ENVIRONMENTAL TECHNOLOGY VERIFICATION

DANETV

DANISH TECHNOLOGICAL INSTITUTE

ETV Verification Statement

TECHNOLOGY TYPE: Mechanical treatment of biomass

APPLICATION: Pretreatment of maize silage for biogas production

PRODUCT NAME: **CELLWOOD, GRUBENS DEFLAKER 200.**

COMPANY: Cellwood Machinery AB (vendor)
ADDRESS:
Box 65 SE- 571 21 Nässjö, Sweden

WEB SITE: http://www.cellwood.se

CONTACT: Olof Lekander, Cellwood AB. **Phone:** +46 (0) 386 76093
E-mail: olof.lekander@cellwood.se / sales@cellwood.se

Danish distributor:
Al 2- Agro Krøgebækvej 25, DK 8682 Hovborg
CONTACT: Preben Nissen, **phone:** +45 3169 6501
E-mail: pbn@al-2.dk

ENVIRONMENTAL TECHNOLOGY VERIFICATION

DANETV, the Danish Centre for Verification of Climate and Environmental Technologies, performs independent test of environmental technologies and monitoring equipment

The test and verification of CELLWOOD, GRUBENS DEFLAKER GLD 200 was conducted by the Danish Technological Institute, DTI Test Center and DTI Verification Subbody under DANETV.

The verifications and tests were planned and conducted in accordance with the guidelines for the ETV scheme currently being established by the European Union.

This verification statement summarizes the results from the ETV test of CELLWOOD, GRUBBENS DEFLAKER 200 used for fiber rich biomass as a pretreatment for anaerobic fermentation at biogas plants.

DANETV was established by four independent Danish research and technology organizations and supported by the Danish Agency for Science, Technology and Innovation under the Danish Ministry of Science, Technology and Innovation to provide environmental technology verification for vendors of innovative energy technologies. Information and DANETV documents are available at www.etv-denmark.com.

TECHNOLOGY AND PRODUCT DESCRIPTION

The product verified is a "Deflaker" used to pretreat biomass fibres suspended in liquid. The purpose of the pretreatment is to increase methane yield when used on fibre rich material like Maize silage. In the pretreatment the fibre structure is disintegrated. The principle is shown in Figure 1.

The system consists of two discs with teeth- One disk rotates and the other is stationary- (stator disc). The fibre pulp is pumped into the centre of the stationary disc passing the teeths which rip up the fibre structure and the fibrepulp is hurled to the outlet. Grubbens Deflaker types GLD 200 have fixed axial rotor discs, and the gap can therefore not be adjusted on this model.

The discs are made of hardened, acid-resistant steel with Brinell hardness of about 400 HB.

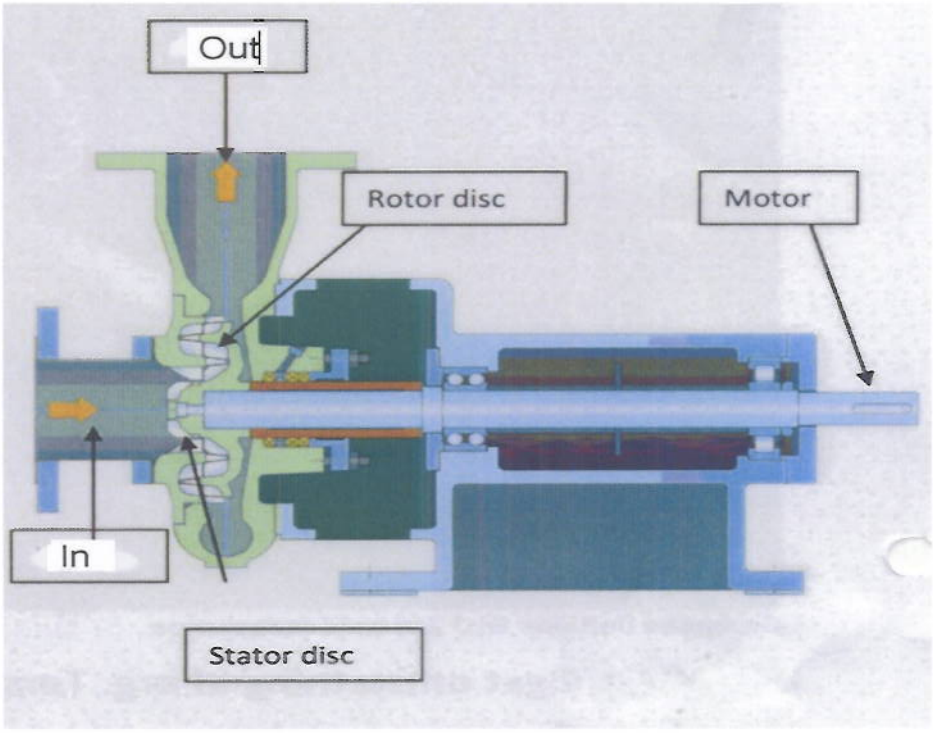

Figure 1 Schematic design of the Grubben Deflaker GLD 200

Figure 2 Discs

VERIFICATION AND TEST DESCRIPTION

The intended application of CELLWOOD, GRUBBENS DEFLAKER 200 is defined in terms of the matrix, the target and the effects of the system.

The matrix is the type of material that the product is intended for.
The targets are the measurable properties that are affected by the deflaker.
The effects describe how the targets are affected by the deflaker

Matrix	Maize silage (or manure fibres)
Target	Methane (CH4) yield of biomass using anaerobic digestion
Effect	Increased methane yield from treated and digested biomass compared to untreated digested biomass
Exclusions	ETV verifications are based on an evaluation of technology performance under specific, predetermined operational conditions and parameters and the appropriate quality assurance procedures. DTI makes no expressed or implied warranties as to the performance of the technology and do not certify that the technology will always operate as verified. The end user is solely responsible for complying with any applicable regulatory requirements.

TEST DESIGN
The detailed test design is given in the test report.

The test design was based on taking representative samples of fed untreated biomass and samples of treated biomass.

The effects of the process were tested by batch digestion experiments in a laboratory setup.

The incubation period in mesophillic anaerobic digesters at biogas plants is approximately 30 days. These conditions were simulated in the tests.

Further the electricity consumption of the Deflaker was logged.

VERIFICATION RESULTS

This section summarizes, in brief the results of the test and verification as described in the test report and the verification report respectively.

Target and measured values of tested parameters.

Parameters	Measured value	Method/comment
Overall performance		
Capacity	Approximately 20 m3/h	Based on set flow.
Chemicals	None	
Energy		
Electricity consumption	35 kw	Based on measurement during test on cow manure (9%DM) and maize silage 9.3% in water
Treatment effects		
Increase in Methane production % (maize silage)	**9.5**	Methane potential (mesophilic 35°C) after 30 days active methane production at 12.3 gVS/l
Increase in Methane production % (cow manure)	No significant increase	Methane potential (mesophilic 35°C) after 30 days active methane production at 25 g VS/l and 10 g VS/l

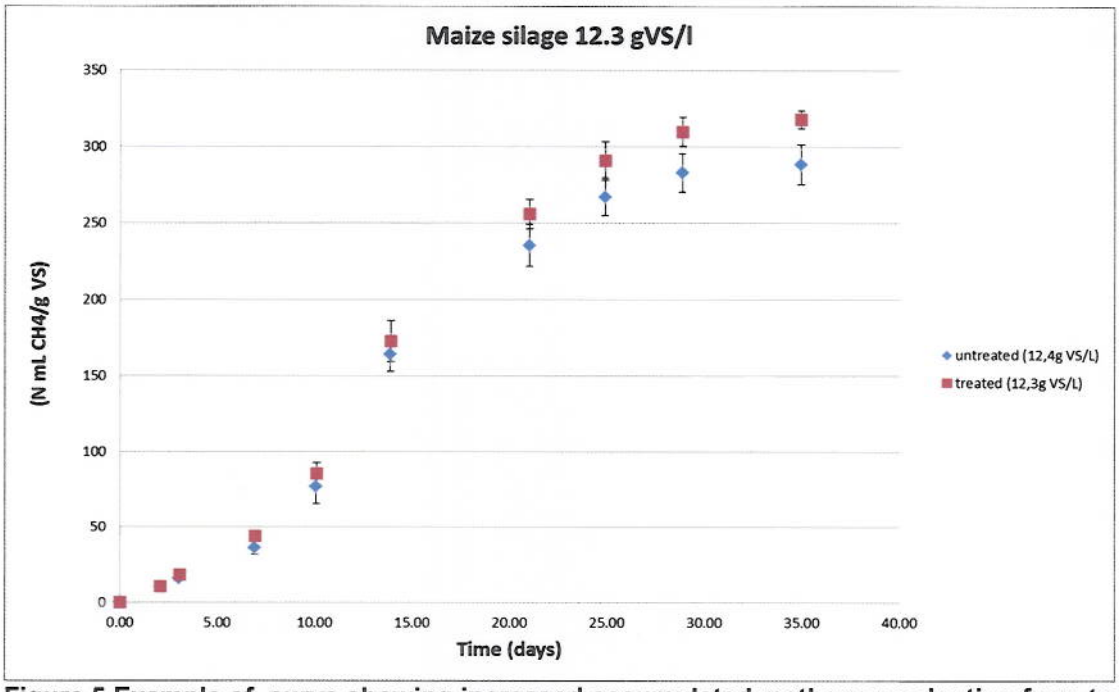

Figure 5 Example of curve showing increased accumulated methane production from treated maize silage using 5 replicates with 12.3gVS/l .

Conclusion on performance

On basis of the results of various tests, it has been concluded that the tested pretreatment system - The CELLWOOD GRUBBENS DEFLAKER GL200 generally performs as claimed when the matrix is maize silage with inoculum from a commercial biogas plant treating manure

- There is a positive effect on methane yield when treating maize silage with CELLWOOD GRUBENS DEFLAKER GL200. The increase is approximately 10% after 30 days active mesophilic biogasification when adding 12 gVS/l
  It is expected that this specific product will increase biogas yield in the range 0-10% when used on maize silage at full scale biogas plants

- There is no significant effect on methane production when treating cow manure after 30 days active mesophilic biogasification when adding 25 gVS/l and 10 gVS/l

- The power consumption when treating maize silage is approximately 0.02 kwh/kg added maize silage.

QUALITY ASSURANCE

The test and verification have been performed according to the DANETV Quality Manual. As part of the quality assurance two technical experts provided review of the planning, conducting and reporting of the test and verification.

Original signed by Arne Grønkjær Hansen,
Verification responsible

Arne G. Hansen 11/6 2012

Original signed by Michael Poulsen
Management Representative

11/6 2012