Sven Schneider (farmer and contractor), Brensbach

Head of Department

Dr. Ulrich Rubenschuh*

Photos and graphs

VEENHUIS MACHINES BV

* Author

DLG – the open network and professional voice

Founded in 1885 by the German engineer Max Eyth, DLG (Deutsche Landwirtschafts-Gesellschaft – German Agricultural Society) is an expert organisation in the fields of agriculture, agribusiness and the food sector. Its mission is to promote progress through the transfer of knowledge, quality standards and technology. As such, DLG is an open network and acts as the professional voice of the agricultural, agribusiness and food sectors.

As one of the leading organisations in the agricultural and food market, DLG organises international trade fairs and events in the specialist areas of crop production, animal husbandry, machinery and equipment for farming and forestry work as well as energy supply and food technology. DLG's quality tests for food, agricultural equipment and farm inputs are highly acclaimed around the world.

For more than 130 years, our mission has also been to promote dialogue between academia, farmers and the general public across disciplines and national borders. As an open and independent organisation, our network of experts collaborate with farmers, academics, consultants, policymakers and specialists in administration in the development of future-proof solutions for the challenges facing the agriculture and the food industry.

Leaders in the testing of agricultural equipment and input products

The DLG Test Center Technology and Farm Inputs and its test methods, test profiles and quality seals hold a leading position in testing and certifying equipment and inputs for the agricultural industry. Our test methods and test profiles are developed by an independent and impartial commission to simulate in-field applications of the products. All tests are carried out using state-of-the-art measuring and test methods applying also international standards.

Internal test code DLG: 19-273

Copyright DLG: © 2019 DLG



DLG TestService GmbH
Groß-Umstadt location

Max-Eyth-Weg 1 • 64823 Groß-Umstadt • Germany
Phone: +49 69 24788-600 • Fax: +49 69 24788-690
Tech@DLG.org • www.DLG.org

Download of all
DLG test reports free of charge
at: www.DLG-Test.de