



**DANISH
TECHNOLOGICAL
INSTITUTE**

ECOGI

Pre-treatment of biomass for anaerobic digestion

Mechanical pretreatment and separation of organic waste from households and industry to obtain a pulp for biogasification

Verification Report
J.no. 1004

Version 1, march. 31th 2013
Revised version 4 may 6th 2013

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1. 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.

DANETV is a Danish center for verification of environmental technology.

This verification report follows guidelines for reporting in Ref.7 (EU general verification protocol version 1.0 December 15th 2011)

1.1. Name of product

The product name is ECOGI

1.2. Name and contact of proposer

Proposer

Komtek Miljø af 2012 A/S, Drivervej 8, DK 6670 Holsted
Contact: Bjarne Larsen, phone: +45 7020 54 89, e-mail: Bjarne@komtek.dk

1.3. Name of centre/verification responsible

Danish Technological **Institute**, Verification Centre, Life Science Division, Kongsvang Allé 29, DK-8000, Aarhus C.

Verification responsible: Lars D. M. Ottosen (LDMO), phone: + 45 72202194, e-mail: ldmo@[teknologisk.dk](mailto:ldmo@teknologisk.dk)

Internal reviewer: Lotte Bjerrum Friis-Holm, phone: + 45 72201837, e-mail: lbfh@[teknologisk.dk](mailto:lbfh@teknologisk.dk)

1.4. Verification organization including experts

The verification will be conducted by Danish Technological Institute.

The organization of test and verification is shown in Figure 1.

The verification is planned and conducted to satisfy the requirements of the ETV scheme currently being established by the European Union (EU ETV).

Verification and tests will be performed by Danish Technological Institute under DANETV under contract with Komtek Miljø af 2012 A/S

The day to day operations of the verification and tests will be coordinated and supervised by TI personnel, with the participation of the proposer.

The testing will be conducted at Komtek Miljø af 2012 A/S Drivervej 8, Holsted

TI test centre, Test subbody will perform the test as described in test plan.

Komtek Miljø personnel will operate the ECOGI plant and assist with all necessary tasks as described necessary for verification as described in the contract.

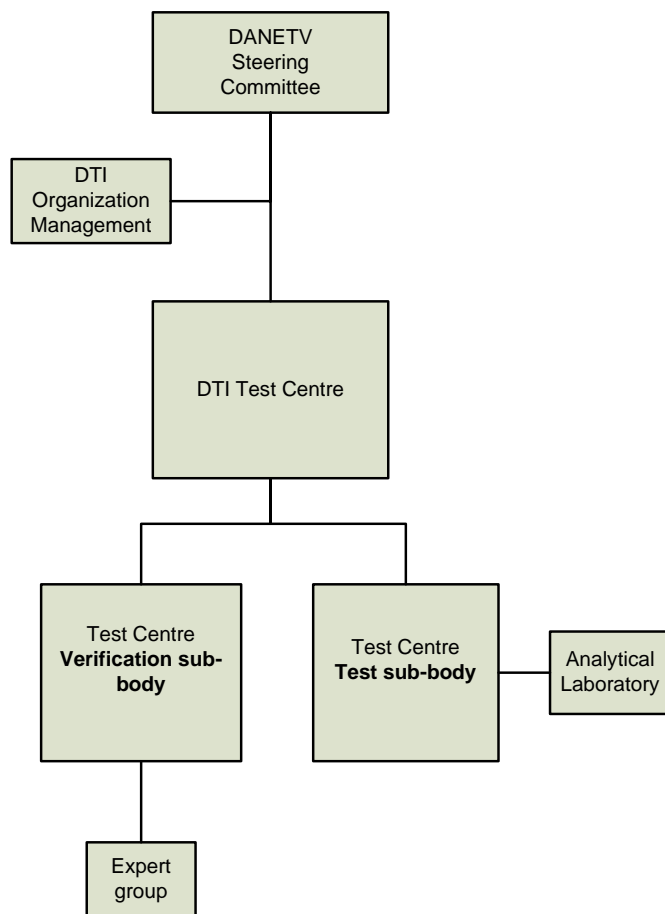


Figure 1 Verification organization

Table 1. Responsible personnel in test organization

Unit in test organization	Responsible
DTI organization management Life science division	Bo Frølund
DTI Life science division Test Centre, Verification subbody	Lars D.M.Ottosen ¹
DTI Life science division Test Centre, Test subbody	Bjørn Malmgren-Hansen

¹ Responsible person for verification has been changed since preparation of verification protocol

The expert group assigned to this verification and responsible for review of the verification plan and report documents includes:

Thorkild Qvist Frandsen (TQF), Agrotech, phone: +45 87438468, e-mail: tqf@agrotech.dk.

1.5. 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 2.

Verification and test will be performed by Danish Technological Institute DANETV verification and test centre. The verification sub-body is responsible for preparation and compilation of the Verification protocol and the Verification report. The Test sub-body is responsible for the test plan and the test report

The day to day operations of the tests and verification will be coordinated and supervised by DTI, with participation of the proposer, Komtek Miljø af 2012 A/S

Komtek Miljø af 2012 A/S will provide the “ECOGI plant”, user manuals, operation instruction and other necessary information regarding preparation of the verification protocol and test plan.

A part of the verification organization is the expert group who supports DTI and reviews all plan and report documents during the verification process.

The steps in the verification are shown in Figure 2.

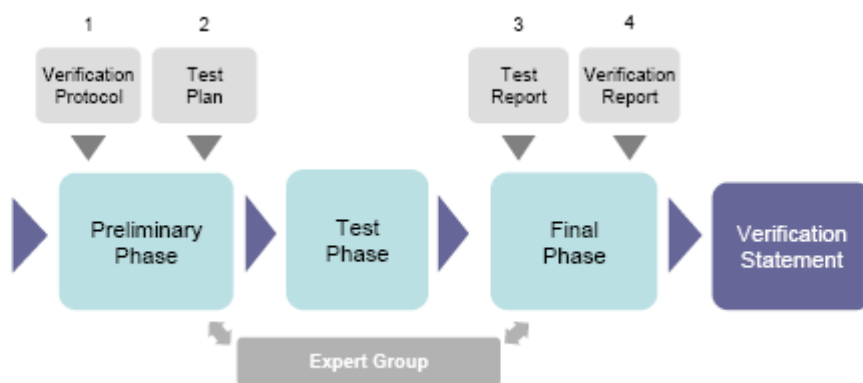


Figure 2 Verification steps

A DANETV verification statement will be issued after completion of the verification

1.6. Deviations to verification protocol

Responsible person for verification has been changed since preparation of verification protocol.

2. Description of the technology

The process is a pulper/separator for extraction of organic waste from pre-sorted household waste containing packaging material and other residues.

The operation is a batch process. The waste is introduced to a pulper with initial addition of water. After approx. 30 minutes pulping the material is transferred to a reject separator which produces an organic pulp (biopulp) and a solid fraction with all solid particles larger than 6 mm. The pulp is then concentrated using a screw separator. The solid fraction consisting of plastic bags, plastic packaging, glas, metal and some organic material larger than 6 mm is washed in the reject separator before transferring to a container for further treatment. Water from washing and screw press is recirculated for use in the next batch production of biopulp.

3. Description of the product

The product to be verified is a pulper/reject separator for extraction of organic waste from pre-sorted household or industrial waste.

The principle is shown in Figure 3 with the pulping step, reject separation, washing and dewatering of solid fraction. Only these components are used in the test for recovery and purity of the biopulp. In normal operation a screw press is used for concentrating the pulp. The water from the screw press is collected in a collection tank together with water from the washing process and utilized for pulping of the next batch. In normal operation the pulp is dewatered to an extent where no excess waste water is produced. If however excess waste water arise it is treated by a waste treatment plant.

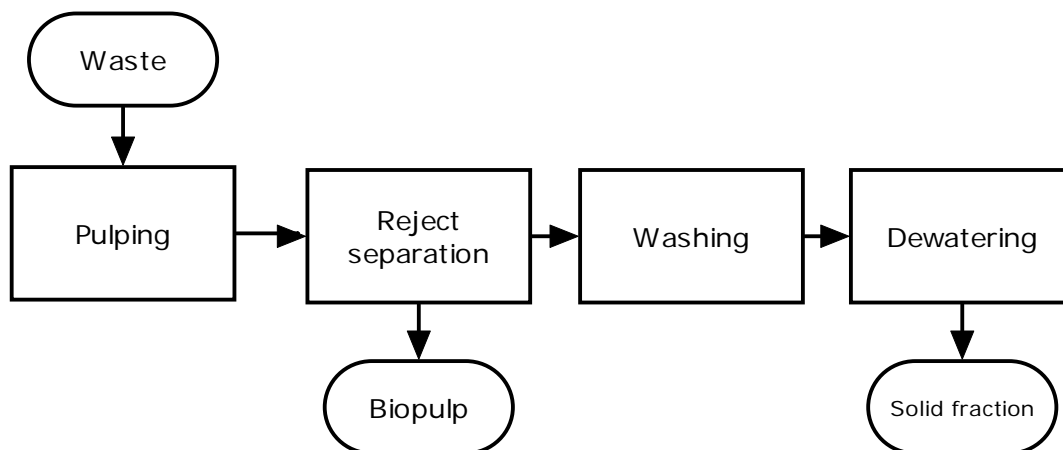


Figure 3 Principle of the ECOGI process

3.1. Application and performance parameter definitions

3.1.1. Matrix/matrices

The matrix is the type of material the product is intended for.

Matrix: Biomass for anaerobic digestion

Application: Mechanical pre-treatment of biomass

3.1.2. Purpose

The purpose of the verification is to verify that the process has

- a high purity of the produced biopulp (low content of non biodegradable material such as plastics, glass metal, textile)
- a high recovery of organic matter in pulp.

Additional parameters include

- energy consumption (electricity)
- water consumption

The targets of the product are:

- Organic pulp amount, residue amount produced per ton waste
- Dry matter and volatile solids of fractions
- Weight % foreign matter (plastics, glass, metal, textile) in organic pulp
- Energy consumption of process
- Water consumption of process

The effects of this application are

- Recovery of organic matter in pulp
- Purity of organic matter in pulp
- Energy consumption per ton waste
- Water consumption per ton waste

4. Existing data

4.1. Accepted existing data

Existing data before verification plan were not suitable for verification of purity and recovery of the solid fraction. A more precise method for measuring content in organic matter in the solid fraction has been developed in test plan.

5. Evaluation

The evaluation includes calculation of the performance parameters, see Section 3.1 for definition, evaluation of test quality and additional parameters summary.

5.1. Calculation of performance parameters

All parameters of interest were analysed and performance parameters calculated. For each sample average, standard deviation for all performance parameters was calculated.

5.2. Performance parameter summary

For the following types of waste the performance parameters in the table below was obtained:

A: Organic fraction from household waste Vejle Kommune waste sorting system.

B: Food waste from supermarket 25 %, 25% dairy waste and 50% of (A)

Parameters	Target	Measured value	Method/comment
Overall performance			
Capacity		5-6 ton organic waste /h	Based on test.
Chemicals		None	
Pure Water		approx. 1 ton water/ton wet waste	Based on test.
Energy			
Electricity consumption		20-30 kwh/ton	based on consumption in the tests
Treatment effects			
Purity of pulps (nondegradable particles plastic, glas, metal of 2-6 mm) % in a pulp with TS 15%	95%	Test with A >99.86 % in pulp with 15% TS Test with B >99.96 % in pulp with 15% TS	
Recovery % VS	90%	Test with A: 94.8 % with standard deviation of 0.7 % Test with B: 95.9 % with standard deviation of 0.6 %	

5.3. Evaluation of test quality

The test results were of sufficient quality to verify claims in verification protocol.

5.3.1. Control data

Not relevant

5.3.2. Audits

Not relevant

5.3.3. Deviation

There are no deviations from the testplan. The test however only concerned the pulping unit, as described in the testplan. Under expected normal operating conditions a dewatering unit will be added in extension to the pulping unit, and the resulting produced pulp will be higher in TS than in the performed test. This is described further in section 3.

5.4. Additional parameter summary

5.4.1. User manual

The present plant is a demonstration plant.

When sold as a plant a manual/ instructions must be provided. In particular the manual should bear instructions for:

- Operation of the system
- Prevention of and dealing with incidents
- Occupational health and safety measures
- Service and maintenance
- Surveillance of the installation

5.4.2. Occupational health and environment

Machinery for treatment of biomass must comply with the Machinery Directive /3/. It must be designed and constructed in such a way that it can be used, adjusted and maintained throughout all phases of lifetime without putting persons at risk.

In detail the installations must satisfy the essential safety requirements contained in Annex I of the Directive, a correct conformity assessment must be carried out and a “Declaration of Conformity” must be given.

It is the responsibility of the manufacturer, importer or end supplier of the equipment to ensure that equipment supplied is in conformity with the Directive. In addition, Council Directive 89/655/EEC of November 30th, 1989 /4/ places obligations on businesses and employers to take into account potential dangers to operators and other persons using or affected by machines and equipment.

In general terms, the directive requires that all equipment provided for use at work is: Suitable for the intended use; safe for use, maintained in a safe condition and, in certain circumstances, inspected to ensure this remains the case; used only by people who have received

adequate information, instruction and training; and accompanied by suitable safety measures, e.g. protective devices, markings, warnings.

In addition, ISO 12100-2:2003 /5/ defines technical principles to help designers in achieving safety in the design of machinery.

The safety instructions must be documented for example in a safety data sheet and must be observed carefully.

5.5. Operational parameters

The test was conducted under normal expected full scale operating conditions (2-3 tons of waste pr batch run)

5.6. Recommendations for verification statement

Is recommended to issue a verification statement exclusively on the ECOGI process as described in section 3, for the tested waste types

1. Organic fraction from household waste Vejle Kommune waste sorting system.
2. Food waste from supermarket 25 %, 25% dairy waste and 50% of (1)

6. Quality assurance

The test protocol, test plan, test report and verification report was reviewed by internal and external experts according to the Quality plan for the verification, see Table 2.

Table 2 QA plan for the verification

Reviewers	DTI	Experts
Plan document with application definition, verification protocol and test plan	LBFH	TQF
Report document with test report and verification report	LBFH	TQF

Reviews will be done using the DTI review report template.

7. References

1. DANETV. Centre Quality Manual, DTI 2009. Updated 2012.
2. European Parliament and Council. Directive 2006/42/EC of the 17th May 2006 on machinery and amending Directive 95/16/EC (recast).
3. European Council: Directive 89/655/EEC of 30 November 1989 concerning the minimum safety and health requirements for the use of work equipment by workers at work (amended 2007/30/EC).
4. ISO 12100-2:2003: Safety of machinery - Basic concepts, general principles for design - Part 2: Technical principles.

5. Teknisk beskrivelse af organisk affald, Resultat af 8 måneders erfaring, Version 1, Juni 2012, Komtek notat.
6. Measurement protocol for biogas potential measurements for ETV tests at DANETV. (Method 1 and 2)
7. EU general verification protocol version 1.0 December 15th 2011

Appendix 1 Terms and definitions

Terms and definitions used in the protocol are explained in table 1.

Table 1 Terms and definitions used by the DANETV test centres

Word	DANETV	Comments on the DANETV approach
Analytical laboratory	Independent analytical laboratory used to analyse test samples	The test centre may use an analytical laboratory as subcontractor
Application	The use of a product specified with respect to matrix, target, effect and limitations	The application must be defined with a precision that allows the user of a product verification to judge whether his needs are comparable to the verification conditions
DANETV	Danish centre for verification of environmental technologies	
(DANETV) test centre	Preliminary name for the verification bodies in DANETV with a verification and a test sub-body	Name will be changed, when the final nomenclature in the EU ETV has been set.
Effect	The way the target is affected	The effect could be concentration reduction, decrease in treatment period, pH increase etc
(Environmental) product	Ready to market or prototype stage product, process, system or service based upon an environmental technology	The product is the item produced and sold and thus the item that a vendor submit for verification
Environmental technology	The practical application of knowledge in the environmental area	The term technology is covering a variety of products, processes, systems and services.
Evaluation	Evaluation of test data for a technology product for performance and data quality	None
Experts	Independent persons qualified on a technology in verification	These experts may be technical experts, QA experts for other ETV systems or regulatory

Word	DANETV	Comments on the DANETV approach
		experts
Matrix	The type of material that the product is intended for	Matrices could be soil, drinking water, ground water etc.
Method	Generic document that provides rules, guidelines or characteristics for tests or analysis	An in-house method may be used in the absence of a standard, if prepared in compliance with the format and contents required for standards.
Performance claim	The effects foreseen by the vendor on the target (s) in the matrix of intended use	None
Performance parameters	Parameters that can be documented quantitatively in tests and that provide the relevant information on the performance of an environmental technology product	The performance parameters must be established considering the application(s) of the product, the requirements of society (regulations), customers (needs) and vendor claims
Procedure	Detailed description of the use of a standard or a method within one body	The procedure specifies implementing a standard or a method in terms of e.g.: equipment used
Producer	The party producing the product	None
Proposer	Any legal entity established in or outside the European Union presenting an innovative environmental technology for verification under the EU ETV pilot programme	None
Standard	Generic document established by consensus and approved by a recognized standardization body that provides rules, guidelines or characteristics for tests or analysis	None
Target	The property that is affected by the product	Targets could be <i>e.g.</i> contaminant concentration
Test centre, test sub-body	Sub-body of the test centre that plans and performs test	None

Word	DANETV	Comments on the DANETV approach
Test centre, verification sub-body	Sub-body of the test centre that plans and performs the verification	None
Test/testing	Determination of the performance of a product for parameters defined for the application	None
Vendor	The party delivering the product to the customer	Can be the producer
Verification	Evaluation of product performance parameters for a specified application under defined conditions and adequate quality assurance	None

Parameter definition table

Appendix 2 Quick Scan



QUICK SCAN REPORT		Product name:	ECOGI
Test center		Vendor	
Name:	DTI ETV testcenter, Lifescience Division	Name:	Komtek Miljø A/S
Contact:	Arne Grønkjær Hansen	Contact:	Bjarne Larsen
Address:	Danish Technological Institute, Kongsvang Alle 29, DK8000 Aarhus C, Denmark	Address:	Komtek Miljø A/S Drivervej 8, DK 6670 Holsted
Telephone:	+45 72201000	Telephone:	Phone: +45 7020 54 89 Mobile: +45 22 22 25 40
E-mail	agha@gmail.com	E-mail	bjarne@komtek.dk

Quick scan		Previous quick scan	
Date:	1-7-12	Yes	No
			X

Product description			
Pulper technology for treatment and separation of organic waste with packaging material			
Product ready to market		Product in last development phase	
Yes	X	No	
		Yes	No
Performance claims			
Matrices:	House hold waste	Application:	
Targets:	Organic pulp amount, residue amount per ton waste Eight% of foreign matter in pulp Energy consumption Water consumption		
Effects:	Recovery of organic matter in pulp, purity of pulp, energy and water consumption per ton waste		

Product description clear		Performance claims clear	
Yes	X	No	
		Yes	x
		No	

Existing test data			
Tests performed		Test body qualified	
Yes	Operational data	No	
		Yes	No
			X
Test report available		Test report qualified	
Yes	Partly	No	
		Yes	No
			X
Test methods available		Test methods adequate	
Yes	Not etv	No	
		Yes	No
			Must be



	standard						refined
Raw data available				QA of raw data adequate			
Yes	Maybe	No		Yes		No	X
Performance claims sustained				Performance claims relevant			
Yes	Probably ok	No		Yes	X	No	

Conclusions quick scan
Process suitable for ETV but new tests required.

Date 1-7-12	Name	Signature
	Bjørn Malmgren-Hansen Arne Grønkjær	<i>Bjørn Malmgren-Hansen</i> <i>Arne Grønkjær</i>

Appendix 3 Proposal

Exists as separate document

Appendix 4 Specific verification protocol

see separate document

Appendix 5 Amendment and deviation report for verification