



# **Cimbria Manufacturing A/S**

SHSD - Super Heated Steam Drier

**Verification Report** 

**Energy efficient pre-treatment of biomass** 

Date: 12. May 2010

Project Manager: Marianne Kyed Ørbæk

Task no: 110-22627





# 0. Table of contents

| 0.        | Table of contents                                 | 2 |
|-----------|---|---|
| 1.        | Abbreviations and definitions                     | 3 |
| 2.        | Introduction                                      | 5 |
| 2.1.      | Name of product                                   | 5 |
| 2.2.      | Name and contact of vendor                        | 5 |
| 2.3.      | Name of centre / verification responsible         | 5 |
| 2.4.      | Verification documentation                        | 5 |
| 2.4.1.    | Verification document status                      | 5 |
| 2.5.      | Verification process                              | 6 |
| 2.6.      | Verification and test organization                | 6 |
| 2.7.      | Expert group                                      | 7 |
| 3.        | Description of the technology                     | 8 |
| 4.        | Description of the product                        | 8 |
| 5.        | Application and performance parameter definitions | 9 |
| 5.1.      | Matrix  | 9 |
| 5.2       | Target  | 9 |
| 5.3       | Effects   | 9 |
| 54        | Additional parameters 1                           | 0 |
| 6         | Existing data                                     | õ |
| 7         | Test plan requirements                            | 0 |
| 7.1       | Test design                                       | õ |
| 7.1.      | Data management                                   | 1 |
| 73        | Ouality assurance 1                               | 1 |
| 7.0.      | Test report                                       | 1 |
| Q.4.      | Evaluation 1                                      | 1 |
| 0.<br>Q 1 | Calculation of porformance parameters             | 1 |
| 0.1.      | Performance parameter summary                     | 1 |
| 0.2.      | Dry matter content in manure fibres               | 1 |
| 0.2.1.    | Dry matter content in manure libres               | 2 |
| 0.2.2.    | Energy Datance                                    | 4 |
| 0.3.      | Evaluation of test quality                        | 4 |
| 0.4.      | Control data                                      | 4 |
| 8.5.      |   | 4 |
| 8.6.      | Additional parameter summary                      | D |
| 8.7.      | User manual                                       | 5 |
| 8.8.      | Product costs                                     | 5 |
| 8.9.      | Occupational health and environment1              | 5 |
| 8.10.     | Recommendations for verification statement        | 5 |
| 9.        | References1                                       | 6 |
| 10.       | Appendix1   | 6 |





# 1. Abbreviations and definitions

The abbreviations and definitions used in the verification report are summarized below.

| Word                        | DANETV   |
|-----------------------------|--|
| AMS                         | Automated Monitoring System  |
| Analytical labora-<br>tory  | Independent analytical laboratory used to analyze reference samples  |
| Application                 | The use of a product specified with respect to matrix, target, effect and limitations  |
| CEN                         | European Committee for Standardization   |
| DS                          | Danish Standardisation   |
| Effect                      | The way the target is affected   |
| EN                          | European standard  |
| Environmental product       | Ready to market or prototype stage product, process, system or service based upon an environmental technology  |
| Environmental<br>Technology | The practical application of knowledge in the environmental area   |
| ETV                         | Environmental technology verification (ETV) is an independent (third party) assessment of the performance of a technology or a product for a specified application, under defined conditions and adequate quality assurance. |
| Evaluation                  | Evaluation of test data for a technology product for performance and data<br>quality   |
| Expert                      | Independent person qualified on a technology in verification or on verifi-<br>cation as a process  |
| ISO                         | International Standardization Organization   |
| Matrix                      | The type of material that the product is intended for  |
| Method                      | Generic document that provides rules, guidelines or characteristics for tests or analysis  |
| Performance<br>claim        | The effects foreseen by the vendor on the target(s) in the matrix of in-<br>tended use   |
| Performance<br>parameters   | Parameters that can be documented quantitatively in tests and that pro-<br>vide the relevant information on the performance  |
| QA                          | Quality assurance  |
| Reference analy-<br>ses     | Analysis after a reference method in an accredited (ISO 17025) labora-<br>tory.  |



| Reference sam-<br>ples | Samples taken for and analyzed after a reference method in an accredited (ISO 17025) laboratory.   |
|------------------------|--|
| RSD                    | Relative standard deviation in %.  |
| Standard               | Generic document established by consensus and approved by a recog-<br>nized standardization body that provides rules, guidelines or characteris-<br>tics for tests or analysis |
| Target                 | The property that is affected by the product   |
| Test/testing           | Determination of the performance of a product for parameters defined for the application   |
| VDI                    | Verein Deutscher Ingenieure  |
| Verification           | Evaluation of product performance parameters for a specified application<br>under defined conditions and adequate quality assurance  |
| VTC                    | Verification and Test Centre   |





# 2. Introduction

Environmental technology verification (ETV) is an independent (third party) assessment of the performance of a technology or a product for a specified application, under defined conditions and quality assurance.

# 2.1. Name of product

The product is Super Heated Steam Drier - hereafter called SHSD.

# 2.2. Name and contact of vendor

| Cimbria Manufacturing A/S | 5 |
|---------------------------|---|
| Faartoftvej 22            |   |
| 7700 Thisted              |   |
| Denmark                   |   |
| Phone +45 9617 9000       |   |
| Contact Bent Bjerregaard  |   |
| E-mail: bbj@cimbria.com   |   |
| Phone +45 9617 9149       |   |

# 2.3. Name of centre / verification responsible

<u>Test centre:</u> FORCE Technology Park Allé 345 DK - 2605 Brøndby Denmark Verification responsible: William Hansen E-mail: wha@force.dk Phone +45 4326 7174 Cell phone +45 2218 1138

# 2.4. Verification documentation

The documentation of the verification process is described in four main documents in the order indicated below following the template of DANETV FORCE Technology verification centre quality manual /1/. The verification protocol and test plan result in a test and verification report, respectively. The verification report is the final completing document.

- 1. Verification Protocol
- 2. Test plan
- 3. Test Report
- 4. Verification Report

The verification process is summarized in the verification statement.

## 2.4.1. Verification document status

This Verification Report is a result of the Verification Protocol, November 2009 /7/ and is referring to the Test Report (Appendix 2).



# 2.5. Verification process

Verification and tests will be conducted in two separate steps, as required by DANETV. The steps in the verification are shown in Figure 1.

## Figure 1. Verification steps.



References for the verification process are the Quality Management Plan for DANETV /1/.

# 2.6. Verification and test organization

The verification was conducted by the Danish test centre DANETV. The verification was planned and conducted to satisfy the requirements of the ETV scheme currently being established by the European Union (EU ETV). The verification and test was performed by FORCE Technology as the Air Emission and Energy Efficient Technology Verification Center (VTC) under DANETV.

The day to day operations of the verification and test was coordinated and supervised by FORCE Technology, with participation of the vendor, Cimbria Manufacturing A/S. The testing was conducted at Fangel Bioenergi (Bigadan), Østermarksvej 70, 5260 Odense S., Denmark, and coordinated by FORCE Technology. Cimbria Manufacturing A/S was providing FORCE Technology with the necessary documentation and operation instructions. In addition Cimbria Manufacturing A/S was also participating in the development of the verification protocol and test plan together with FORCE Technology.

A part of the verification organization is the expert group who supports FORCE Technology in planning, conducting and reporting the verification and tests. The expert group makes the review of the test plan and test report.

The organization chart in Figure 2 identifies the relationships of the organization associated with this verification and tests.



# Figure 2. Organization of the verification and tests.



# 2.7. Expert group

The expert group assigned to this test and responsible for review of test plan and test report includes:

Stig Lind Schmidt (SLS) Head of Department Carlo Lorentzen Smed A/S Håndværkervej 76 4000 Roskilde E-mail: sls@cl-smed.dk Phone +45 7222 8270

## Qualification:

Several years of practical experience with energy processes in the environmental industry Orla Munk Jensen (OMJ) Department: "Energy & Building" FORCE Technology Hjortekærsvej 99 2800 Kgs. Lyngby E-mail: omj@force.dk Phone +45 7215 7808

#### **Qualification:**

Several years of practical and theoretical experience with energy processes (biomass and incineration) as specialist.





# 3. Description of the technology

The technology is "superheated steam drying" where the dewatering process takes place under positive pressure approximately 1 bar relative, with a material temperature above 100°C.

# 4. Description of the product

The set-up for the verification test consists of the SHSD and hot exhaust gas from a biogas engine producing district heating and electricity.

The dewatering process takes place in an enclosed cabinet without any emissions to the surrounding area.

The process is a continuous evaporation process, using overheated steam as a mean to evaporate the water from the fibrous material. The temperature of the manure is increased under pressure (1 bar abs) to above 100°C, where the water content in the media is evaporated. The evaporated water, now as steam, is withdrawn from the cabinet and condensed. The energy in the condensate is recovered and reused as district heating.

The wet manure is introduced to the SHSD through a preheated screw conveyer, which equally distributes the material on a slat conveyor belt and leads it horizontally through four sections of dryers. Finally the fibrous material leaves the cabinet in dry form for storage or further treatments.

Inside the cabinet, diagonally with the slat conveyor belt is a number of fans and heating coils. The fan in each section generates a closed circulated flow (fan – heating coil – manure material – fan etc.).

The heating coil is fed with energy from an external source.

The dewatering process accelerates when the temperature inside the cabinet increases to above 100 °C. The circulated media inside the cabinet is water vapour. Each time the water vapour passes the heating coil the temperature will increase up to the set-point – operation value. The superheated steam passes through the fibrous material and will generate an evaporation equal to the heated value of the circulated water vapour (superheated steam).

The generated superheated steam is continuous diverted from the cabinet and its energy content is reused in the district heating system.

The following figure 3 shows the SHSD. A schematic diagram of the energy and manure flow is illustrated in section 8.2.2.



# Figure 3. SHSD - Super Heated Steam Drier.



# 5. Application and performance parameter definitions

This section defines the application and the relevant performance parameters application as input for verification and test of an environmental technology following the DANETV method.

The application is described in detail in Appendix 1, in terms of matrix for use, targets and effects.

## 5.1. Matrix

The matrix of the application is biomass and for this verification it is manure fibre fractions, with high water content.

# 5.2. Target

The target of the application is the dry weight of the manure fibres.

# 5.3. Effects

The performance parameters (effect) for the application are the steam drier's capability to dry manure fibres and it is reported in terms of dry matter in % of the manure fibres and the related energy consumption.





# 5.4. Additional parameters

No additional parameters.

Besides the performance parameters to be obtained by testing, compilation of parameters describing user manual, product costs and occupational health & safety issues of the product are required as a part of the verification.

# 6. Existing data

No existing data are available.

# 7. Test plan requirements

Based upon the application and performance parameter identification, Section 5, the requirements for test design is set - see section 7.1 "Test design". The detailed test report is in a separate document see Appendix 2.

The test plan for this application was based upon the identified performance parameters, see section 5.

# 7.1. Test design

The test design outlined in the test plan is summarized in the following table 1.

| Performance parameters            | Scope of measurement                                | Measurements methods and readings   |
|-----------------------------------|---|---|
| Energy supply<br>Flue gas         | Volume<br>Temperature<br>Humidity<br>O <sub>2</sub> | Manuel measurement in accordance with DANAK ac-<br>creditation no. 51 held by FORCE Technology /7/  |
| Condensate                        | Quantity<br>Temperature                             | Quantity:     Manuel measurements, measured by weight and volume. <u>Temperature:</u> In Accordance with DANAK accreditation no. 51 held by FORCE Technology  |
| Fibrous material inlet and outlet | Quantity<br>Dry matter content<br>Temperature       | Quantity:Manual measurements, measured by weight.Temperature:Manuel measurement in accordance with DANAK accreditation no. 51 held by FORCE TechnologyDry matter contents:Laboratory analysis in accordance with CEN/TS 14774-3and CEN/TS 14774-1 |
| Power Consumption                 | Quantity  | Scanning and reading the data from the operation panel.   |

## Table 1. Test design.





# 7.2. Data management

Data storage, transfer and control was carried out in accordance with the requirements of ISO 9001 /2/ enabling full control and retrieval of documents and records.

# 7.3. Quality assurance

The quality assurance of the tests includes all handwritten data sheets and data dumps from the online registrations, control of the test system and control of the data quality and integrity.

The test report was reviewed by the expert group in accordance to the Quality Management Plan see Figure 1.

# 7.4. Test report

The test report is a result of the test plan as described in section 2.4 and follows the template of DANETV FORCE Technology verification centre quality manual /1/ with data and records from the tests presented.

# 8. Evaluation

The evaluation includes calculation of the performance parameters, see Section 5.4 for definition.

Evaluation of the data quality is based upon the test quality assurance; see Section 7.3 for requirements, and compilation of the parameters as specified in Section 5.4.

# 8.1. Calculation of performance parameters

Calculations are done according to generally accepted mathematical and statistical principles such as those described in /2/ and as described in the Test Report (Appendix 2)

# 8.2. Performance parameter summary

According to the Test Report (Appendix 2) the Cimbria Manufacturing, SHSD was tested for its ability to dry manure fibres. To determine the steam driers capability to dry manure fibres, measurements of the dry matter content in the manure fibres and the related energy parameters were carried out. Results of measurements, full data printout and the original analysis report from the laboratory is available in the Test Report (Appendix 2).

# 8.2.1. Dry matter content in manure fibres

In table 2 the dry matter content in the manure fibres is shown. Additional the production capacity of the SHSD drier is given. All values are average values from the entire sampling period starting on September  $28^{th}$  and ending on October  $1^{st}$  2009.



## Table 2. Dry matter content in manure fibres $(28.9 - 1.10.2009)^{1}$ .

| (% ±      | RSD <sup>2</sup> ) |
|-----------|--------------------|
| Inlet     | Outlet             |
| 32,4 ±3,1 | 90,2 ± 6,9         |

<sup>1</sup> Refers to Test Report Appendix 2

<sup>2</sup> Relative standard deviation in %

# 8.2.2. Energy Balance

The drying process of the manure is based on supply of energy in the form of heat. The sources of this energy are the flue gas from the biogas engine and the electricity to the fans circulating the drying steam inside the SHSD (see figure 1a). The energy from the flue gas is captured in the heat exchanger which overheats the steam inside the SHSD and the circulating fans ensure that superheated steam evaporates the water in the wet manure. The excess steam energy ( $Q_s$ ) from the drying process is later utilized into district heating. The remaining energy after the district heating is derived as condensate. Figures 3 to 5 are schematic diagrams of the flow of energy and manure to and from the SHSD.

Figure 3. SHSD flow diagram of Energy and Manure.





The energy used to dry the manure is provided by the sources mentioned above, i.e. flue gas  $(Q_{FG})$  and electricity (Pe) assuming that the manure does not contribute to the energy input (or output). Regarding the energy provided by the fans it is assumed, that 85 % of the electricity input to the fans is used to move the fans or used to equipment outside the SHSD and the remaining 15 % is transferred to heat inside the SHSD.

The SHSD energy demand is given in table 3 and table 4 reflect the available energy from the process and how it is recovered.

| Energy flow | Parameter   |                 | Amount<br>MJ/h |
|-------------|---|-----------------|----------------|
|             | Energy contribution from the flue gas to the heat exchanger | Q <sub>FG</sub> | 1.407          |
| Input       | Electricity to fans   | Pe <sup>2</sup> | 27             |
|             | Te  | otal Input      | 1.434          |

# Table 3. Energy demand to dry manure (28.9 – 1.10. 2009)<sup>1</sup>

<sup>1</sup>Refers to the Test Report Appendix 2.

<sup>2</sup> Calculated as 15 % of electricity input to fans (27 MJ = 176,8 MJ x 15%)

#### Table 4. Energy recovery in the plant $(28.9 - 1.10.2009)^1$

| Energy flow | Parameter                                      |              | Amount<br>MJ/h |
|-------------|--|--------------|----------------|
| Output      | Energy contribution from the ex-<br>cess steam | Qs           | 1.288          |
| output      | Energy loss                                    | QL           | 146            |
|             | Tot  | al Output    | 1.434          |
| Net en      | ergy needed to evaporate 1 kg of               | water is 0,  | 6 MJ           |
| 2,4         | 4 MJ/kg is utilized energy for dist            | rict heating | I              |

<sup>1</sup>Refers to the Test Report Appendix 2.

The calculation of energy used to dry the manure is associated with uncertainty due to the measurements included. This uncertainty is estimated to approximately 10 % and it is to some extend included in the figure of the energy loss ( $Q_L$ ).





Figure 4. SHSD flow diagram including the energy loss

Figure 5. SHSD flow diagram with energy values (MJ)

# 8.3. Evaluation of test quality

All measuring, handling of data and calculation of results have been carried out according to the FORCE Technology DANAK accreditation No. 51 (also for parameters not covered by the accreditation).

Transfer of data from handwritten form to computer, has been subjected to 100 % control by another person.

The evaluation of the test and the results has proven that the quality and the accuracy fulfil the requirements or guidelines stated in the DANAK accreditation No. 51 and 65/2/ and /8/

In connection with data processing and evaluation of the test results it is concluded that the specifications and guidelines complies with the test plan /6/.

## 8.4. Control data

Approved spread sheets for calculations of results has been subjected to an intensive control, to assure correct calculations, and consequently no further control is necessary.

## 8.5. Deviations

The test was performed according to the test plan. In general there were no deviations from the test plan regarding measurements, data logging and sampling.

However it is of importance to mention that a minor problem occurred during the test due to a blockage in the decanter. The blockage gave high water content in the inlet to the SHSD



system. The SHSD system was on stand-by for approximately 30 - 45 minutes. The break is considered as neglect able.

A blockage will result in a poor drying effectiveness of the system due to high water content in the fibrous material.

## 8.6. Additional parameter summary

No additional parameters.

## 8.7. User manual

The product is a prototype and there is no user manual available.

# 8.8. Product costs

The product is a prototype and there are no information regarding products costs available at present.

# 8.9. Occupational health and environment

It is confirmed that the use of the product does not imply special health, safety and waste issues during the test.

The work during testing was carried out according to the FORCE Technology Safety Rules, which complies with the extensive Danish rules for safe occupational health and the European regulations of work with chemicals.

## 8.10. Recommendations for verification statement

The verification of the Super Heated Steam Drying technology is completed. All documents (cf. /1/) are available.

On the basis of the verification process, relevant documents and the evaluation (see section 8) it is recommendable to issue a verification statement to the vendor.

| AC  | $ \rightarrow $ | Nationa                  | ion     |
|---|-----------------|--------------------------|---------|
| Signed by   | 12/5 -10        | Signed by                | 12/5–10 |
| Annemette Geertinger  | Date            | William Hansen           | Date    |
| Technical Vice President  |                 | Verification Responsible |         |
| DANETV Steering Committee member DANETV Verification Centre                         |                 |                          |         |
| FORCE Technology - Air Emission and Energy Efficient Technology Verification Centre |                 |                          |         |



# 9. References

- 1. DANETV at FORCE Technology. Verification Test Centre Quality Manual. 27-2-2009.
- 2. DANAK accreditation number 51
- 3. Method for the determination of moisture content. CEN/TS 14774-1
- 4. Method for the determination of moisture content. CEN/TS 14774-3
- 5. The heavy current regulation. 01-06-2001 (In Danish)
- Cimbria Manufacturing A/S SHSD, Energy efficient pre-treatment of biomass, Test Plan, September 2009
- 7. Cimbria Manufacturing A/S SHSD, Energy efficient pre-treatment of biomass, Verification Protocol, November 2009
- 8. DANAK accreditation number 65

# 10. Appendix

- Appendix 1 Application and performance parameter definitions
- Appendix 2 Test Report
- Appendix 3 Review reports

# Appendix 1

# Application and performance parameter definitions



This appendix defines the application and the relevant performance parameters application as input for verification and test of an environmental technology following the DANETV method.

# 1. Application

The intended application of the product for verification is defined in terms of the matrix, the targets and the effects of the product.

# 1.1. Matrix

The matrix of the application is biomass. An investigation of different types of biomasses shows that the water content varies considerably. For this verification it is manure fibre fractions, with a high water content that are suitable as biomass product. Furthermore the biomasses should be penetrable, and tolerate temperatures above 100°C.

# 1.2. Target(s)

The target of the application is the dry weight of the manure fibres.

The dry weight verified shall accordingly reflect both calculated energy balance, and measured temperature/humidity changes.

# 1.3. Effects

The effect for the application is generally reported in terms of dry matter in (%) of the manure fibres. Additional the following parameters are observed as side effect parameters: The energy efficiency and the energy balance of the drying process is measured and evaluated together with any emissions air-born or held back in the product or condensate from kk the process.

During operation, the following operation conditions are recorded and sampled:

- District heating flow
- Temperature (inlet)
- Temperature (outlet)
- Power Consumption (in generally, all related systems)
- Excess steam (temperature)
- Fibrous material collected before and after the SHSD unit

In figure 1 is a schematic diagram of the flow of energy and manure to and from the SHSD.

# **Appendix 1**

# Application and performance parameter definitions



Figure 1. Diagram of Energy and Manure flow in the SHSD.



# 1.4. Exclusion

The energy source deriving from the decanter is excluded from the calculated energy balance, due to the fact that the decanter together with the boiler was a part of the established system.

The technology product to be verified is an add-on system which reuses the generated energy from the existing process, as mentioned above.

# 2. General performance requirements

No formal performance requirements for the application have been identified in the European Union or the US.

# 2.1. Regulatory requirements

There are no general requirements for the application.

# 2.2. Application based needs

Not relevant.

# 3. State of the art performance

Not relevant.

# 4. Performance parameter definitions

No elaborating comments.

**Appendix 2** 

**Test Report** 

**Cimbria Verification Report** 



# **Cimbria Manufacturing A/S**

SHSD - Super Heated Steam Drier

**Energy efficient pre-treatment of biomass** 





# 0. Table of contents

| Table of contents                                   | 2                 |
|---|-------------------|
| Abbreviations and definitions                       | 3                 |
| Introduction  | 5                 |
| Verification protocol reference                     | 5                 |
| Name and contact of vendor                          | 5                 |
| Name of centre/test responsible                     | 5                 |
| Expert group  | 5                 |
| Test design   | 6                 |
| Test site   | 6                 |
| Tests   | 6                 |
| Test methods  | 6                 |
| Test staff  | 8                 |
| Test schedule including types and number of samples | 8                 |
| Test equipment                                      | 11                |
| Operational measurements                            | 12                |
| Health, safety and wastes                           | 12                |
| Reference analysis                                  | 12                |
| Analytical laboratory                               | 12                |
| Analytical parameters                               | 13                |
| Analytical methods                                  | 13                |
| Preservation and storage of samples                 | 13                |
| Data management                                     | 13                |
| Data storage, transfer and control                  | 13                |
| Quality assurance                                   | 13                |
| Test report review                                  | 13                |
| Data integrity check procedures                     | 14                |
| Test results  | 14                |
| Test summary  | 14                |
| Test results  | 14                |
| Dry matter content in manure fibres                 | 14                |
| Energy balance                                      | 15                |
| Deviations from test plan                           | 17                |
| References  | 18                |
| Appendix  | 18                |
|   | Table of contents |





# 1. Abbreviations and definitions

The abbreviations and definitions used in the verification and the test report are summarized below.

| Word                        | DANETV   |
|-----------------------------|--|
| AMS                         | Automated Monitoring System  |
| Analytical labora-<br>tory  | Independent analytical laboratory used to analyze reference samples  |
| Application                 | The use of a product specified with respect to matrix, target, effect and limitations  |
| CEN                         | European Committee for Standardization   |
| DS                          | Danish Standardisation   |
| Effect                      | The way the target is affected   |
| EN                          | European standard  |
| Environmental product       | Ready to market or prototype stage product, process, system or service based upon an environmental technology  |
| Environmental<br>Technology | The practical application of knowledge in the environmental area   |
| ETV                         | Environmental technology verification (ETV) is an independent (third party) assessment of the performance of a technology or a product for a specified application, under defined conditions and adequate quality assurance. |
| Evaluation                  | Evaluation of test data for a technology product for performance and data<br>quality   |
| Expert                      | Independent person qualified on a technology in verification or on verifi-<br>cation as a process  |
| ISO                         | International Standardization Organization   |
| Matrix                      | The type of material that the product is intended for  |
| Method                      | Generic document that provides rules, guidelines or characteristics for tests or analysis  |
| Performance<br>claim        | The effects foreseen by the vendor on the target(s) in the matrix of intended use  |
| Performance<br>parameters   | Parameters that can be documented quantitatively in tests and that pro-<br>vide the relevant information on the performance  |
| QA                          | Quality assurance  |



| Reference<br>analyses | Analysis after a reference method in an accredited (ISO 17025) labora-<br>tory.  |
|-----------------------|--|
| Reference<br>samples  | Samples taken for and analyzed after a reference method in an accredited (ISO 17025) laboratory.   |
| RSD                   | Relative standard deviation in %.  |
| Standard              | Generic document established by consensus and approved by a recog-<br>nized standardization body that provides rules, guidelines or characteris-<br>tics for tests or analysis |
| Target                | The property that is affected by the product   |
| Test/testing          | Determination of the performance of a product for parameters defined for the application   |
| VDI                   | Verein Deutscher Ingenieure  |
| Verification          | Evaluation of product performance parameters for a specified application<br>under defined conditions and adequate quality assurance  |
| VTC                   | Verification and Test Centre   |



# 2. Introduction

This test report is the implementation of a test design developed for verification of the performance of an environmental technology following the DANETV guideline. See the verification protocol /1/ for details on organization and implications.

# 2.1. Verification protocol reference

Cimbria Manufacturing, SHSD - Super Heated Steam Drier, November 2009.

## 2.2. Name and contact of vendor

Cimbria Manufacturing A/S Faartoftvej 22 7700 Thisted Denmark Phone +45 9617 9000 Contact Bent Bjerregaard E-mail: <u>bbj@cimbria.com</u> Phone: +45 9617 9149

## 2.3. Name of centre/test responsible

<u>Test centre:</u> FORCE Technology Test centre Park Allé 345 DK - 2605 Brøndby Denmark.

Test responsible:

Ole Tvede Larsen E-mail otl@force.dk Phone +45 4326 7168 Cell phone +45 4082 9873

## 2.4. Expert group

The expert group assigned to this test and responsible for review of test plan and test report includes:

Stig Lind Schmidt (SLS) Head of Department Carlo Lorentzen Smed A/S Håndværkervej 76 4000 Roskilde E-mail: <u>sls@cl-smed.dk</u> Phone +45 7222 8270 Orla Munk Jensen (OMJ) Department: "Energy & Building" FORCE Technology Hjortekærsvej 99 2800 Kgs. Lyngby E-mail: <u>omj@force.dk</u>, Phone +45 7215 7808



# 3. Test design

The test design outlined in the verification protocol /1/ is summarized in the following Table 1.

## Table 1. Test Design.

| Performance parameters            | Scope of<br>measurement                       | Measurements methods and readings  |
|-----------------------------------|---|--|
| Energy supply<br>Flue gas         | Volume<br>Temperature<br>Humidity<br>O2       | Manuel measurement in accordance with DANAK accreditation no. 51 held by FORCE Technology /7/  |
| Condensate                        | Quantity<br>Temperature                       | <u>Quantity:</u><br>Manuel measurements, measured by weight and<br>volume.<br><u>Temperature:</u><br>In Accordance with DANAK accreditation no. 51<br>held by FORCE Technology   |
| Fibrous material inlet and outlet | Quantity<br>Dry matter content<br>Temperature | Quantity:<br>Manual measurements, measured by weight.<br><u>Temperature:</u><br>Manuel measurement in accordance with DANAK<br>accreditation no. 51 held by FORCE Technology<br><u>Dry matter contents:</u><br>Laboratory analysis in accordance with CEN/TS<br>14774-3 and CEN/TS 14774-1 |
| Power Consumption                 | Quantity                                      | Scanning and reading the data from the operation panel.  |

# 3.1. Test site

The test is conducted at Fangel Bioenergi (Bigadan), Østermarksvej 70, 5260 Odense S on behalf of Cimbria Manufacturing and coordinated by FORCE Technology.

# 3.2. Tests

Cimbria Manufacturing, Super Heated Steam Drier - hereafter called SHSD - is tested for its ability to dry manure fibres.

# 3.2.1. Test methods

The test methods are divided into two types of measurements: Continuous and manual measurements. The detections levels of the test methods, references and uncertainty are shown in Table 2.



# Table 2. Test methods.

| Test methods                                     | Type of measurement  |
|--|--|
| Volume of flue gas                               | Manuel measurement in accordance with DANAK accreditation no. 51<br>held by FORCE Technology, and acknowledged international standards.<br>Reference: DS/ISO 10780 / US EPA Method 1-3 /4/<br>Detection Level: 2,3 m/s   |
| Temperature                                      | Continuously measurement in accordance with DANAK accreditation no.<br>51 held by FORCE Technology, and acknowledged international stan-<br>dards.<br>Reference/standard: VDI 3511 bl.1-5, DS/IEC 584-2 /5/<br>Measurement range: 40 – 600°C<br>Uncertainty: 4°C (absolute)  |
| Humidity / water content of fibrous material     | Manuel measurement in accordance with DANAK accreditation no. 51<br>held by FORCE Technology, and acknowledged international standards.<br>Reference: DS/EN 14790 US EPA M. 4. US EPA M. 4 /6/<br>Measurement range: 0 – 75 Vol %<br>Uncertainty: 14 %<br>Detection Level: 2 Vol % of the measured value (95 % confidence in-<br>terval)             |
| Fibrous material inlet and outlet, hu-<br>midity | Manuel collecting of samples.<br><u>Analysis:</u><br>Reference/standard: CEN/TS 14774 – 1 /9/<br>Solid bio fuels. Methods for the determination of moisture content.<br>Uncertainty: +/- 0,2 % V/V<br>Reference/standard: CEN/TS 14774 – 3 /10/<br>Solid bio fuels. Methods for the determination of moisture content.<br>Uncertainty: +/- 0,5 % V/V |
| Fibrous material inlet and outlet, amount        | Logging of data from the operation panel.  |
| District heating production                      | Continuously reading and logging data from the operation panel.  |
| Energy consumption                               | Continuously reading data from the operation panel.  |
| Energy efficiency                                | Calculations based on the results of the measurements and analysis.  |





#### **Detection and uncertainty limits:**

#### **Continuous measurements**

The detection levels used in this verification are the normally achievable under a normal performance control.

The detection levels are defined as the average value plus 3 times the scattering of the equipments deviation in the span calibration range.

The uncertainty levels are calculated as the normally achievable uncertainty at the measuring point, which full fills the guidelines in the chapter 8. in the "Luftvejledningen", from the Danish EPA\2\. By any deviation from the guidelines stated in the "Luftvejledningen" the uncertainty may increase.

#### **Manuel measurements**

The detection levels are defined as the normally achievable under a normal performance control, equal 60 minutes measurements. The detection level is defined as the average value of repeated "blind samples" plus three times the deviation of the samples.

The uncertainty level is calculated as the normally achievable uncertainty at the measuring point, which full fills the guidelines in the chapter 8. in the "Luftvejledningen", from the Danish EPA By any deviation from the guidelines stated in the "Luftvejledningen" the uncertainty may increase.

The uncertainty of the measurement is defined in % of the measured value (95 % confidence interval) equal 2 times RSD. Measured values between 5 and 1 times the detection level, will increase the uncertainty from the stated %-value to 50 - 100 % by the detection level.

# 3.2.2. Test staff

Test responsible: Ole Tvede Larsen (OTL)

Field responsible: Steen Meldorf (SME)

## 3.2.3. Test schedule including types and number of samples

The test schedule is shown in the following Table 3a and 3b.



#### Table 3a. Test schedule.

| Component   | Id/position no <sup>1</sup> | Plant equipment     | Method  |
|---|-----------------------------|---------------------|---|
| Fibrous material inlet<br>Quantity                  | SRO – no. CF03              | Plant AMS           | Manuel measurement by weight.   |
| Fibrous material outlet,<br>Quantity                | None                        | Plant AMS           | Manuel measurement by weight.   |
| Fibrous material inlet,<br>water content            | None                        | FORCE manual sample | Collecting of 5 samples a day for<br>analysis at the laboratory.<br>Quantity: 250 ml.<br>Storage: Glass container with cap  |
| Fibrous material outlet,<br>water content           | None                        | FORCE manual sample | Collecting of 5 samples a day for<br>analysis at the laboratory.<br>Quantity: 250 ml.<br>Storage: Glass container with cap  |
| District heating produc-<br>tion                    | SRO – no. 450               | Plant AMS           | Continuous logging of data from the operation panel.  |
| District heating tem-<br>perature given             | SRO – no. 451               | Plant AMS           | Continuous logging of data from the operation panel.  |
| District heating tem-<br>perature return            | SRO – no. 452               | Plant AMS           | Continuous logging of data from the operation panel.  |
| Condensate Quantity                                 | None                        | FORCE manual sample | Manuel measurement by volume.   |
| Condensate temperature                              | None                        | Plant AMS           | Continuous logging of data from the outlet of the convey belt.  |
| Energy inlet heat ex-<br>changer<br>Temperature     | None                        | FORCE manual sample | Manuel measurement in accor-<br>dance with DANAK accreditation<br>no. 51 held by FORCE Technology,<br>and acknowledged international  |
| Energy inlet heat ex-<br>changer<br>pressure drop   | None                        | FORCE manual sample | standards.<br>Reference/standard: VDI 3511<br>bl.1-5, DS/IEC 584-2<br>Measure range -40 – 600°C   |
| Energy inlet heat ex-<br>changer<br>volumetric flow | None                        | FORCE manual sample | Manuel measurement in accor-<br>dance with DANAK accreditation<br>no. 51 held by FORCE Technology,<br>and acknowledged international<br>standards.<br>Standard: DS/ISO 10780, |
| Screw Conveyer Bottom                               | None                        | Plant AMS           | Manual measurement of consump-<br>tions - Amp   |

<sup>1</sup>Identity numbers used at Fangel Bioenergi electric documentation



| Component  | Id/position no <sup>1</sup> | Plant equipment     | Method  |  |  |  |
|--|-----------------------------|---------------------|---|--|--|--|
| Energy outlet heat<br>exchanger<br>Temperature     | None                        | FORCE manual sample | Manuel measurement in accor-<br>dance with DANAK accreditation<br>no. 51 held by FORCE Technology,<br>and acknowledged international<br>standards.<br>Reference/standard: VDI 3211<br>bl.2-5, DS/IEC 584-2<br>Measure range -40 – 600°C /5/ |  |  |  |
| Electricity infuse<br>Horizontal screw<br>conveyer | None                        | Plant AMS           | Manual measurement of consump-<br>tions - Amp   |  |  |  |
| Screw conveyer                                     | M10 - 025U2                 |                     |   |  |  |  |
| Feeder bowl  | M30 – 027U2                 |                     |   |  |  |  |
| Fan 31   | Fan 31 M31 – 028U2          |                     |   |  |  |  |
| Fan 32   | M32 – 029U2                 |                     |   |  |  |  |
| Fan 33   | M33 – 030U2                 |                     |   |  |  |  |
| Fan 34   | M34 – 031U2                 | FORCE               | Continuous logging of data from   |  |  |  |
| Fan 35   | M35 – 032U2                 | pling               |   |  |  |  |
| Fan 36   | M36 – 033U2                 |                     | the operation panel.  |  |  |  |
| Fan 37   | M37 – 034U2                 |                     |   |  |  |  |
| Fan 38   | M38 – 035U2                 |                     |   |  |  |  |
| Conveyer Drier                                     | M39 – 036U2                 |                     |   |  |  |  |
| Rotating Brush <sup>2</sup>                        |                             | Plant AMS           | Manual measurement of consump-<br>tions - Amp   |  |  |  |
| Camber Sluice                                      | None                        | Plant AMS           | Manual measurement of consump-<br>tions - Amp   |  |  |  |

# Table 3a. Test schedule (continued).

<sup>1</sup> Identity numbers used at Fangel Bioenergi electric documentation
<sup>2</sup> Rotating brush for cleaning the slate conveyer belt, placed at the outlet of the cabinet.





#### Table3b. Test schedule.

| Task                      | Week number 2009 |    |    |    |    |    |    |    |    |
|---------------------------|------------------|----|----|----|----|----|----|----|----|
|                           | 35               | 36 | 37 | 38 | 39 | 40 | 48 | 49 | 50 |
| Test plan                 | х                |    |    |    |    |    |    |    |    |
| Measuring point<br>layout |                  | x  |    |    |    |    |    |    |    |
| Test plan QA              |                  |    |    |    | x  |    |    |    |    |
| Pre-test measuring device |                  | _  |    |    | x  |    |    |    |    |
| Sampling equipment        |                  |    |    |    | x  |    |    |    |    |
| Test                      |                  |    |    |    |    | ×  |    |    |    |
| Test Report draft         |                  |    |    |    |    |    | х  |    |    |
| Test Report QA            |                  |    |    |    |    |    |    | x  |    |
| Test report               |                  |    |    |    |    |    |    |    | x  |

# 3.2.4. Test equipment

Flue gas flow:

The gas velocity is measured by a pitot tube determining the dynamic pressure in connection with an inclined tube manometer. Based on the velocity and the area of the measuring cross section the flue gas flow is calculated.

Reference: US EPA Method 1-3 /4/

Flue gas temperature:

A type K temperature sensor (NiCr/NiAl) connected to a digital thermometer (accuracy 1°C) is applied. The indicated values are read with short intervals or recorded on a data logger.

Reference: VDI 3511 bl. 1-5. /5/





#### Moisture:

A well-determined partial quantity of flue gas is cleaned for particles and aspirated through a column containing silica gel to adsorb the water. The collected Quantity of water is determined by differential weighing. Alternatively the weight gain of impinger trains, condensation units etc. can be applied for moisture determination.

Reference: US EPA M. 4. /6/

## 3.2.5. Operational measurements

During operation, the following operational conditions are recorded and sampled, see table 2 and 3:

- District heating flow
- Temperature (inlet)
- Temperature (outlet)
- Power Consumption (in generally, all related systems)
- Excess steam (temperature)
- Fibrous material collected before and after the SHSD unit

# 3.2.6. Health, safety and wastes

The use of the product does not imply special health, safety and waste issues.

The work during testing is done according to the FORCE Safety Rules that are compliant with the extensive Danish rules for safe occupational health and the European regulations of work with chemicals.

#### **Regarding waste:**

The Cimbria Manufacturing, SHSD is build in an enclosed cabinet, which ensure that the emission or environmental impact is limited if any. There are no air-born emissions from the system. The condensate can be reused as fertilizers and the final by-product of the drying process can also be used as fertilizers or bio-fuel.

# 4. Reference analysis

## 4.1. Analytical laboratory

Reference analyses are done by:

| FORCE Technology          |
|---------------------------|
| FORCE Technology          |
| Park Alle 345             |
| 2605 Brøndby              |
| Denmark                   |
| Phone +45 4326 7000       |
| Contact: Susanne Westborg |
| E-mail swe@force.dk       |

#### Reference analysis

All analysis, measurements and calculations are performed in accordance to the FORCE Technology DANAK accreditation No. 65 /8/. For parameters not covered by the accreditation the analysis is carried out according to well known and accepted standards.





# 4.2. Analytical parameters

Dry matter content of the fibrous material from manure, before and after drying with Cimbria Manufacturing, SHSD.

# 4.3. Analytical methods

Sampling and analysis of dry matter is performed according to Reference analysis: Reference/standard: CEN/TS 14774 – 1 /9/, Solid bio fuels.

Methods for the determination of moisture cont, uncertainty: +/- 0,2 % V/V, and reference/standard: CEN/TS 14774 – 3 /10/, Solid bio fuels.

# 4.4. Preservation and storage of samples

The samples are stored in a sealed glass bottle, and analyzed within 14 days from sampling, according to the requirements in the mentioned standard.

# 5. Data management

Handling of data and calculation of results is performed according to the FORCE Technology DANAK accreditation no. 51. For parameters not covered by the accreditation the analysis is carried out according to well known and accepted standards.

Calculations are performed by approved and controlled spread sheet.

# 5.1. Data storage, transfer and control

All reading data is stored in handwritten form on paper and schemes.

All the data stored in data loggers is transferred to the FORCE computer system, which is regularly backed up for data safety.

Analytical raw data is filed and archived according to the specifications of the DANAK accreditation no. 51  $\ensuremath{/7/}$ 

# 6. Quality assurance

All measuring, handling of data and calculation of results is performed according to the FORCE Technology DANAK accreditation no. 51 (also for parameters not covered by the accreditation).

All measuring data is available in handwritten form.

Transfer of data from handwritten form to computer, is subjected to 100 % control.

Approved spread sheets for calculations of results is subject to an intensive control, to assure correct calculations, and consequently no further control is necessary.

# 6.1. Test report review

The test report is subject to internal review by the verification responsible from FORCE Technology VTC:

William Hansen E-mail: wha@force.dk Phone +45 4326 7174 Cell phone: +45 2218 1138



External review of the test report is done by the expert group assigned to this verification (see paragraph 2.4). The re-view of the verification report will include the full test report as an Appendix.

# 6.2. Data integrity check procedures

All transfer of data from handwritten form to computer, is subject to 100 % control by another person.

Approved spread sheets for calculations of results has been subject to an intensive control, to assure correct calculations, and consequently no further control is necessary.

New calculations in spread sheets are subject to 100 % check of all formulas and spot check of at least 20 % of all copies of the formulas.

# 7. Test results

# 7.1. Test summary

The test was conducted at Fangel Bioenergi (Bigadan), Østermarksvej 70, 5260 Odense S on behalf of Cimbria Manufacturing and coordinated by FORCE Technology. Cimbria Manufacturing, SHSD was tested for its ability to dry manure fibres.

During operation, the operation conditions were recorded and sampled as mentioned in section 3.2.5

The test was carried out over 4 day's continuous running process. Representatives from Cimbria Manufacturing and FORCE Technology were at site under the whole period in order to observe and secure samples and recorded data from the test.

In total 18 samples were collected. Due to decanter default 1 sample was discarded from the data base.

## 7.2. Test results

In order to determine the steam driers capability to dry manure fibres, measurements of the dry matter content in the manure fibres and the related energy parameters are carried out.

## 7.2.1. Dry matter content in manure fibres

Based on the measurements and analysis from the verification test the dry matter content in the manure fibres is concluded in table 4. Additionally the production capacity of the SHSD is given. All values are average values from the entire sampling period starting on September 28<sup>th</sup> and ending on October 1<sup>st</sup> 2009.



# Table 4. Dry matter content in manure fibres (28.9 – 1.10.2009)<sup>1</sup>.

| (% ±      | RSD <sup>3</sup> ) |  |
|-----------|--------------------|--|
| Inlet     | Outlet             |  |
| 32,4 ±3,1 | 90,2 ± 6,9         |  |

<sup>1</sup> Refers to Appendix 6A (table 1-3): Results of all measurements - Manure

<sup>2</sup> Refers to Appendix 6A - Table 1

<sup>3</sup> Relative standard deviation in %

<sup>4</sup> Refers to Appendix 6A – Table 3

# 7.2.2. Energy balance

The drying process of the manure is based on supply of energy in the form of heat. The sources of this energy are the flue gas from the biogas engine and the electricity to the fans circulating the drying steam inside the SHSD (see figure 1a). The energy from the flue gas is captured in the heat exchanger which overheat the steam inside the SHSD and the circulating fans ensure that superheated steam evaporates the water in the wet manure. The excess steam energy ( $Q_s$ ) from the drying process is later utilized into district heating. The remaining energy after the district heating is derived as condensate. Figures 1a – 1c are schematic diagrams of the flow of energy and manure to and from the SHSD.

#### Figure 1a. SHSD flow diagram of Energy and Manure.





The energy used to dry the manure is provided by the sources mentioned above, i.e. flue gas  $(Q_{FG})$  and electricity (Pe) assuming that the manure does not contribute to the energy input (or output). Regarding the energy provided by the fans it is assumed, that 85 % of the electricity input to the fans is used to move the fans or used to equipment outside the SHSD and the remaining 15 % is transferred to heat inside the SHSD.

The SHSD energy demand is given in table 5 and table 6 reflect the available energy from the process and how it is recovered.

In Appendix 6 all test results from the measurements are given (App 6A: Manure, App 6B: Flue Gas, App 6C: Condensate and App 6D: Electricity) and appendix 4 shows the calculation formulas used.

| Energy flow | Parameter                      | Parameter  |                          | MJ/h            | Amount<br>MJ/h |
|-------------|--------------------------------|--|--------------------------|-----------------|----------------|
|             | Energy contribution from the   | $\mathbf{Q}_{FG} = \frac{Q_{FG} (inlet)}{Q_{FG} (outlet)}$ | Q <sub>FG</sub> (inlet)  | 2.457           | 1 407          |
|             | flue gas to the heat exchanger |  | Q <sub>FG</sub> (outlet) | 1.050           | 1.407          |
| Input       | Electricity to fans            | Pe <sup>3</sup>  |                          |                 | 27             |
|             |                                |  | Total 1                  | Input           | 1.434          |
|             | Gross energy needed to evapo   | rate 1 kg  | of water is 3            | MJ <sup>4</sup> |                |

#### Table 5. Energy demand to dry manure (28.9 - 1.10. 2009)<sup>1, 2</sup>

<sup>1</sup> Refers to Appendix 6A – 6D: Results of all measurements

<sup>2</sup> Refers to Appendix 4: Calculations formulas

<sup>3</sup> Calculated as 15 % of electricity input to fans (27 MJ = 176,8 MJ x 15%) – see appendix 6D

<sup>4</sup> Calculated as 3 MJ=1.434 MJ/h (input)/489 kg/h (evaporated water ~ mass of condensate(see Appendix 6C))

#### Table 6. Energy recovery in the plant (28.9 – 1.10. 2009)<sup>1, 2</sup>

| Energy flow | Parameter                                 |             | Parameter     | MJ/h            | Amount<br>MJ/h |
|-------------|---|-------------|---------------|-----------------|----------------|
|             | Energy contribution from the excess steam |             | Q51           | 21              |                |
|             |   | Qs          | Q52           | 1.104           | 1.288          |
| Output      |   |             | Q53           | 164             |                |
|             | Energy loss                               | QL          |               |                 | 146            |
|             | Total Output 1.4                          |             |               |                 |                |
|             | Net energy needed to evapora              | te 1 kg of  | water is 0,6  | MJ <sup>4</sup> |                |
|             | 2,4 MJ/kg is utilized ener                | gy for dist | trict heating | 2               |                |

<sup>1</sup> Refers to Appendix 6A – 6D: Results of all measurements

<sup>2</sup> Refers to Appendix 4: Calculations formulas

<sup>3</sup> Calculated as 15 % of electricity input to fans (27 MJ = 176,8 MJ x 15%) – see appendix 6D

<sup>4</sup> Calculated as 0,6 MJ=(1.434 - 21-1.104 MJ/h (output) )/489 kg/h (evaporated water ~ mass of condensate(see Appendix 6C))



The calculation of energy used to dry the manure is associated with uncertainty due to the measurements included. This uncertainty is estimated to approximately 10 % and it is to some extend included in the figure of the energy loss ( $Q_L$ ). Figure 1b including the energy loss and figure 1c including energy values (MJ).

Figure 1b. SHSD flow diagram including the energy loss

Figure 1c. SHSD flow diagram with energy values (MJ)



# 7.3 Deviations from test plan

The test was performed according to the test plan. There were no deviations from the test plan regarding measurements, data logging and sampling.

However some process problems occurred during the test, but the influence on the results of the test and the test itself is probably limited or confined when taken care off.

The first problem occurred on the 29th September, where the decanter went faulty due to a blockage. The blockage gave high water content in the inlet to the SHSD system – above the systems limit, and as a result a poor effectiveness over the system. After the problem had been taken care of, the decanter was back on-line. The SHSD system was on stand-by for approximately 30 - 45 minutes. The break is considered as neglect able.

The second problem occurred after the blockage of the decanter and gave an ongoing problem throughout the rest of the test. Dust from the fibrous matter gave some growth on the heat exchanger and could on a long term basis give some problems if not taking care of. A routine, where the SHSD system was inspected every 12 hours, was introduced to take care of the problem.

| AG                               |                  | Ole Trede 6                 | 2             |
|----------------------------------|------------------|-----------------------------|---------------|
| Signed by                        | 12/5 -10         | Signed by                   | 12/5-10       |
| Annemette Geertinger             | Date             | Ole Tvede Larsen            | Date          |
| Technical Vice President         |                  | Test Responsible            |               |
| DANETV Steering Committee member |                  | DANETV Verification Centre  |               |
| FORCE Technology - Air Emis      | ssion and Energy | Efficient Technology Verifi | cation Centre |





# 8. References

- 1. Cimbria Manufacturing A/S SHSD, verification protocol, Energy efficient pretreatment of biomass, November 2009.
- 2. Vejledning Nr. 2 2001. Luftvejledningen. Miljøstyrelsen (The Danish EPA air pollution guideline).
- 3. DANETV. Verification Test Centre quality manual. FORCE Technology. 27-2-2
- 4. US EPA M 1-3. 10780. Determination of volumetric flow of gas stream, velocity measurements, pito tube.
- VDI 3211 bl. 2-5. Measurements of temperature of gas streams NiCr-NiAl and pt 100.
- 6. US EPA M4. 14790. Measurements of vapour content (H2O) in gas streams.
- 7. DANAK Accreditation number 51
- 8. DANAK Accreditation number 65
- 9. Method for the determination of moisture content. CEN/TS 14774-1
- 10. Method for the determination of moisture content. CEN/TS 14774-3

# 11. Appendix

- Appendix 1 SHSD flow sheet
- Appendix 4 Calculation formulas
- Appendix 5 Test datasheets
  - 5A Laboratory report dry and wet matter (6 pages)
  - 5B Graphs showing the current usage during the test on all relevant components (16 pages)
  - 5C Printout of the calculation of the volumetric flow (5 pages)
  - 5D Logbook of sample collection and manual measurement of dry, wet matter and condensate (4 pages)
  - 5E Printout of flue gas (inlet & outlet), temperatures, flow decanter. Shown as graphs and summarized spreadsheets (11 pages)
  - 5F Screen dumps, load gas motor (energy source)
- Appendix 6 Results of measurements
  - 6A Manure
  - 6B Flue Gas
  - 6C Condensate
  - 6D Electricity
Appendix 1

Cimbria Test Report



Super Heated Steam Drier flow sheet









### **Appendix 4**

### **Calculation formulas**





The following table shows the calculated formulas used for energy calculations between different units. All values used in the calculations are average values.

To calculate energy content the following formula in Table 1 is used:

| Table 1. | Calculation | formula | used for | Eneray   | Calculations |
|----------|-------------|---------|----------|----------|--------------|
|          | ouncention  | Ionnaia | ascallor | LIICI 93 | ourculations |

| Energy sources         | Energy pa        | rameter                                   | Calculation formula                             |      |
|------------------------|------------------|---|---|------|
| Electric Power<br>(Pe) |                  | Ре  | $Pe^{a} = E^{b} x I x \cos \varphi^{c} x 3.600$ | (kJ) |
|                        |                  | Q <sub>FG</sub>                           | $Q_{FG} = V x Cp^{d} x Cv^{e} x T$              | (kJ) |
|                        |                  | Q <sub>c</sub>                            | $Q_{c} = M x Cv^{f} x T$                        | (kJ) |
| Energy (Q)             | Q <sub>S1</sub>  | 120 °C <sup>g</sup> steam to 100 °C steam | $Q_{S1} = M \times Cp^h \times \Delta T$        | (kJ) |
|                        | Q <sub>\$2</sub> | 100 °C steam to 100 °C water              | $Q_{S2} = M \mathbf{x} \mathbf{r}^{i}$          | (kJ) |
|                        | Q <sub>\$3</sub> | 100 °C water to 20 °C <sup>9</sup> water  | $Q_{S3} = M \times Cp^{j} \times \Delta T$      | (kJ) |

| Nome   | nclature              |         |                 |                    |                 |                   |                  |                    |             |                 |                 |                        |
|--------|-----------------------|---------|-----------------|--------------------|-----------------|-------------------|------------------|--------------------|-------------|-----------------|-----------------|------------------------|
| Symbol | E                     | I       | cos φ           | V                  | Т               | Ср                | Cv               | М                  | FG          | С               | S               | r                      |
| Term   | Electric<br>potential | Current | Phase<br>factor | Volumetric<br>flow | Tempe<br>rature | Density           | Specific<br>heat | Mass<br>Condensate | Flue<br>Gas | Conden-<br>sate | Excess<br>Steam | Heat of<br>Evaporation |
| Unit   | V                     | A       |                 | m <sup>3</sup>     | ٥C              | kg/m <sup>3</sup> | kJ/kg ⁰C         | Kg                 |             |                 |                 |                        |

<sup>&</sup>lt;sup>a</sup> For 3 phase motor multiply with 1,73

 $<sup>^{\</sup>rm b}$  The electric potential (V) for the Pe calculation is 400 Voltage

<sup>&</sup>lt;sup>c</sup>  $\cos \phi$  is used to determine the efficiency of the electric motor. The  $\cos \phi$  value used in the calculation are the values given on the electric motor rating plate, which and can vary from the actual  $\cos \phi$  value.

<sup>&</sup>lt;sup>d</sup> Cp is assumed to be 1,1 kg/m3. Cp varies depending on the fuel.

<sup>&</sup>lt;sup>e</sup> The specific heat for Flue Gas is 1,0 kJ/kg  $^{\circ}$ C

<sup>&</sup>lt;sup>f</sup> The specific heat for Condensate is 4,2 kJ/kg  $^{\circ}C$ 

<sup>&</sup>lt;sup>g</sup> Temperature is assumed values based on experience.

<sup>&</sup>lt;sup>h</sup> The specific heat for steam is 2,14 kJ/kg  $^{\circ}C$ 

<sup>&</sup>lt;sup>i</sup> The heat of evaporation is 2.257 KJ/kg

<sup>&</sup>lt;sup>j</sup> The specific heat for water is 4,18 kJ/kg  $^{\circ}C$ 

Appendix 5A

Cimbria Test Report



Laboratory report dry and wet matter

IECHNOLOG

Journal nr.: U09-858

2009.10.08

Rekvirent : Sag 109-20531.12.02 Vedr.: Platform 3, Videncenteret Att.: WHA

### PRØVNINGSRAPPORT

### Undersøgelse af fast brændsel

| Sag. nr.          | : | 109-20531.12.02       |
|-------------------|---|-----------------------|
| Rekvisitions nr.  | : | -                     |
| Prøve modtaget d. | : | 2009.10.05            |
| Prøvningstermin   |   | 2009.10.05-2009.10.08 |
|                   |   |                       |

Resultaterne for prøvningen findes på side:

2

### **FORCE Technology**

Susanne Westborg Specialist

Kemisk Analyse

161 Henning Munk Jensen Tekniker

Kemisk Analyse

Side 1 af 2

Prøvningsrapporten må kun gengives i uddrag med FORCE Technology's skriftlige tilladelse. Prøvningsresultaterne gælder udelukkende for de prøvede emner.

De "Almindelige betingelser" på bagsiden er en integreret del af vor ydelse.



ADVANCED TECHNOLOGY GROUP

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www.force.dk



Rekvirent :

Sag 109-20531.12.02

Vedr.: Platform 3, Videncenteret

Journal nr.: U09-858

### PRØVNINGSRAPPORT

Undersøgelse af gyllefibre

Prøve af Mærket : 19 stk gyllefibre : Tilgang, Pr. 1 - 19

mærket : Higang, Pr. I - J

Emballage : 19 stk tætte glasflasker

| Prøve mærket    | Prøvens størrelse i g | % tørstof bestemt v. 105° C |
|-----------------|-----------------------|-----------------------------|
|                 |                       |                             |
| 1               | 161,8 g               | 31,7                        |
| 2               | 221,5 g               | 30,6                        |
| 3               | 173,5 g               | 31,2                        |
| 4               | 223,4 g               | 31,3                        |
| 5               | 236,6 g               | 31,2                        |
| 6               | 189,7 g               | 31,8                        |
| 7               | 245,1 g               | 30,4                        |
| 8               | 187,6 g               | 32,1                        |
| 9               | 173,1 g               | 33,1                        |
| 10              | 184,4 g               | 32,6                        |
| 11              | 146,2 g               | 32,8                        |
| 12              | 154,9 g               | 32,5                        |
| 13              | 165,9 g               | 33,3                        |
| 14              | 152,0 g               | 33,1                        |
| 15              | 166,9 g               | 34,0                        |
| 16              | 171,1 g               | 33,6                        |
| 17              | 172,3 g               | 33,1                        |
| 18-Test         | 192,6 g               | 33,0                        |
| 19-Produktprøve | 198,3 g               | 32,6                        |
|                 |                       |                             |



Journal nr.:U09-860

2009.10.08

### **Rekvirent** : Sag 109-20531.12.02 Vedr.: Platform 3, Videncenteret Att.: WHA

### PRØVNINGSRAPPORT

### Undersøgelse af kondensat

| Sag. nr.          | : | 109-20531.12.02       |
|-------------------|---|-----------------------|
| Rekvisitions nr.  | : | -                     |
| Prøve modtaget d. | : | 2009.10.05            |
| Prøvningstermin   | : | 2009.10.05-2009.10.05 |
|                   |   |                       |

Resultaterne for prøvningen findes på side:

2

### **FORCE Technology**

Susanne Westborg Specialist

Kemisk Analyse

1 Wert Henning Munk Jensen Tekniker

Kemisk Analyse

Side 1 af 2

Prøvningsrapporten må kun gengives i uddrag med FORCE Technology's skriftlige tilladelse. Prøvningsresultaterne gælder udelukkende for de prøvede emner.

De "Almindelige betingelser" på bagsiden er en integreret del af vor ydelse.



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Journal nr.: U09-860

Rekvirent :

Sag 109-20531.12.02

Vedr.: Platform 3, Videncenteret

Undersøgelse af spildevand 1. Prøve af Kondensat Kondensat glasflaske Mærke Emballage 2. Prøve af Mærke Emballage 3. Prøve af Mærke Emballage Prøve 1. 2. 3. Enhed Ledningsevne ved 25 °C DS/EN 27888 μS/cm // // //, pH-værdi ved 25 °C DS 287 // // // Suspenderet stof DS/EN 872 (GF/A) mg/l 11, /// //, COD<sub>CR</sub> Kemisk oxygenforbrug DS 217 mg/l 14 // // Chlorid  $(C|^{-})$ DS 239 ĥ mg/l //, // Sulfat  $(SO_4^{--})$ DS 286 mg/l /// // // **Total fosfor** (P) DS/EN ISO 6878 mg/l //, // ĥ Syreopløselige metaller: Oplukning jf. DS 259 og Arsen (As) DS/ISO 17294-2 (ICP-MS) μg/l // /// // Cadmium (Cd) // DS/ISO 17294-2 (ICP-MS) µg/l //, // Cobalt (Co) //, /// /// DS/ISO 17294-2 (ICP-MS) µg∕l 11, Chrom (Cr) DS/EN ISO11885 (ICP-OES) μg/l // //, Kobber (Cu) //, DS/EN ISO11885 (ICP-OES) // /// μg/l Jern (Fe) DS/EN ISO11885 (ICP-OES) µg/l // // //, (Mn) 11 11, //, Mangan DS/EN ISO11885 (ICP-OES) µg/l Molybdæn ĥ (Mo) DS/ISO 17294-2 (ICP-MS) μg/l //, // Nikkel (Ni) // /// // DS/EN ISO11885 (ICP-OES) μg/l Bly (Pb) DS/ISO 17294-2 (ICP-MS) µg/l /// // // Zink (Zn) // // /// DS/EN ISO11885 (ICP-OES) μg/l Vægtfylde (målt v. 22° C) 0,999 g/ml /// // Udseende Uklar /// // gulgrøn

Bemærkninger:

//: Ikke analyseret parameter



Journal nr.: U09-859

2009.10.08

### **Rekvirent** : Sag 109-20531.12.02 Vedr.: Platform 3, Videncenteret Att.: WHA

### PRØVNINGSRAPPORT

### Undersøgelse af fast brændsel

| : | 109-20531.12.02                         |
|---|---|
| : | -                                       |
| : | 2009.10.05                              |
| : | 2009.10.05-2009.10.08                   |
|   | ::::::::::::::::::::::::::::::::::::::: |

Resultaterne for prøvningen findes på side:

2

### **FORCE Technology**

and Susanne Westborg / Specialist

Kemisk Analyse

Henning Munk Jensen

Kemisk Analyse

Side 1 af 2

Prøvningsrapporten må kun gengives i uddrag med FORCE Technology's skriftlige tilladelse. Prøvningsresultaterne gælder udelukkende for de prøvede emner.

De "Almindelige betingelser" på bagsiden er en integreret del af vor ydelse.



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Rekvirent :

1007-1013

Sag 109-20531.12.02

Vedr.: Platform 3, Videncenteret

Journal nr.: U09-859

### PRØVNINGSRAPPORT

Undersøgelse af gyllefibre

Prøve af: 18 stk gyllefibreMærket: Afgang, Pr. 1 - 18

Emballage : 18 stk tætte glasflasker

| Prøve mærket | Prøvens størrelse i g | % tørstof bestemt v. 105° C |
|--------------|-----------------------|-----------------------------|
|              |                       |                             |
| 1            | 75,1 g                | 96,3                        |
| 2            | 66,2 g                | 95,6                        |
| 3            | 81,2 g                | 83,0                        |
| 4            | 88,6 g                | 96,0                        |
| 5            | 93,1 g                | 96,9                        |
| 6            | 72,4 g                | 95,7                        |
| 7            | 100,0 g               | 60,9                        |
| 8            | 98,4 g                | 87,5                        |
| 9            | 73,4 g                | 93,7                        |
| 10           | 80,9 g                | 95,2                        |
| 11           | 93,0 g                | 81,0                        |
| 12           | 97,0 g                | 89,3                        |
| 13           | 93,1 g                | 81,0                        |
| 14           | 79,4 g                | 96,3                        |
| 15           | 88,3 g                | 88,7                        |
| 16           | 111,4 g               | 85,7                        |
| 17           | 114,8 g               | 81,6                        |
| 18-test      | 83,8 g                | 87,6                        |
|              | <u> </u>              |                             |

### Appendix 5B

Cimbria Test Report



Graphs showing the current usage during the test on all relevant components

































Appendix 5C

Cimbria Test Report



Printout of the calculation of the volumetric flow

# Anlæg/afkast: Tilgang rågas

| Parameter   | Enhed    | Måling 1      | Middel        |
|-------------|----------|---------------|---------------|
| Dato        | dd-mm-åå | 28.9.2009     | 28.9.2009     |
| Måleperiode | tt:mm    | 16:21 - 16:29 | 16:21 - 16:29 |
|             |          |               |               |

# Produktions- og driftsoplysninger \*

| 1,72               |  |
|--------------------|--|
| 1,72               |  |
| Y                  |  |
| tilnærmet værdi) * |  |
| uftoverskud (t     |  |

### Hjælpeparametre

|                             |            | 11111 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |        |
|-----------------------------|------------|---------------------------------------|--------|
| Temperatur                  | °c         | 405                                   | 405    |
| 02                          | Vol %, tør | 8,80                                  | 8,80   |
| Volumenstrøm                | m³(n,t)/h  | 5.400                                 | 5.400  |
| Volumenstrøm driftstilstand | m³/h       | 15.000                                | 15.000 |
|                             |            |                                       |        |

(n,t) angiver tør gas ved normaltilstanden (0°C, 101,3 kPa)
\* betyder "ikke omfattet af akkreditering 51"

X:\Div030\Tasks\Kunder-otl\2008\108-31919 ETV KRO\Cimbria\109-27226 Cimbria DANETV WHA\Målinger Fange\Manuelt aflæst\Emis1fangel\_28092009.xls

## Anlæg/afkast: Tilgang rågas

| Dato     dd-mm-åå     29.09.2009 | Parameter   | Enhed    | Måling 1    | Måling 2    | Måling 3      | Middel       |
|--|-------------|----------|-------------|-------------|---------------|--------------|
| Måleperiode htt:mm 7:35 - 7:40 8:20 - 8:25   10:00 - 10:15 7:3   | Dato        | dd-mm-åå | 29.09.2009  | 29.09.2009  | 29.09.2009    | 29.09.2009   |
|  | Måleperiode | tt:mm    | 7:35 - 7:40 | 8:20 - 8:25 | 10:00 - 10:15 | 7:35 - 10:15 |

### Hjælpeparametre

| Temperatur                  | °C        | 406    | 406    | 406    | 406    |
|-----------------------------|-----------|--------|--------|--------|--------|
| Volumenstrøm                | m³(n,t)/h | 5.000  | 5.500  | 5.500  | 5.400  |
| Volumenstrøm driftstilstand | m³/h      | 14.000 | 15.000 | 15.000 | 15.000 |

(n,t) angiver tør gas ved normaltilstanden (0°C, 101,3 kPa)

¥

| Anlæg/afkast: Tilgang rågas |          |             |             |               |               |              |
|-----------------------------|----------|-------------|-------------|---------------|---------------|--------------|
| Parameter                   | Enhed    | Måling 1    | Måling 2    | Måling 3      | Måling 4      | Middel       |
| Dato                        | dd-mm-åå | 30.09.2009  | 30.09.2009  | 30.09.2009    | 30.09.2009    | 30.09.2009   |
| Måleperiode                 | tt:mm    | 9:10 - 9:15 | 9:15 - 9:20 | 11:15 - 11:20 | 00:00 - 00:00 | 9:10 - 00:00 |

### Hjælpeparametre

| Temperatur                  | °C        | 411    | 406    | 412    | 411    | 410    |
|-----------------------------|-----------|--------|--------|--------|--------|--------|
| Volumenstrøm                | m³(n,t)/h | 5.800  | 5.500  | 5.500  | 5.200  | 5.500  |
| Volumenstrøm driftstilstand | m³/h      | 16.000 | 15.000 | 16.000 | 15.000 | 15.000 |
|                             |           |        |        |        |        |        |

(n,t) angiver tar gas ved normaltilstanden (0°C, 101,3 kPa)

| Anlæg/afkast: Tilgang rågas |          | :           |               |              |
|-----------------------------|----------|-------------|---------------|--------------|
| Parameter                   | Enhed    | Måling 1    | Måling 2      | Middel       |
| Dato                        | dd-mm-åå | 01.10.2009  | 01.10.2009    | 01.10.2009   |
| Måleperiode                 | tt:mm    | 7:52 - 7:57 | 14:05 - 14:10 | 7:52 - 14:10 |

### Hjælpeparametre

| Temperatur                  | °C        | 412    | 410    | 411    |
|-----------------------------|-----------|--------|--------|--------|
| Volumenstrøm                | m³(n,t)/h | 6.000  | 5.600  | 5.800  |
| Volumenstrøm driftstilstand | m³/h      | 17.000 | 16.000 | 16.000 |

(n,t) angiver tør gas ved normaltilstanden (0°C, 101,3 kPa)

| Anlæg/afkast: Tilgang rågas |          |             |             |
|-----------------------------|----------|-------------|-------------|
| Parameter                   | Enhed    | Måling 1    | Middel      |
| Dato                        | dd-mm-åå | 02.11.2009  | 02.11.2009  |
| Måleperiode                 | tt:mm    | 7:28 - 7:38 | 7:28 - 7:38 |

### Hjælpeparametre

| Temperatur                  | °C        | 412    | 412    |  |
|-----------------------------|-----------|--------|--------|--|
| Volumenstrøm                | m³(n,t)/h | 6.000  | 6.000  |  |
| Volumenstrøm driftstilstand | u,₅m      | 17.000 | 17.000 |  |
|                             |           |        |        |  |

(n,t) angiver tør gas ved normaltilstanden (0°C, 101,3 kPa)

p
Appendix 5D

**Cimbria Test Report** 



Logbook of sampling collection and manual measurement of dry, wet matter and condensate

# Samples to analysis: Water content

## Taking:

| Date      | Time  | Id.no. | Inlet | Outlet                |   |
|-----------|-------|--------|-------|-----------------------|---|
| 8.09.2009 | 15:15 | Pr.1   | ×     | ×                     |   |
| 8.09.2009 | 23:17 | Pr.2   | ×     | ×                     |   |
| 9.09.2009 | 03:38 | Pr.3   | ×     | < ×                   |   |
| 9.09.2009 | 09:53 | Pr.4   | ×     | <ul> <li>×</li> </ul> |   |
| 9.09.2009 | 15:10 | Pr.5   | ×     | <ul> <li>×</li> </ul> |   |
| 9.09.2009 | 23:21 | Pr.6   | ×     | ×                     | Decanter problems - high water contents in the inlet somels     |
| 0:09.2009 | 05:02 | Pr.7   | ×     | ×                     |   |
| 0:09.2009 | 10:30 | Pr.8   | ×     | ×                     |   |
| 0:09.2009 | 15:37 | Pr.9   | ×     | ×                     |   |
| 1.10.2009 | 01:08 | Pr.10  | ×     | : ×                   |   |
| 1.10.2009 | 04:48 | Pr.11  | ×     | ×                     | Decanter problems - high water contents in the indust common    |
| 1.10.2009 | 13:10 | Pr.12  | ×     | ×                     | בספרינים להמשמיוים יוואו אמנה מתוומווז ווו וופ ווומובן אמווולופ |
| 1.10.2009 | 15:13 | Pr.13  | ×     | ×                     |   |
| 2.10.2009 | 00:29 | Pr.14  | ×     | ×                     |   |
| 2.10.2009 | 04:12 | Pr.15  | ×     | ×                     |   |
| .10.2009  | 07:50 | Pr.16  | ×     | ×                     |   |
|           |       |        |       |                       |   |

**Registrations: Condensate** 

| Mellemregninger<br>44 1 1,733333<br>51 1 1,85<br>54 1 1,9<br>47 1 1,783333<br>38 1 1,63333          |
|---|
| <b>Total kg</b><br><b>Time</b><br>501,4<br>469,7<br>457,4<br>487,3<br>532,0                         |
| <b>Total</b><br><b>Time</b><br>01:44<br>01:54<br>01:54<br>01:47<br>01:38                            |
| <b>Stop</b><br><b>Time</b><br>14:11<br>14:30<br>03:11<br>14:25<br>10:28                             |
| <b>Start</b><br><b>Time</b><br>12:27<br>13:25<br>01:17<br>12:38<br>08:50                            |
| <b>kg</b><br><b>Ajusted</b><br>869<br>869<br>869<br>869   |
| <b>kg</b><br>Diff<br>870<br>870<br>870<br>870   |
| <b>Weight kg</b><br>Full<br>3.200<br>3.200<br>3.200<br>3.200<br>3.200                               |
| Weight kg<br>Empty<br>2.330<br>2.330<br>2.330<br>2.330<br>2.330<br>2.330                            |
| <b>Date</b> 29.09.2009 30:09.2009 30:09.2009 01.10.2009 01.10.2009 02.10.2009 02.10.2009 02.10.2009 |

869,13

6666'0

VF condensate:

Registrations: Dry amound produced

| Mellemregninger<br>0<br>0<br>0<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1<br>1 |
|--|
| <b>Total kg</b><br><b>Time</b><br>250,0<br>300,0<br>260,0<br>290,0   |
| <b>Total</b><br><b>Time</b><br>01:00<br>01:00<br>01:00<br>01:00<br>01:00                                       |
| <b>Stop</b><br><b>Time</b><br>06:00<br>13:57<br>14:37<br>02:24<br>02:39  |
| <b>Start</b><br><b>Time</b><br>05:00<br>12:57<br>13:37<br>01:24<br>14:49<br>01:39                              |
| <b>kg</b><br>Diff<br>300<br>300<br>250<br>260<br>290   |
| Weight kg<br>Full<br>2.770<br>2.820<br>2.820<br>2.780<br>0<br>2.810  |
| Weight kg<br>Empty<br>2.520<br>2.520<br>2.520<br>2.520<br>2.520<br>2.520<br>2.520<br>2.520                     |
| <b>Date</b><br>29.09.2009<br>30.09.2009<br>30.09.2009<br>01.10.2009<br>01.10.2009<br>02.10.2009                |

Registrations: Raw manure inlet feed

| Mellemregninger<br>15 1 1,25<br>21 1 1,35          |
|--|
| <b>Total kg</b><br>Time<br>864,0<br>851,9          |
| <b>Total</b><br><b>Time</b><br>01:15<br>01:21      |
| <b>Stop</b><br><b>Time</b><br>13:13<br>12:50       |
| <b>Start</b><br><b>Time</b><br>11:58<br>11:29      |
| <b>kg</b><br>Diff<br>1.080<br>1.150                |
| Weight kg<br>Full<br>3.600<br>3.670                |
| <b>Weight kg</b><br><b>Empty</b><br>2.520<br>2.520 |
| <b>Date</b><br>29.09.2009<br>02.10.2009            |

Appendix 5E

**Cimbria Test Report** 



### Printout of flue gas (in & outlet), temperatures, flow decanter Shown as graphs and summarized spreadsheets





dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20092809.xls!Roggas Sagsnr : Fangel Biogasanlæg DANAK : DANETV 12-11-2009 14:42





dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20092809.xls!Chart2 Sagsnr : Fangel Biogasanlæg DANAK : DANETV 12-11-2009 14:43

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| Periode                                      |  | J2<br>Vol % (tør)<br>15012,00 | Køggas retur<br>°C<br>23003,00 | Køggas Frem<br>°C<br>23003,00 | T kondensat<br>°C<br>Ch:2 (□C) | Flow dekanter<br>m <sup>3</sup> /h<br>Ch:13 (mA) | Flow Fjv.<br>m³/h<br>Ch:14 (mA) | T frem<br>°C<br>Ch:15 (mA) | T retur<br>°C<br>Ch:16 (mA) |
|--|--|-------------------------------|--------------------------------|-------------------------------|--------------------------------|--|---------------------------------|----------------------------|-----------------------------|
| Beskrivelse<br>Periode-start<br>Periode-slut | 28/09-2009 12.35.00<br>29/09-2009 00.01.00 |                               |                                |                               |                                |  |                                 |                            |                             |
| Afvis værdier <<br>Afvis værdier >           |  |                               |                                |                               |                                |  |                                 |                            |                             |
| Middelværdi                                  |  | 8,92                          | 154,35                         | 366,12                        | 72,46                          | 11,70  | 5,75                            | 46,49                      | 80,80                       |
| Spredning                                    |  | 0,58                          | 24,46                          | 90'66                         | 21,05                          | 1,61   | 2,39                            | 11,61                      | 22,42                       |
| Mindste værdi                                |  | 0                             | 0                              | 0                             | 0                              | -11  | 9-                              | -30                        | -30                         |
| Største værdi                                |  | 21                            | 200                            | 406                           | 200                            | 45   | 24                              | 120                        | 120                         |
| Antal værdier i middelværdien                |  | 686                           | 686                            | 686                           | 686                            | 686  | 686                             | 686                        | 686                         |
| Antal uden for grænser                       |  | 0                             | 0                              | 0                             | 0                              | 0  | 0                               | 0                          | 0                           |
| Antal markerede som fejl                     |  | 0                             | 0                              | 0                             | 0                              | 0  | 0                               | 0                          | 0                           |
| Antal fejl                                   |  | 0                             | 0                              | 0                             | 0                              | 0  | 0                               | 0                          | 0                           |
| Periode                                      | 「「「「「「「「」」」」」」」」」」」」」」」」」」」」」」」」」」」」」      |                               |                                |                               |                                |  |                                 |                            |                             |
| Beskrivelse                                  |  |                               |                                |                               |                                |  |                                 |                            |                             |
| Periode-start                                |  |                               |                                |                               |                                |  |                                 |                            |                             |
| Periode-slut                                 |  |                               |                                |                               |                                |  |                                 |                            |                             |
| Afvis værdier <                              |  |                               |                                |                               |                                |  |                                 |                            |                             |

dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20092809.xls/Middel Sagsnr: Fangel Biogasanlæg DANAK: DANETV 12-11-2009 14:43

Cimbria Manufacturing A/S



12-11-2009 14:43 Sagsnr : Fangel Biogasanlæg DANAK : DANETV dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20092909.xls!Roggas







dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20092909.xlstChard3 Sagsnr : Fangel Biogasanlæg DANAK : DANETV 12-11-2009 14:43





12-11-2009 14:43 Sagsnr : Fangel Biogasanlæg DANAK : DANETV dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20092909.xls!Chart2

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Cimbria Manufacturing A/S



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dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20093009.xls!Chart3 Sagsnr : Fangel Biogasanlæg DANAK : DANETV 12-11-2009 14:44





12-11-2009 14:44 dk-TEKNIK kalibrering Version 3.1 23/8-2007 Autokal1\_20093009.xlstChart2 Sagsnr : Fangel Biogasanlæg DANAK : DANETV Cimbria Manufacturing A/S

| 02<br>Vol % (tør)<br>15012.00                   |             | 29/09-2009 00.01.52<br>29/09-2009 23.58.03 | 8,87   | 1,15  | 0   | 21  | Værdien 1437 | эг<br>0 | fejl 0 | 0 |  |  |
|---|-------------|--|--------|-------|-----|-----|--------------|---------|--------|---|--|--|
| Røggas retur R<br>°C<br>23003.00                |             |  | 165,13 | 16,09 | 0   | 173 | 1437         | 0       | 0      | 0 |  |  |
| køggas Frem<br>°C<br>23003.00                   |             |  | 401,56 | 38,53 | 0   | 412 | 1437         | 0       | 0      | 0 |  |  |
| T kondensat<br>°C<br>Ch:2 (□C)                  | (2-1)       |  | 81,88  | 10,48 | 0   | 95  | 1437         | 0       | 0      | 0 |  |  |
| Flow dekanter<br>m <sup>3/h</sup><br>Ch·13 (mA) | frank er me |  | 11,58  | 1,74  | -11 | 14  | 1437         | 0       | 0      | 0 |  |  |
| Flow Fjv.<br>m <sup>3</sup> /h<br>Ch-14 (mA)    | form a mo   |  | 5,91   | 1,75  | ę   | 6   | 1437         | 0       | 0      | 0 |  |  |
| T frem<br>°C<br>Ch-15 (mA)                      | form) or mo |  | 48,45  | 6,66  | -30 | 56  | 1437         | 0       | 0      | 0 |  |  |
| T retur<br>°C<br>Ch-16 (mA)                     |             |  | 87,01  | 9,72  | -30 | 98  | 1437         | 0       | 0      | 0 |  |  |
|   |             |  |        |       |     |     |              |         |        |   |  |  |

**Cimbria Test Report** 



Screen dumps, load gas motor (energy source)

|                      |                   |   |              |               |   |         |   |  |                |       | ÷. | niith<br>12 - 12<br>14 - 12<br>14 - 12 | <br>£484¥ . | <br>                       | 25 31<br>4<br>4  | ₩.<br>4<br>19  | 12 |       | 454.<br>477<br>477<br>477 |  | राज्येस<br>चार्च<br>कर्मन<br>नर | 4  | e<br>S  |
|----------------------|-------------------|---|--------------|---------------|---|---------|---|--|----------------|-------|----|--|-------------|----------------------------|------------------|--|----|-------|---------------------------|--|---------------------------------|--|---|
| 39.4                 | τa a              | 5.11<br>C.11  | -0.2         | ,<br>,        | > 4                                     | Cursor  | 007-60-87                               |  | 12:44          | 28:09 |    |  |             | <br>a na hay an ball an an |                  | антий так алагын ал<br> |    | ***** |                           |  |                                 |  | n on the second |
| 1000<br>1000<br>1000 |                   |   |              |               | ) []<br>] [3                            |         | IZ:4                                    |  | 13:49          | 28/09 |    |  |             |                            | -<br>-<br>-<br>- |  |    |       |                           |  |                                 | the second the   | VAL-L-SVAN AST IN SYNAMY ANALYSING AN ANALYSING ANALYSING ANALYSING   |
| 6                    |                   |   |              | ר<br>ר<br>חור | ><br>];                                 |         |   | nei an   |                | 28    |    |  |             |                            |                  | :  |    |       |                           | 1  |                                 | and in the second  | na sa katalan na katala   |
| j motor 1,           |                   |   | Motor 2,     | Wollsey       | , Gastlow                               | 10      | แหลงสมอนขนองอองนุณโลยม                  |  | 55             | 60    |    |  |             |                            |                  |  |    |       |                           | 4<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>-<br>- | ·                               | بهوري المراجع معارضا المركو المرا  |   |
| UASTIYK              |                   | Gaskicke  | El-effekt JE | gaskedel v-   | total 6-1000                            |         | annan an an ann ann ann an ann ann ann  |  | 16:00          | 28/09 |    |  |             |                            |                  |  |    |       | ï                         |  |                                 | and a fair of the sources.   |   |
|                      |                   | \$\$*\$ | S generator  | 500m? h       | ίξ. τε                                  | Besk    | 11-11-11-11-11-11-11-11-11-11-11-11-11- |  | 17:00          | 28/0  |    |  |             |                            |                  |  | z  |       |                           | ,  | 14                              |  | B<br>Ö  |
|                      |                   | 10000000000000000000000000000000000000                                | 2-225.900k   |               |   | livelse |   |  |                | -     |    |  |             |                            |                  | :  |    |       |                           |  |                                 | and the second s | otor. g   |
|                      |                   | 19199999999999999999999999999999999999                                | W            |               |   | ****    | hinaton: 1                              |  | 18:11          | 28,09 |    |  |             |                            | 1                |  |    |       |                           |  |                                 | and the state of t | asked   |
|                      |                   | 000000000000000000000000000000000000000                               |              |               |   | *****   | 2:00:00                                 | no mandre i na construmente la prima de la construmente de la | 19:17          | 28/09 |    |  |             |                            |                  | :  |    |       | *<br>*<br>*               | 1  |                                 | an and a substantian a   | el 09 (   |
| 0                    |                   | 0   | 565-         | Ð             | ţ,                                      | Min.    |   |  | 20             | 28    |    |  |             |                            |                  |  |    |       |                           |  |                                 | alesta a de la contra de  | jasklo <sup>,</sup>   |
|                      |                   |   |              |               |   |         |   |  | ŝ              | 800   |    |  |             |                            |                  |  |    |       |                           |  |                                 | and the second second second   | 6   |
| 300                  | μα [1] :<br>[1] : | 10F   | 900          | 500           | 1400                                    | Maks.   |   |  | 21:28          | 28,09 |    |  |             |                            |                  | 1  | :  |       |                           |  |                                 | se and be a set and an of set of a   |   |
| \$                   |                   | ð   |              |               | a se | Akt.    |   |  | 22:            | 28/   |    |  |             |                            |                  |  |    |       | 2                         |  | •                               | a da a d   |   |
| 0.3                  |                   | 4.6   |              | 0             | 0                                       | væidi   | 29.09/20                                |  | 8              | 00    |    |  |             |                            |                  |  |    |       |                           | i  | - · · • •                       | e e e e e e e e e e e e e e e e e e e  | Tidsmarko   |
| nbàt                 |                   | ¢.  | ΚW           | 11·10         | <b>U</b> ', (13                         | Enhed   | :00 × 001                               |  | 23:39          | 90/82 |    |  |             |                            |                  |  |    |       |                           | r  |                                 | <ol> <li>A - A - A - A - A - A - A - A - A - A -</li></ol>   | 0002009.29<br>0   |
|                      |                   |   |              |               |   |         | 14:29 🗢                                 | ~  | 11:00<br>10:41 | 00.00 |    |  |             |                            |                  |  |    |       |                           |  |                                 | and a second second second   | 00:44:29  |

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|                 | 60.1  |   | 13.65                  |  | \$                                     | ••••••••••••••••••••••••••••••••••••••   |  | 00:00:00   | × • •         | 2009  |   |      |  |               |            |   | 1<br>1<br>1 | 1           |          | 466656669993 |   |                                      |  | Summer State   |
| Suma Sumo       |   |   |                        |  | ) [<br>(                               | the second s   |  |  | 1             | 29/09 |   |      |  |               |            |   |             |             | 1        |              |   | 1                                    | n a na   |  |
|                 |   |   |                        |  |  | in the second se |  | V. CF.   | 00.20         | 29,09 | No. of the Association of |      |  |               |            |   | •<br>•      |             |          |              | : | -<br>-<br>-<br>-                     | n al base of the second second second  | n formen for motor and a new particular which and community  |
| otor 3, wastryk |   |   | otor 2 Costokto        | and a line of the second s | istion metadat                         |  | ર કે ગે બેલે કે કે બે  |  | 20:40         | 29/09 |   |      |  |               |            |   |             |             |          |              |   |                                      | والمعالم المحالية المحالم المحالية   | n - Cân stand a deal a construction of a construction of the const |
|                 | $\frac{1}{2}$   |   | ,<br>r> generator z -z | 11 JE 11   |  | Beskiive   |  |  | 1840          | 29/09 |   |      |  |               |            |   |             |             |          |              |   |                                      | د. د د د د د د بارش <sub>ا</sub> ین از این   | Gr mot   |
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|                 |   | 174979114944499999999999999999999999999 |                        |  |  |  | IN I   | annonimum manager and a state of the state o | 07:18         | 29/09 |   |      |  |               |            |   |             |             |          |              |   |                                      | and a start of the second structure of the second stru | del og gi  |
| Ф               | Ċ.  | <b>e</b>                                | 560-                   | Φ  | 0                                      |  | na han na handa na hana na na na na na hana na |  | 08:23         | 29/09 |   |      |  |               |            | : |             |             | ·        |              |   |                                      | a a a a a a a a a a a a a a a a a a a  | asklo, √e  |
| 300             | $\left\{ {{{\boldsymbol{\lambda }}_{i}} \right\}_{i=1}^{n}$ | <b>101</b>                              | 996                    | 500  | 移移集                                    | Nizt S.  | ઌઌૡૡઌૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡૡ   |  | 09:29         | 29/09 |   |      |  |               |            |   |             |             | r        |              |   |                                      | anoneninananon serie and a serie and a serie and a series of the series  |  |
| 60              | [4:1]   | 946                                     | *                      | 0  | 0                                      | Akt. vætti   | 29   |  | <b>10:</b> 34 | 29/09 |   |      |  |               |            |   |             |             | i.       |              |   |                                      | anvenna andreasta an   | Tids   |
| nda             |   | ¢.                                      | WW                     | ₹ <u>1</u> , s <b>t</b> t#   | <b>t.</b> ; c.(.)                      | Enled  | 09:2009 V 12   |  | 11:40         | 29,09 |   |      |  |               |            | • |             |             |          |              |   |                                      | narandingingingingingingingingingingingingingi   | narkor: 29/09/20   |
|                 |   |   |                        |  | 40000000000000000000000000000000000000 |  | :45:42 🗧   | ***  | 12:45         | 29/09 |   | <br> | <br>   |               |            |   |             |             |          |              |   |                                      |  | 19 12:45:42  |

| -2000        |         |  |                     | and the state    |                             | *****                                    |  |   |                  |                | <br>       |        | . 15 H . |      | 1949)<br>1940<br>1947 |                 | 878145                                 |                 | *****  | 14 th 1 | ****<br>** |   | uuui<br>+ 7<br># 7  | 3 ta Q  | •  |
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| 64.44        | 6 - C   |  | n<br>⇒ ⊈<br>¢       | ~                | ⊳ 4                         | n<br>CUI SOI                             | 17:60:67   |   | 12:47            | 29/09          | <br>****** | ****** | *******  | **** | ******                | ***********     | *****                                  | <br>:<br>;<br>; |        |         |            |   |   |   | , sisterumen i dirista elisterinette popu  |
| 2.000 A.     |         |  |                     |                  | 3 C<br>1 <b>(</b>           |  | 12:47:1<br>  |   | 13:52            | 29/09          |            | -      |          |      |                       | -tot -tota to a | •••••••••••••••••••••••••••••••••••••• |                 |        | <br>2   |            | : :::::::.                              |   | and a second concernent of the second   | na de contribune núcleo frinkriggen par consistent i frenkrigen a parte de parte                               |
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|              | ·[[T]]  | 02010000000000000000000000000000000000 | Sigenerator 2 - 22  | 500m* h          | 19)'.l)                     | Beskrivek                                |  |   | 17:09            | 29/09          |            |        |          |      |                       |                 |  |                 |        | 1       |            | ى مەرىخى مەمۇرى مەمۇرى ، مەمۇرى ،       | ••••• •   | -<br>   |  |
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|                 |  | ~             |                       |           |   | 0  | ω.  | . s <sup>5</sup> 2. | <b>0</b> 4     | *<br>*******  | 1845)<br>14 <sup>1</sup> 1<br>- 57<br>- 47 |   | 445<br>- 50<br>- 50<br>- 47 |   | 1949<br>8<br>- 90<br>- 40<br>- 100<br>- 10<br>- 1 | 27.<br>40<br>60<br>50<br>80<br>80 | ₩           | **** | .).<br>27<br>28<br>29<br>29<br>29<br>29<br>29<br>29<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20<br>20 | • |   |   |  |  | <b>•</b>   |
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| 6. <del>6</del> |  | مناو<br>سل    | 4                     | \$        | 0   | 10.501   | 0/09/200  |                     | 0:48           | >   |  |   |                             |   |  |                                   | 1<br>8<br>9 |      | 1   |   |   |   |  |  | ταταναναστοποιοποιοποιοιανό<br>Αποτολογιατικό τη |
|                 |  |               | ] [<br>हो (           | (<br>¥1 ( |   | 9  | 00 ~ 6  |                     | 00/09<br>01:53 |   |  |   |                             |   |  |                                   | •           | :    |   | 4 | 2 |   |  |  | e<br>ne vez en                                   |
| bud g           |  |               |                       |           |   | السلام المسلم | 48:11 💸   |                     |                | والمراجع والم |  |   |                             |   |  |                                   | •           |      |   |   |   |   |  | a chu agusta " an a' maga  |  |
|                 |  |               |                       |           | 6.  |  | Ŧ   |                     | 02-50<br>90,09 |   |  |   |                             |   |  |                                   |             |      |   |   |   |   |  | an ara tan tan an  |  |
| xtor 1, Ga      |  |               |                       | stlow as  | stlow to  | به جعوادید می محصوطی الم   |   |                     |                |   |  |   |                             |   |  |                                   |             |      |   |   | ٤ |   |  |  |  |
| stryk           |  |               | offort th             | skerlel f | 1.18 Q. \$1100  | e Manazara a por a de Canada de La Neja de Sera de Sera  |   | 04.04               | 30:09          |   |  |   |                             |   |  |                                   |             |      |   |   |   |   | **<br>*<br>*<br>*<br>*<br>*                        | nation constraining and and a second s  |  |
|                 |  | e lanañ e     |                       | ron       |   | •  |   | ç                   | 2 22           |   |  |   |                             |   |  |                                   |             |      |   |   |   |   |  | and the state of the second se | ŝ  |
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|                 |  |               |                       |           |   |  | ···   | 07:70               | 30:00          | -   |  |   |                             |   |  |                                   |             |      |   |   |   | میں میں میں اور |  | telet inner som fra stør stør for døder i te samte samtes  | el og  |
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| •               |  | 565-          | ¢                     |           | Min.  | ويستنا ستحصصهم فالقاحا م المحصو  |   | 08:26               | 30.09          |   |  |   |                             |   |  |                                   |             |      |   |   |   |   |  | na ba'na lan na sha da   | e<br>V   |
|                 | 969994 2000000 200999                        |               |                       |           |   | er en   |   |                     |                |   |  |   |                             |   |  |                                   |             |      |   |   |   | A   | lasenged i .                                       | оны Верлинура алынурагандага ал же   | ¢  |
| 300             | 100  | 900           | 500                   | 496F      | Maks.   |  |   | 09:31               | 00.00          |   |  |   |                             |   |  |                                   |             |      |   |   |   | ويود فارد الأنارين ال                               |  | , Table (Alexes) (HALA) (Menty Lawrence) (Lawrence)  |  |
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| 50.9            | 6÷.4   | 9             | ¢                     | •         | d. værdi  | 30.  | 2 constants   | 0:37                | 60.0           |   |  |   |                             |   |  |                                   |             |      |   |   |   | ير_ مديد محمي - <sup>ال</sup>                       | in <b>n</b> ann ann ann ann ann ann ann ann ann an | 105R   |  |
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| nbar            | \$`<br>\$                                    | КW            | 11 <sup>, ,</sup> 113 | m²h       | Enhed   | × 12:41  | and the manufacture and | 12                  | 60             |   |  |   |                             |   |  |                                   | •           |      |   |   |   | والمراجع والمحاولين والمحاول                        |  | 6007,54,0  |  |
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| [           |   | ) (<br>)<br>)    |                              |   | the second s  | ÷<br>3)                  | 9 ~ 23:22:56 |           | 00:28          | 09:40   |                   |       |       |       |            |        |          |       |       |      |                | د در هم اور در معالم<br>در در هم معالم  |   |                                       |  |   |                          | Kurvei             |                                      |
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|             | 100                                     | 006              | 003                          | 1001  | Waks.   |                          |              | 08:06     | 02/10          |   |                   |       |       |       |            |        |          |       |       |      |                | Le V Augus  | 20 2 10 20 20 20 20 20 20 20 20 20 20 20 20 20  |                                       | يى بىر يېرىيىنى بىرىغىنىدىنى بىرىكى بىرىغانى بىرىكى بىرىكى بىرىكى بىرىكى بىرىكى بىرىكى بىرىكى بىرىكى بىرىكى بىر<br>بىرىكى بىرىكى |   |                          | OPKS Envilina aris |                                      |
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| e<br>La tri | 2                                       | 144 M            | ₹8 <sup>.</sup> ; f. Q.B     | 1, <sub>5</sub> 113   | Enhed   | 109 V 11:22:56           |              | 10:17 11: | 02/10 02/      |   |                   |       |       |       |            |        |          |       |       |      |                |   | 1997 - 1997 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - 1998 - |                                       | rens το την το ποιογοργαφία Το του του  | u: 01/10/2009 23:2:   | 11. Dh. :007-01          |                    |                                      |
|             |   |                  |                              |   | >]  | \$}                      | <i>`</i> &¢  | 8         | 6              |   |                   |       |       |       |            |        |          |       |       |      |                | 4 <b>1</b>  |   |                                       |  | 2:56  | 23.03                    | )<br>)<br>)        |                                      |

| Casmoror, gaskedel og gasklokke     Hømmer 01 (1000)       Hømmer 01 (1000)     Hømmer 01 (1000) <t< th=""><th>e<br/>e</th><th>58.7</th><th>100</th><th>0</th><th></th><th></th><th></th><th></th><th>10000 (</th><th></th><th></th></t<>   | e<br>e                                  | 58.7  | 100   | 0  |                                       |  |   |  | 10000 (   |   |                 |
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|   | <b>o</b> r           | <u>.</u>                | -                              | NI PRIVATA A PROVIDENT   | Cu<br>Cu   | 2              | лļ    | 9 <b>2</b>                          | :<br>   | دهم<br>2 ۲<br>2 ۲ | ***** | 20<br>20<br>20 | ******* | * | <br> | <br>4.<br>4. | 44.<br>***<br>***   |  |   | Č917        |
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| ¢   | WM                   | ens <sup>2</sup> .Th    | 11.5 LL                        | Enhed  | × 11:21    | -              | G     | (10                                 |   |                   |       |                |         |   |      |              | n se suit anna an Aighde  | ، ۵ ت ترکیل در در ترکیل او میکرد. و ترکیل در در در ترکیل در د. | 0.09:290.9  | OUC THE     |
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| ] [                  |            |                 | a c<br>dic<br>Xic   | management parameters  | ۳:<br>۱      | 09 × 11:20:05                           | 67171         | 30/09        | بۇرىنى مەھەر   |                 |   |      |  |      |                 |  |      | ان منه، اور محمد والارتيان مايين والمريد المريد.<br>الإيران المريد المريد المريد المريد المريد المريد المريد المريد الم  | .àfnnagag   | متعامل منازلة المعاملية والمراكبة والمراكبة والمراكبة والمراكبة والمراكبة والمراكبة والمراكبة والمراكبة والمراكبة   |                | Kurvei           | de cherte adore esta anno esta esta de casa esta esta de france. |
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| L. Remulations James |            | w gaskedel 0-50 | NA 70148 A. EAAAEI. | nearennearennearennearennearen   |              |   | 1436          | 60/06        | na de mandre de la compositiva de la c |                 |   |      |  |      |                 |  |      | يوم يو رقب مين المريخ (يون مير وم). رون <sup>1</sup> يون م   |   | יין אין איזער א<br>איזער איזער איזע | ~              | Rapport          | 3131327, g =   |
| Jenerator 2-225      |            | (m)             |                     | DCMINER.   |              |   | 19<br>14<br>1 | 90.09        |  |                 |   |      |  |      |                 |  |      | 5<br>5<br>5<br>7<br>7<br>7<br>7  | and the second  | ** *** *** ***  | <b>à</b> smoto | e, Ijæ           | *****  |
|                      | M3006      |                 |                     | no noine anna an ann an ann an an an ann an ann an a   |              | LESSEE IFFE                             | 16:47         | 30,09        |  |                 |   |      |  |      |                 |  |      | and the second state of second states with the   | n national states and | بلاعه يؤرمانان معالمات المواليات والمحادث والمحادث والمحادث   | r. gaskec      | Đ                |  |
|                      |            |                 | :                   | A NOVA NA  |              | 2:00:00                                 | 17:52         | 30/09        |  |                 |   |      |  |      |                 |  |      | an a   | 1   | ********  | lel og ga      | nger 🚇           |  |
| -225                 | 5 F F      | ¢               | •                   | TERMENTER AND A TERME  |              |   | 18:58         | 30/09        |  |                 |   |      |  |      |                 |  |      |  | tines and a strange water and the strange of the s | ومربوحا وموارعا والمعالية والمتوارية ومحادثهما والمحادية والمحادية والمحادية  | sklokke        |                  |  |
| 006                  |            | 500             | <b>19</b> 89        | . so state and a second s |              |   | 20:03         | 60/05        |  |                 |   |      |  |      |                 |  |      | لاي المراجع ال<br>المراجع المراجع ا  | والمحافظة المحرفين  | ******  |                | jin @ PKS Engine |  |
| 4.1                  |            | <b>e</b> .      | •                   | Akt. væt fli   | 60:05        | 2 · · · · · · · · · · · · · · · · · · · | 21:09         | 30.09        |  |                 |   |      |  |      |                 |  |      | <b>**</b> ,  | ينها الالالالالة المراجع المراجع المراجع  | anaa miintaa ahaa ahaa ahaa ahaa ahaa ahaa ahaa   | Titlen         | ering © Dato: 02 |  |
|                      | 1. Sec. 1. | 11.5 ELB        | u, u                | Enhed  | 12009 × 23:2 |   | 22:14         | 30/09        |  |                 |   |      |  |      |                 |  |      |  | and a state of the state of   | 1925 - 2018 - 2010  |                | 2-10-200¢ Th     |  |
|                      |            |                 |                     | >  | 0:05         |   | 23:20         | 30.00        |  |                 |   |      |  |      |                 |  |      |  | a na far a na maraite   | 54:070  | 44-58-45       | 11:24:38         |  |

|  | - K                  | <u>.</u>   | :                                     |   | Curse        | 29.0             | ٨                      | 23:21<br>23:21 | 3   | ****** | ***** | <br>÷. | <br> | ******* | <br> | **** | 4<br>4 | ,<br>,<br>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, |   | سفت<br>بالنان<br>بالنان<br>منابع  |  | 441 ····   |                      | Billed   |
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|  |                      |  |                                       |   | 3)<br>3)     | 9/2009 × 23:25:2 |                        | 06:30          | 20,000  |        |       |        |      |         | r    |      |        |  |   | ₩***<br>*<br>{  | المريدة المريم والمريد المريد المريم والمريمة والمريد والمريد  | יש אירא שישר אירא אירא אירא אירא אירא אי   |                      | er Kuver   |
| rikki                                    |                      |  |                                       |   | <b>\$</b>    |                  |                        | JU199          | A VI V V  |        |       |        |      |         |      |      |        |  |   | r na star i na fazi a v na fazi na v  | and the set of the set | بريده معامله معامله ورث جب لتحتيز فلاسط بارد بدر بارجم معاملا والإسلام معا   |                      | Aanel  |
| , uashokke                               |                      |  | · · · · · · · · · · · · · · · · · · · | ······································  |              |                  |                        | 10-11<br>10-11 | surprise and the second se  |        |       |        |      |         |      |      |        |  |   |   | والمحاور والمحاور المراجع والمحاور والمحاور والمحاور   | ere er av  | ۵                    | Rapporte   |
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|  |                      | 18.<br>19.<br>19.  |                                       | U V V MELLE V MENNEN KO V V V V V V V V V V V V V V V V V V   |              | Duration: 12:00  | 76540                  | 30.09          | والمحاصر والمح |        |       |        |      |         |      |      |        |  |   |   | الله الامر أبرار الار المادين فإينام اللام يحدران المركم الاي  | 9999999888   |                      | Bue  |
| n na | :                    |  |                                       | donomentation of the state of the |              | 00               | 05:58                  | 30,09          |   |        |       |        |      |         |      |      |        |  |   | م ، بالا مردسة محمد المراجع الم | a martin and a second  |  |                      | e m  |
| 0  | NÚ<br>VT             | •  | •<br>•                                |   | ~            |                  | 07:03                  | 30/09          |   |        |       |        |      |         |      |      |        |  |   | in the between the only of the second se  |  | <b>WNNG</b>  |                      | ogvi siles a   |
| 100                                      | 900                  | 500  | 1994                                  | Anks. A   |              |                  | 06:80                  | 5000 E         |   |        |       |        |      |         |      |      |        |  |   |   |  | الالات المالي المحالي المراجع المراجع المحالية | Retera configura con | oka Filsinaating   |
| 50                                       | 0.4                  | ٠  | 0                                     | st. væt di  | 5007-500 DE  |                  | 19:14                  | 10/09 3(       |   |        |       |        |      |         |      |      |        |  |   | y ( <del>ABOSTORY</del> )   |  | Tidsmarkor: 2  | ~ pary, vc- 1V-      | 8. B.44. A7. 40.   |
| ¢<br>¢                                   | НW                   | ini<br>ini<br>ini<br>ini<br>ini<br>ini<br>ini<br>ini<br>ini<br>ini | 835 JY                                | Enhed ~   | < 11:25:27 ÷ |                  | 11:20 11:25            | 09 30.09       |   |        |       |        |      |         |      |      |        |  | مىيىدىنى بىرىمىيىنى بىرىمىيە بىرىمىيەن بىرىمىيەن بىرىمىيەن بىرىمىيەن بىرىمىيەن بىرىمىيەن بىرىمىيەن بىرىمىيەن بى<br>مىلىمىيە | -<br>-<br>-   | ***  | 19,49,2809 23:25:27  | 200, 201, 101, 2005  | and the second |

|        | 6.4-1  | 4                                      |                  | ÷  | <b>1</b>  | Curso         | 29.09.20       | ^           |                 | 2000  | ₩<br>₩<br>₩ | <br>2.<br>2. | 5-<br>5-<br>11111111111   | 6.<br>7<br>7 | <br>~.<br>2 |      | 34.<br>27<br>27: |     | 444<br>1<br>2<br>2<br>3<br>1<br>3<br>1<br>3<br>1<br>3<br>1<br>3<br>1<br>3<br>1<br>3<br>1<br>3<br>1<br>3 | *******                   |            | به سردین در میلوند.<br>به سردین در میلوند   |                  | Billeder       |
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|        |  | ) (<br>] (                             |                  |  |   | <b>3</b> )    | 009 × 11:23:17 | 1 <b></b>   | 42:22           |   |             |              |   |              |             |      |                  |     |   |                           |            | an a  |                  | Kurej          |
|        | Motor  | Internet T                             |                  |  |   | <u>va</u>     |                | ت بر م<br>ا | F5-5F<br>80.67  | 30 WA   | <br>        |              | Mage 2014 - 121 - | <br>         |             | <br> |                  | 6 2 |   |                           |            | an an aige geo anns agus an   |                  | teurcy.        |
|        | 2. Gasklokke<br>miliministration                         | z, ei-eitekt Jes g                     | w gaskedel 0-50  | m that the state of the second s | meannannannannannannannannannannannannann         |               |                | 14.00       | 02-11-<br>60.67 | 20 DA   |             |              |   |              |             |      |                  |     |   |                           |            | د وی و از این از این این این میکورسید.<br>در این از این این این این میکورسید میکور این این این این این این این این  |                  | Rappor         |
|        | n kan ber ber an ber | Jenerator 2 - 225.                     | LE:              |  |   | Reskrivels    |                | 12:42       | 10-10<br>60/67  |   |             |              |   |              |             |      |                  |     |   |                           |            | મે.આ  | <b>Basmoto</b>   | te, Hæ         |
|        |  | W1006.                                 |                  |  | ach ch fan cha ac briten na marthaire e briten an |               | Duration       | 16:50       | 20:09           | an a  |             |              |   |              |             |      |                  |     |   | · mar ar chargers         |            | 4<br>4<br>-<br>-  | r, gaskee        | p<br>Bu        |
|        |  |  |                  |  |   |               | 2:00:00        | 17:56       | 29/09           | ne in a substantia de la constanta de la const  |             |              |   |              |             |      |                  |     |   | nome ž n                  | 4y (       | a the second  | lel og ga        | iyei E         |
|        | •  | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~ | \$               | ¢  |   |               |                | 10:01       | 29/09           | rifers fan it feisie fan de de ferske skjerer gere ferste skielen skielen skielen skielen skielen skielen skie  |             |              |   |              |             |      |                  |     |   | jer z ne                  |            | المراجع المراجع المحالية المحالي | sklokke          | 11V40°, []]]   |
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| 1<br>L | 58.7   | Ð.                                     | •                | Q  | Akt. værdi  | ,             |                | 21:12       | 29:09           |   |             |              |   |              |             |      |                  |     |   | ά                         |            | annannannannannannannannannannannannan<br>Late - Storet - Ar Jugarannannannannan  | Tidsn            | eering © Dato: |
|        | ç  | MH                                     | m <sup>*</sup> h | U <sub>s</sub> ui  | Enhed   | 09.2009 V 23: |                | 22:17       | 29/09           |   |             |              |   |              |             |      |                  |     |   | × > >                     |            | ανλοποποιοποιοποιοποιοποιογίας για το β   | lafker: 2949-260 | 02-10-200° Ti  |
|        | ·  |  |                  | and the second   | >   | 23:11 7       |                | 23:23       | 29,09           |   |             |              |   |              |             |      |                  |     |   | <b>X</b> 5 %              | •••••<br>• | romotion because a second s   | 9 11:23:17       | d: 11:25:1     |

|                |                  |                                 | ;                                       | G   | )<br>   | ۰.                 | ŅΙ             | vı <sup>sın</sup> ı   | **** | ຜາ<br>ເອົາ<br>ເອົາ | ***** | йт<br>1971<br>1972 | <br>***** | 2 | * | 2.<br>2. | 1 | <br>-244.<br>  | ***<br>   | <del>ک</del><br>: : | ۲  |
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|                | ſ                |                                 |   | HSO1  | 8/09/2009   | -                  | 321            | 00/8  |      |                    |       |                    |           |   |   |          |   |  | م بله ترس محمد م  |                     |  |
|                | 3 C<br>3 C       |                                 |   |   | · · 23:21:51  |                    | 00:27          | 20,00   |      |                    |       |                    |           |   |   |          |   |  | s w   |                     |  |
| NOTO           |                  |                                 |   |   |   |                    | 01:32          | 20100   |      |                    |       |                    |           |   |   |          |   |  | and the second of the second se |                     |  |
| H 2, GASKIOKKE | H N, CI-CHERT JE |                                 | low total 0-1000<br>low mobalai n       |   | real of the second s |                    | 220238         | owoc  |      |                    |       |                    |           |   |   |          |   |  | وجهرائي رواية وسرد تروارين فرد كرامه كل   |                     |  |
|                | s generator 2 -  | IC TRADE                        |   | Beskriv   |   | i t                | 67427<br>60467 |   |      |                    |       |                    |           |   |   |          |   |  | ىرىم ۋىلەر ئۆلەر ۋە بەرۇسىيەتەرىرىمەرەرەمەرەمەرەمەرەمەرەمەرەمەرەمەرەم   | Gasmot              |  |
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|                |                  |                                 |   | uniona a muunon a sundan araa anaa anaa anaa anaa anaa anaa | n: 12:00:00   | 20.04              | 29/09          | مىزىدىنىيە مەرىپىدە مەرىپىدە مەرىپىيە مەرىپىيە تەرىپىيە تەرىپىيە تەرىپىيە تەرىپىيە تەرىپىيە تەرىپىيە تەرىپىيە ت   |      |                    |       |                    |           |   |   |          |   |  | randahanafandianananananananananananananananananan  | edel og             | • •  |
| •              | -225             | •                               | 0                                       | Miles   |   | 06.70              | 29/09          | - in this bear of the former of the second  |      |                    |       |                    |           |   |   |          |   | مەركى، ھۇرە قىرىمىيە مەرمە مەرمىيە مەرمىيە يېرىمىيە يېرىمىيە مەرمىيە مەرمىيە مەرمىيە مەرمىيە يېرىمىيە يېرىمىيە<br>مەركى مەرمىيە مەرمىيە مەرمىيە مەرمىيە مەرمىيە مەرمىيە يېرىمىيە يېرىمىيە مەرمىيە يېرىمىيە يېرىمىيە يېرىمىيە يېرىمى  | n na  | gasklokk            |  |
| 14             |                  | 50                              | <b>1</b>                                | TTTT  |   | 80                 | 29             | يدتب ماديني بالماد والمادي والمادين والمادين والمادين والمادين والمادين   |      |                    |       |                    |           |   |   |          |   | ىن بىۋىرلىكى بىلىكى بىرىكى يېرىكى بىرىكى بىلىكى بىلىكى بىلىكى بىلىكى بىلىكى بىلىكى بىلىكى بىلىكى بىلىكى بىلىكى<br>بىلىكى بىلىكى بىلىكى<br>بىلىكى بىلىكى | onices and second s  | 6                   |  |
| <del>ب</del>   | •                | 4                               | 90                                      | <i>.</i>  |   | 165                | 609            | والمراجع المعادمة والمراجع والمراجع والمراجع والمراجع والمراجع والمراجع   |      |                    |       |                    |           |   |   |          |   | ت برایند.<br>۲. برایند. از این میشونیند. از این  | en na frei eine dige na den na h-menn e ste eine eine de  |                     |  |
| 527            | 0                | •                               | •                                       | Akt. værdi  | 29 00   | 09:10              | 29:09          | معمده بالمراجع والمراجع |      |                    |       |                    |           |   |   |          |   | ىرى بىرىنى بىلىغۇرىكى ئېرىن بىرىن ئىرىن كېرىنى بىرىن<br>مەرى   |   | Tulona              |  |
| ,<br>C         | MM               | 11.<br>11.<br>11.               | L (UI                                   | Enhed   | 11 × 6002 (   | 10:16              | 29/09          | errer ni  |      |                    |       |                    |           |   |   |          |   | readian and a constant of the  |   | - kov, 28369-760    | A state of a state |
|                |                  |                                 | *************************************** | >   | р<br>5<br>4 - с   | 14.2               | 29.09          |   |      |                    |       |                    |           |   |   |          |   | للكوى أفلان المالي والموافع الارامي والمحم   |   | 9 33-54-54          |  |

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|                     | <b>86.</b> 8 |                    |                  | *  | 0   | Curso        | 28.09.200     |              | 28/09<br>11:20 |  |   | 5.<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y<br>Y | 54<br>54<br>25<br>25 | <br>2 :<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2 | 2   |   | 44.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2.<br>2. |    | معد<br>تي:<br>نو:<br>نو:<br>نو:<br>نو:<br>نو:<br>تو:<br>تو:<br>تو:<br>تو:<br>تو:<br>تو:<br>تو:<br>تو:<br>تو:<br>ت   | 42.4.<br>***<br>***<br>***   | and second <b>D</b> | ¢   |
|---------------------|--------------|--------------------|------------------|--|---|--------------|---------------|--------------|----------------|--|---|---|----------------------|---|-----|---|---|----|---|--|---------------------|---|
|                     |              |                    |                  |  |   | ( <b>a</b> ) | 01:02:11 × 01 |              | 28/09<br>12/26 | na n |   |   |                      |   |     |   |   | α, | د که مربوطهای بلد مربو به دومانه را ۱۹۹۵<br>ا   | ر به بر مر میران در مانده این میران می<br>مر |                     |   |
|                     | Motor 2      | Motor 2            | Matterie         |  | Gastlow   | 6            | <>            | بر<br>ج<br>ب | 28/09<br>13-24 |  |   |   |                      |   |     |   |   |    | فېم، برو دېکې مار ځونگ <sup>0</sup> مېم رونو سا <sup>ر</sup> سکې  |  |                     |   |
|                     | . Gasklokke  | . El-effekt JES ge | · yashedel 0-500 |  | R. C. L.                    |              | -<br>-        | 142.)<br>1   | 28/09          | AN A |   |   |                      |   |     |   |   |    | يەن بەي بەر بەر يېرى يېشىلەر يەر بەر يېرى يېرىدۇ. يەن يېڭ يېر   | معمد معمانية معمد مريعة والمحموطي والمحمد ماردان والمحمد والمحمد   | 0                   |   |
|                     | ,            | enerator 2 -2250   | 16. 194          | i mi   | 5.<br>  | Reskrivalea  |               | 15.4Z        | 28/09          |  |   |   |                      |   |     |   |   |    | یکریک علمی میروند.<br>محمد اینکار علمی از محمد اینکار میروند میروند.<br>محمد اینکار علمی اینکار محمد اینکار میروند. | ********   | Sasmotor            | teres and the second |
|                     |              | M300(              |                  | ,  | ويعديده وجليا والجا والاستخاص معاملهم فحاجما فالمحافظة المحافظة |              | Duration: 12  | 16:48        | 28.09          |  |   |   |                      |   |     |   | ų   |    | د در میسیودی در مید میشید.<br>از م  |  | , gasked            | ************************************  |
|                     |              |                    |                  | ٢  | MARINAMAN PRIVINAAR CAANAMANAAR                                 |              | 00:00         | 17:53        | 28/09          |  | - |   |                      |   |     | · |   |    | and the second of the second of the   | معدمه ورديدوهم وحالي والمحارب إرتجاع المراجع والمحالية والمحالية والمحالية   | el og gas           |   |
|                     | <b>.</b>     | -225               | •                | •  | ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~                          |              |               | 18:59        | 28/09          |  |   |   |                      |   | • • |   |   |    | مەرمەيەر بەرمەيدىكە بەرمەيەر مەرمەيەر مەرمە   | والمحاجز والمحاط والأولام والمحافظ كالمحاصر والمرار والمحاط والمحاجر والمحاط والمحاجر والمحاط                        | klokke              |   |
|                     | 160          | 000                | 500              | 1000   | Maks.   |              |               | 20:04        | 28/09          |  |   |   |                      |   |     |   |   |    | المريد المريدي المريونين المريد المراجع المريد المراجع  | ****   |                     | Contraction to a  |
| 7 <u>97</u><br>7.92 |              | Þ (                | -                | ()<br>   | Akt. værdi  | 60.82        |               | 21:09        | 28:09          |  |   |   |                      |   |     |   |   |    | والمحافظ والمحافظ المحالف المحافظ والمحافظ  | ILLESDIE   |                     | $\mathcal{L}_{\mathcal{L}}$   |
|                     | PA M         |                    | anatis           | ื่มมี¦ี่⊈รัฐ∄<br>สงการการกระกรรมสาธารรมการกระกรุกม | Enhed   | 2009 ~ 23:20 |               | 22:15        | 00,82          |  |   |   |                      |   |     |   |   |    | and the second secon     | rkor: 28/09/2009   |                     | 301. 2007-01 - 2  |
|                     |              |                    |                  |  | >   | :40<br>~~    | -<br>         | 23:20        | 00180          |  |   |   |                      |   |     |   |   |    | ومودائر فالمراجع  | 11:20:49   |                     | 21-36-1-3   |

#### **Results of measurements** Manure



The following tables 1 – 3 shows the results from measurements of the manure during the test. All data are average values.

| Date       | Sample no <sup>a</sup> | Time             | Dry matter in | manure % |
|------------|------------------------|------------------|---------------|----------|
| Bute       | Sumple no              | Time             | Inlet         | Outlet   |
|            | 1                      | 15:15            | 31,7          | 96,3     |
|            | 2                      | 23:17            | 30,6          | 95,6     |
| 20 00 2000 | 3                      | 03:38            | 31,2          | 83,0     |
| 27.07.2007 | 4                      | 09:53            | 31,3          | 96,0     |
|            | 5                      | 15:10            | 31,2          | 96,9     |
|            | 6                      | 23:21            | 31,8          | 95,7     |
| 20.00.2000 | 8                      | 10:30            | 32,1          | 87,5     |
| 30.09.2009 | 9                      | 15:37            | 33,1          | 93,7     |
|            | 10                     | 01:08            | 32,6          | 95,2     |
| 01 10 2009 | 11                     | 04:48            | 32,8          | 81,0     |
| 01.10.2009 | 12                     | 13:10            | 32,5          | 89,3     |
|            | 13                     | 15:13            | 33,3          | 81,0     |
|            | 14                     | 00:29            | 33,1          | 96,3     |
| 02 10 2009 | 15                     | 04:12            | 34,0          | 88,7     |
| 02.10.2009 | 16                     | 07:50            | 33,6          | 85,7     |
|            | 17                     |                  | 33,1          | 81,6     |
|            |                        | Average          | 32,4          | 90,2     |
|            |                        | RSD <sup>b</sup> | 3,1           | 6,9      |

Table 1. Dry matter content (%) in the manure measured in inlet & outlet.

 <sup>&</sup>lt;sup>a</sup> Sample 7 is discarded due to malfunction during the test
 <sup>b</sup> Relative standard deviation in %

#### Appendix 6A



#### Results of measurements Manure

| Date       | Raw m<br>(k | nanure<br>g) | <b>∆</b> Kg | Tir   | ne    | <b>Time</b> <sub>Total</sub> | Total<br>Raw manure (inlet) |
|------------|-------------|--------------|-------------|-------|-------|------------------------------|-----------------------------|
|            | Empty       | Full         |             | Start | Stop  |                              | Kg/h                        |
| 29.09.2009 | 2.520       | 3.600        | 1.080       | 11:58 | 13:13 | 01:15                        | 864                         |
| 02.10.2009 | 2.520       | 3.670        | 1.150       | 11:29 | 12:50 | 01:21                        | 852                         |
|            |             |              |             |       |       | Average                      | 858                         |

#### Table 2. Amount of manure - Inlet.

Table 3. Amount of manure - Outlet.

| Date       | Dry manure (kg) |       | Δ Kg |       | ne    | Time <sub>Total</sub> | Total<br>Dry manure (outlet) |
|------------|-----------------|-------|------|-------|-------|-----------------------|------------------------------|
|            | Empty           | Full  |      | Start | Stop  |                       | Kg/h                         |
| 29.09.2009 | 2.520           | 2.770 | 250  | 05:00 | 06:00 | 01:00                 | 250                          |
| 29.09.2009 | 2.520           | 2.820 | 300  | 12:57 | 13:57 | 01:00                 | 300                          |
| 30.09.2009 | 2.520           | 2.820 | 300  | 13:37 | 14:37 | 01:00                 | 300                          |
| 01.10.2009 | 2.520           | 2.780 | 260  | 01:24 | 02:24 | 01:00                 | 260                          |
| 02.10.2009 | 2.520           | 2.810 | 290  | 01:39 | 02:39 | 01:00                 | 290                          |
| Average    |                 |       |      |       |       | 280                   |                              |

#### **Appendix 6B**

#### **Results of measurements** Flue Gas



The following Table 1 shows the results from measurements of the flue gas during the test. All data are average values.

|            | Меа                     | Calculated <sup>a</sup> |           |                        |        |
|------------|-------------------------|-------------------------|-----------|------------------------|--------|
| Date       | Volumetric Flow         | Tempera                 | ture (ºC) | Q <sub>FG</sub> (MJ/h) |        |
|            | m3/h (n,d) <sup>⊳</sup> | Inlet                   | Outlet    | Inlet                  | Outlet |
| 28.09.2009 | 5.400                   | 366                     | 154       |                        |        |
| 29.09.2009 | 5.400                   | 402                     | 165       |                        |        |
| 30.09.2009 | 5.500                   | 404                     | 171       |                        |        |
| 01.10.2009 | 5.800                   | 397                     | 187       |                        |        |
| 02.10.2009 | 6.000                   | 418                     | 172       |                        |        |
| Average    | 5.620                   | 397                     | 170       | 2.457                  | 1.050  |

#### Table 1. Flue Gas – Energy source (Q<sub>FG</sub>)

 <sup>&</sup>lt;sup>a</sup> For the calculation formula see Appendix 4
 <sup>b</sup> Standard condition, dry (0°C, 1013 mbar, dry gas)

#### Appendix 6C

#### Results of measurements Condensate



The following Table 1 shows the results from measurements of the flue gas during the test. All data are average values.

|            | Меа         | Calculated <sup>a</sup> |                       |  |
|------------|-------------|-------------------------|-----------------------|--|
| Date       | Mass (kg/h) | Temperature (°C)        | Q <sub>c</sub> (MJ/h) |  |
|            | 0           | Outlet                  |                       |  |
| 28.09.2009 | 501         | 72,5                    |                       |  |
| 29.09.2009 | 470         | 81,9                    |                       |  |
| 30.09.2009 | 457         | 73,9                    |                       |  |
| 01.10.2009 | 487         | 76,7                    |                       |  |
| 02.10.2009 | 532         | 81,9                    |                       |  |
| Average    | 489         | 77,4                    | 159                   |  |

#### Table 1. Condensate (outlet) – Energy source (Q<sub>c</sub>)

<sup>&</sup>lt;sup>a</sup> For the calculation formula see Appendix 4

#### **Appendix 6D**

#### Results of measurements Electricity



The following Tables 1 shows the results from measurements of the electricity during the test. All data are average values.

|                       | Installed <sup>a</sup> |        | Measured |                    | Calculated <sup>bc</sup> |                     |
|-----------------------|------------------------|--------|----------|--------------------|--------------------------|---------------------|
| Item                  | I (A)                  | P (kW) | I (A)    | COS φ <sup>d</sup> | P <sub>e</sub> (kW)      | P <sub>e</sub> (MJ) |
| Fan 31 (cabinet M31)  | 12,00                  | 5,50   | 9,33     | 0,93               | 6,0                      |                     |
| Fan 32 (cabinet M32)  | 12,00                  | 5,50   | 9,62     | 0,93               | 6,2                      |                     |
| Fan 33 (cabinet M33)  | 12,00                  | 5,50   | 9,35     | 0,93               | 6,0                      |                     |
| Fan 34 (cabinet M34)  | 12,00                  | 5,50   | 9,99     | 0,93               | 6,4                      |                     |
| Fan 35 (cabinet M35)  | 12,00                  | 5,50   | 9,45     | 0,93               | 6,1                      |                     |
| Fan 36 (cabinet M36)  | 12,00                  | 5,50   | 9,92     | 0,93               | 6,4                      |                     |
| Fan 37 (cabinet M37)  | 12,00                  | 5,50   | 9,45     | 0,93               | 6,1                      |                     |
| jFan 38 (cabinet M38) | 12,00                  | 5,50   | 9,17     | 0,93               | 5,9                      |                     |
|                       |                        |        |          | Average            | 49,1                     | 176,8               |

#### Table 1. Electricity - Energy source (Pe).

| Nomenclature |                 |              |         |              |             |  |  |  |
|--------------|-----------------|--------------|---------|--------------|-------------|--|--|--|
| Symbol       | V               | р            | I       | cos φ        | Т           |  |  |  |
| Term         | Volumetric Flow | Effect Power | Current | Phase factor | Temperature |  |  |  |
| Unit         | m <sup>3</sup>  | J<br>kW      | А       | (None)       | °C          |  |  |  |

<sup>&</sup>lt;sup>a</sup> The electric motor rating plate current

<sup>&</sup>lt;sup>b</sup> For the calculation formula see Appendix 4

 $<sup>^{\</sup>rm c}$  The electric potential (V) for the Pe calculation is 400 Voltage

d cos  $\varphi$  are used to determine the efficiency of the electric motor. The cos  $\varphi$  value used in the calculation are the values given on the electric motor rating plate, which and can vary from the actual cos  $\varphi$  value
## Appendix 3

**Cimbria Verification Report** 







## Review report 1

|                 |   | -              | -          |  |  |
|-----------------|---|----------------|------------|--|--|
| Document title: | Cimbria Test Report FINAL draft         | Document date: | 09.12.2009 |  |  |
| Reviewer name:  | Stig Lind Schmidt Review date: 18.12.20 |                |            |  |  |
| Name:           |   |                |            |  |  |
| Organization:   | Carlo Lorentzen Smed A/S                |                |            |  |  |
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| <b>Review results</b> |              |                |     |                        |   |  |
|-----------------------|--------------|----------------|-----|------------------------|---|--|
| Rate items            | Satisfactory | Unsatisfactory |     | Overall recommendation |   |  |
| Contents              | х            |                |     |                        |   |  |
| Scope                 | х            |                |     | Acceptable as is       |   |  |
| Organization          | х            |                |     | Minor revisions        | х |  |
| Data quality          | х            |                |     | Major revisions        |   |  |
| Method validity       | х            |                |     | Not acceptable         |   |  |
| Conclusions           | х            |                |     |                        |   |  |
| Other (specify)       |              |                | Rea | Reason                 |   |  |
|                       |              |                |     |                        |   |  |

| Revision | details         |          |              |   |
|----------|-----------------|----------|--------------|---|
| Торіс    | Report chapter, | Revision | Reason       | Revision action(to be filled in by document |
|          | section, page   | required |              | owner during revision after review)         |
| COS φ    | 7               | х        | Argument for | Adjusted in accordance with recommendations |
|          | 7.2 / page 13   |          | using COS φ  |   |
|          |                 |          | is missing   |   |

## Appendix 3

**Cimbria Verification Report** 







## Review report 2

|                 | -                                     |                |           |  |  |
|-----------------|---------------------------------------|----------------|-----------|--|--|
| Document title: | Cimbria Test Report FINAL draft       | Document date: | 9.12.2009 |  |  |
| Reviewer name:  | Orla Munk Jensen Review date: 20.12.2 |                |           |  |  |
| Name:           |                                       |                |           |  |  |
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| <b>Review results</b> |              |                |                        |  |            |
|-----------------------|--------------|----------------|------------------------|--|------------|
| Rate items            | Satisfactory | Unsatisfactory |                        | Overall recommendation   |            |
| Contents              | Х            |                |                        |  |            |
| Scope                 |              | Х              |                        | Acceptable as is   |            |
| Organization          | Х            |                |                        | Minor revisions  | Х          |
| Data quality          | Х            |                |                        | Major revisions  |            |
| Method validity       | Х            |                |                        | Not acceptable   |            |
| Conclusions           |              | Х              |                        |  |            |
| Other (specify)       |              |                | Rea<br>Ob<br>spe<br>Co | ason<br>ject to be formulated m<br>ecific<br>nclusions were not clea | iore<br>ar |

| Revision details  |                                       |                      |  |   |  |
|-------------------|---------------------------------------|----------------------|--|---|--|
| Topic             | Report chap-<br>ter, section,<br>page | Revision<br>required | Reason   | Revision action(to be filled in by document owner during revision after review) |  |
| Table 6           | 7<br>7.2 / 14                         | x                    | Different order in<br>data<br>Results converted<br>into kg/h | Adjusted in accordance with recommendations                                     |  |
| Table 12          | 7<br>7.3 / 17                         | х                    | Cp as density and not mass                                   | Adjusted in accordance with recommendations                                     |  |
| Energy<br>balance | 7<br>7.3 / 16                         | x                    | Missing outline chart<br>with testresults                    | Adjusted in accordance with recommendations                                     |  |