ETV Verification Statement

Technology type	Screw press	
Application	Separation of cattle slurry	
Technology name	SB 250	
Company	SB Engineering	
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DANETV, The Danish Centre for Verification of Climate and Environmental Technologies, undertakes independent tests of environmental technologies and monitoring equipment.

DANETV is a co-operation between five technological service institutes, DHI, Danish Technological Institute, FORCE Technology, Delta and AgroTech. DANETV was established with financial support from the Danish Ministry of Science, Technology and Innovation. Information and DANETV documents are available at www.etv-denmark.com.

AgroTech Verification Centre undertakes verifications of environmental technologies for the agricultural sector. The verifications and tests are 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 the SB Engineering separator model SB 250 applied for separation of cattle slurry.

Description of technology

SB 250 is a slurry separator of the screw press type. This separator is functioning mechanically and no additives are used in the process. The end products are a liquid fraction and a solid fraction with higher concentrations of solids and nutrients than in the input slurry.

The slurry is led into a cylindrical screen with a screw. The diameter of the openings in the screen of the separator in the test is 250 µm. However, the screen can easily be replaced with screens with other diameters. During the separation process the liquid passes through the screen and is collected in a container surrounding the screen. To remove even more liquid the solid fraction is pressed against a plate at the end of the axle. The solid fraction drops out from the opening between the plate and the opening of the cylindrical mesh. From the screw press the solid fraction is transported to a closed container whereas the liquid fraction is pumped from the separator to a big storage slurry tank with a cover.

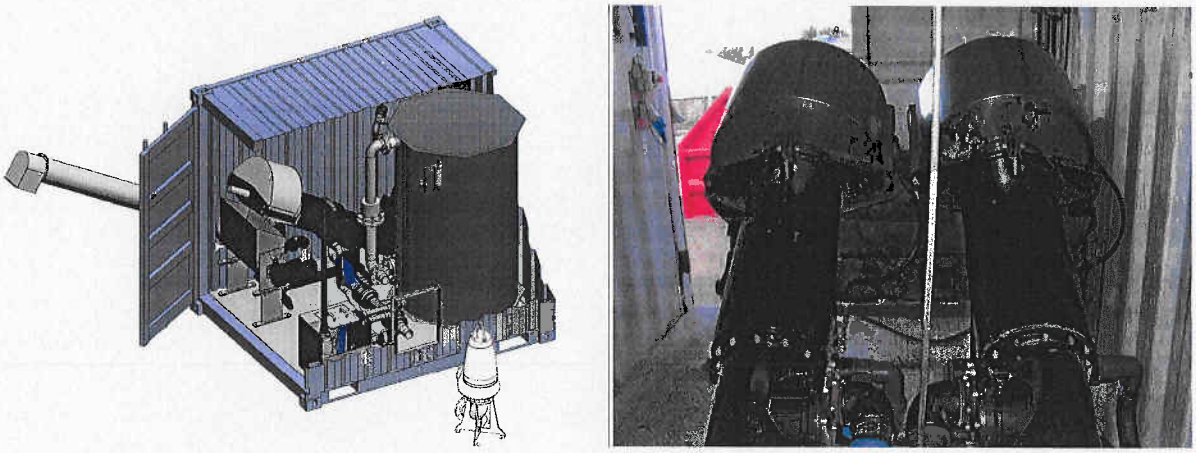

Figure 1. SB 250 separator installed in a container and a photo from inside the container.

Application of technology
The intended application of the SB 250 is defined in terms of the matrix, the target and the effect of the slurry separator.

The matrix is the type of material that the product is intended for. Targets are the measurable properties that are affected by the SB 250 separator. The effects describe how the targets are affected by the separator.

Matrix	The SB 250 separator was tested and performance verified for separation of regularly mixed cattle slurry representing prevalent combinations of cattle housing systems, management systems and feeding strategies in Denmark, Germany, the Netherlands and other countries with similar cattle production systems. Normally the dry matter content of such cattle slurry is between 6,5 % and 10 % TS.
Targets	• Concentrations of total solids (TS) and volatile solids (VS) in input slurry, liquid output fraction and solid output fraction. • Concentrations of total nitrogen (N_{tot}), ammonium nitrogen N_{amm}), phosphorous (P) and potassium (K) in input slurry, liquid output fraction and solid output fraction. • Weight of input slurry, liquid output fraction and solid output fraction. • Methane yield of solid fraction from slurry separation when used for biogas production.
Effects	• Increased concentrations of total solids (TS) and volatile solids (VS) in solid fraction compared to input slurry. • Increased concentrations of total nitrogen and phosphorous (P) in solid fraction compared to input slurry. • Increased methane yield of solid fraction per unit of weight compared to slurry.
Exclusions	The results of the verification of SB 250 for separation of cattle slurry are not necessarily valid for separation of pig and mink slurry. Additional tests are necessary to verify the performance of SB 250 for separation of other slurry types.

Description of test
The SB 250 separator used in the test is installed at Risgaard I/S, Svinget 10, Gl. Hvam, DK-9620 Aalestrup, Denmark. Risgaard I/S is a commercially operated dairy farm with a production of 400 dairy cows.

The test was designed so that mass balances of total solids, volatile solids, total nitrogen, ammonium nitrogen, phosphorous and potassium could be calculated. This was done by testing the separator in batches with a fixed start time and end time.

For each batch the weight of input slurry, liquid output fraction and solid output fraction was measured and concentrations of solids and nutrients were determined by analyzing representative samples of the inlet and the two outlet flows. The test included 5 batches with an average duration of 3,5 hours. The first batch was undertaken on the 26-08-2009 and batch 5 was completed on 22-09-2009.

During the 5 batches the SB 250 separator treated 109 m^3 of digested biomass corresponding to an average capacity of 21,82 m^3 slurry treated per batch and 6,3 m^3 treated per hour. The SB 250 separator can operate at higher capacities but it was not part of the test to verify the maximum capacity.

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

In average for 5 batches the solid output fraction constituted 18 % of the input slurry and the liquid output fraction constituted 82 %. In table 1 and 2 the average concentrations of solids and nutrients are presented.

Table 1. Average content of total solids, ash, volatile solids and pH over 5 batches.

Fraction	Total solids (%)	Ash content (%)	Volatile solids* (%)	pH (ph units)
Input slurry	7,88	1,60	6,28	6,85
Liquid output fraction	4,95	1,50	3,45	6,86
Solid output fraction	22,39	2,06	20,33	7,58

* Values for volatile solids are not measured but calculated as the difference between total solids and ash content.

Table 2. Average concentrations of nutrients over 5 batches.

Fraction	Total Nitrogen (Kg/ton)	Ammonium Nitrogen (Kg/ton)	Organic Nitrogen* (Kg/ton)	Total phosphorous (Kg/ton)	Total potassium (kg/ton)
Input slurry	3,70	1,72	1,98	0,50	3,30
Liquid output fraction	3,48	1,73	1,75	0,47	3,40
Solid output fraction	4,59	1,45	3,14	0,65	3,08

* Values for organic nitrogen are not measured but calculated as the difference between total-N and ammonium-N.

The primary performance parameters of this test and verification are the separation efficiencies with respect to total nitrogen, total phosphorous, total solids and volatile solids. In this context separation efficiency is defined as the proportion of a given component in the input slurry that is recovered in the solid fraction.

In addition to the separation efficiencies total solids concentration in liquid output fraction and methane yield of the solid fraction have been selected as performance parameters of this test and verification. Table 3 summarizes the evaluation of the performance parameters based on the results of this test.

Table 3. Evaluation of performance parameters.

Performance parameter	Claimed performance	Verified performance
Total nitrogen separation efficiency	Min. 18 %	22 %
Total phosphorous separation efficiency	Min. 30 %	23 %
Total solids separation efficiency	Min. 40 %	50 %
Volatile solids separation efficiency	Min. 50 %	56 %
Total solids concentration in liquid fraction	Max. 5 %	4,95 %
Methane yield of the solid fraction (Nm^3 CH_4/ ton solid fraction)	Min. 45	53

On the basis of this test all claims have been confirmed except the claim for separation efficiency for total phosphorous. The average electricity consumption of the SB 250 separator during the test was 0,80 kWh per ton of input slurry treated.

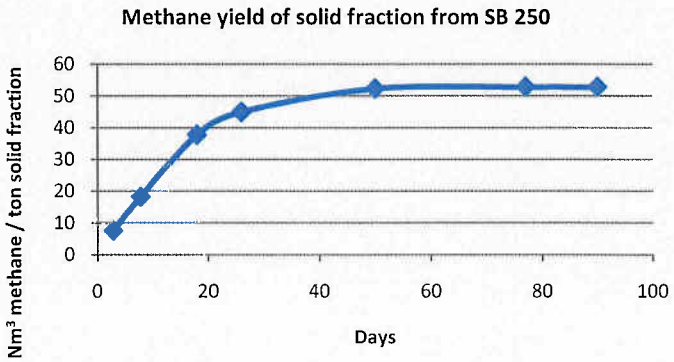

Figure 2. Accumulated methane yield per ton solid fraction (fresh weight) at 48° C.

Quality assurance

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

29.10.04		Thorkild Q. Frandsen	24.04.10
Signed by Lars Byrdal Kjær AgroTech Management representative	Date	Signed by Thorkild Q Frandsen Verification responsible, AgroTech	Date