



**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 Protocol
J.no. 1004

Version 1, Oct. 29th 2012
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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 centre for verification of environmental technology.

This protocol describes the framework for the verification of the technology product and provides information required for the Test plan. The format used for reporting follows guidelines in Ref.7.

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: Arne Grønkjær Hansen, phone: +45 72202142; e-mail:

bmh@teknologisk.dk.

Internal reviewer: Lotte Bjerrum Friis-Holm (LBFH), phone: +45 72201837, e-mail:

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 testcentre, Test subbody will perform the test as described in test plan.
 Komtek Miljø af 2012 A/S personnel will operate the ECOGI plant and assist with all necessary tasks as described necessary for verification as described in the contract.

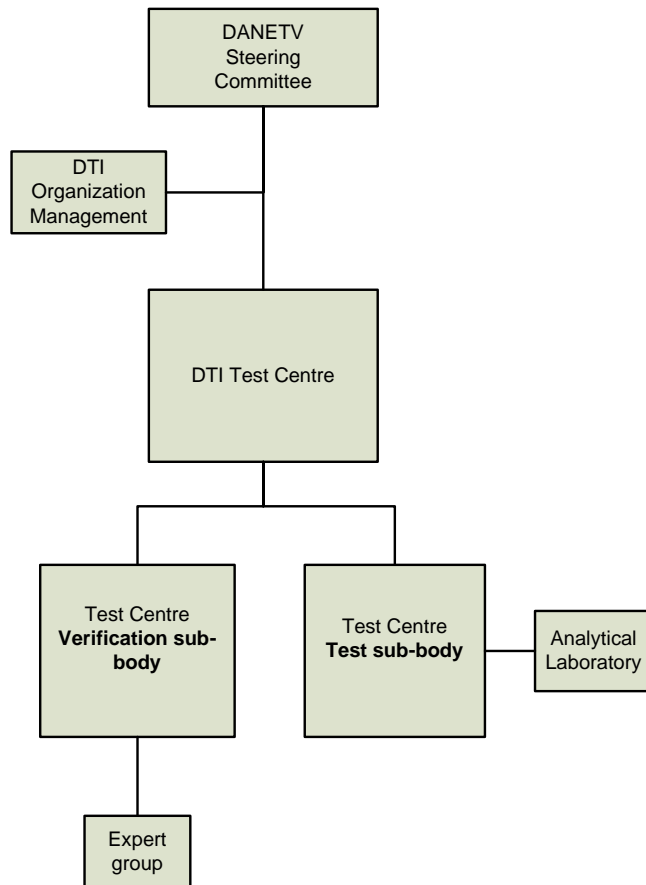


Figure 1 Verification organization

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	Arne Grønkjær Hansen
DTI Life science division Test Centre, Test subbody	Bjørn Malmgren-Hansen

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.

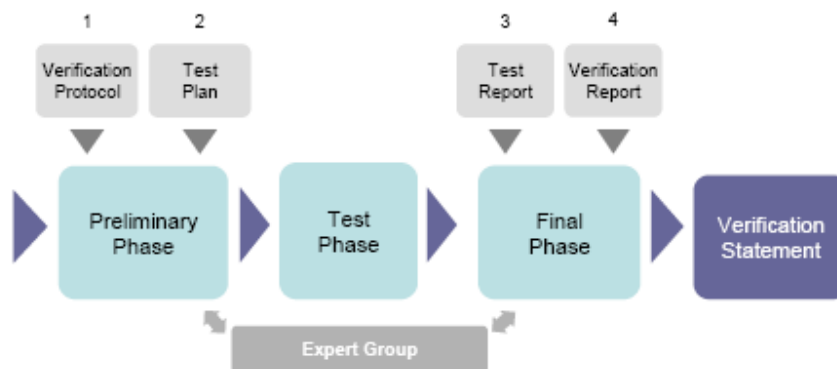


Figure 2 Verification steps

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

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, glass, 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.

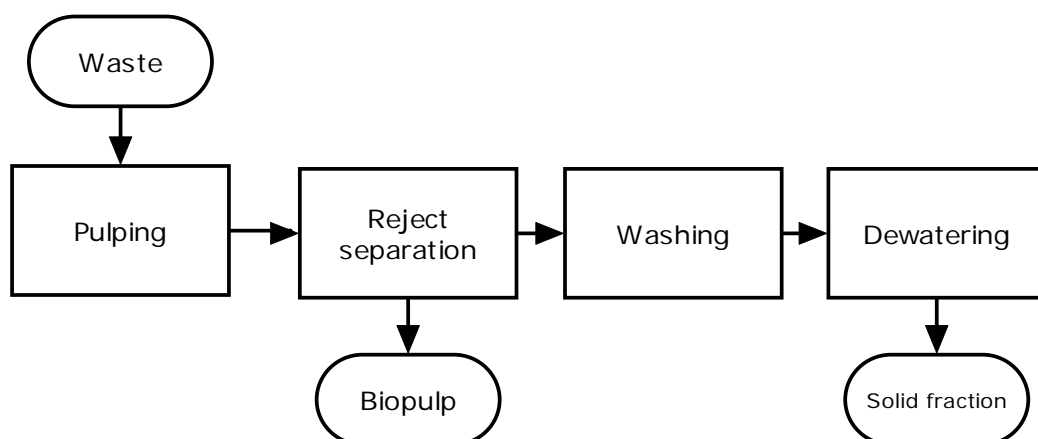


Figure 3 Principle of the ECOGI process

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

3.2. Performance parameters for verification

The ranges of performance relevant for the application, as derived in Appendix 3, are presented in Table 2. These ranges are used for planning the verification and testing only.

The performance parameters relevant for this protocol are:

	Biopulp	Reject	Process
Dry matter	X		
Ash content	X		
Plastic and metal particles by drying and weighing (glass/ceramics may be included)	X		
Biopulp content based on weighing of washable dry matter		X	
Large biodegradable material (roots , wood etc)		X	
Non-bio degradable content (plastics, metals, textiles, glas) 1)		X	
Water consumption (based on flow measurements) 2)			X
Energy consumption (electricity)			X

Other performance-parameters which must be measured include:

- The amount of added biomass for each testrun
- The amount of added additives (water) for each testrun
- All other added or removed amounts either through weighing or from calculation
- Electricity consumption

3.3. Additional parameters

Besides the performance parameters to be obtained by testing, compilation of parameters described in user manual/documentation, occupational health & safety issues of the product are required as part of the verification.

4. Existing data

4.1. Summary of existing data

The Ecogi process has been operated on a significant amount of organic waste (approx. 2500 ton from august 2011 to May 31st, 2012)

A number of sorting analyses have been performed and reported by komtek in june 2012 , ref.5. The analyses indicate a high recovery and a high purity of the biopulp based on dry matter.

4.2. Quality of existing data

The existing data for content of organic matter in the solid fraction are not sufficiently documented.

4.3. Accepted existing data

Existing data are 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 to be used.

5. Test plan requirements

5.1. Test design

The test design is based on representative sampling of pulp and solid fraction

The effects of the process are tested by:

- Measuring all mass streams in process
- Determining composition of biopulp and reject
- Measuring current consumption during test

Further the electricity consumption, consumption of water of the ECOGI is logged/measured.

The detailed test design is given in the test plan.

The test design must include a tested method for measuring recovery of organic matter in biopulp. The method is expected to require a method for proper cleaning of the solid fraction, description of sorting steps of organic/non organic matter and accurate weighing of organic matter based on dry matter and volatile solids.

Tests must be made with at least 3 repetitions on each waste stream.

5.2. Reference analysis

5.3. Data management

Data storage, transfer and control must be done in accordance with the requirements of the “ETV centre quality manual “DTI Water and Chemistry Technology” enabling full control and retrieval of documents and records.

5.4. Quality assurance

The quality assurance of the tests must include control of the reference system, control of the test system and control of the data quality and integrity.

The test plan and the test report will be subject to review by the expert group as part of the review of this verification protocol and the verification report, see Figure 2.

5.5. Test report requirements

The test report must follow the template of the TI verification centre quality manual /2/ with data and records from the tests presented.

6. Evaluation

The evaluation includes calculation of the performance parameters, see Section 3.1 for definition, evaluation of the data quality based upon the test quality assurance, see Section 5.4 for requirements, and compilation of the additional parameters as specified in Section 3.3.

6.1. Calculation of performance parameters

All parameters of interest are analyzed and performance parameters are calculated. For each sample average, standard deviation and 95 % confidence intervals for all performance parameters are calculated.

6.2. Evaluation of test quality

The test report must follow the template of the DANETV Centre Quality Manual /1/.

6.3. Additional parameter summary

6.3.1. User manual

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

6.3.2. 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.

7. Verification schedule

The verification is planned for 2012. The overall schedule is given in Table 2.

Table 2 Verification schedule

Task	Timing
Application definition document	Oct. 2012
Verification protocol with test plan	Primo nov 2012
Test	Ultimo nov 2012
Analysis phase	Jan. 2013
Test reporting	Jan. 2013
Verification	Jan.-Feb. 2013
Verification report	March-April 2013
Verification statement	April.2013

8. Quality assurance

The test protocol, test plan, test report and verification report will be reviewed by internal and external experts according to the Quality plan for the verification, see Table 3.

Table 3 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.

9. References

1. DANETV. Centre Quality Manual, DTI 2009.
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, July 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 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.

A3.1 Applications

A3.1.1 Matrix/matrices

A3.1.2 Target(s)

A3.1.3 Effects

The effects claimed by the proposer are presented in Table 2:

Table 2 Performance parameters and proposer claims

Performance parameter	Proposer claim of performance
Recovery of organic matter in pulp (excluding wood >5*5*5 mm)	>90% based on dry matter
Purity of organic matter in pulp (particles less than 5-6 m and bigger than 1 mm)	>95% based on dry matter
other	
Electricity consumption	Electricity consumption kWh/kg treated waste will be calculated from measurements