Initial type test secondary treatment efficiency in accordance with EN 12566-6
Small wastewater treatment systems for up to 50 PT - Part 6: Prefabricated treatment units for septic tank effluent

Range/Model : “FytoCube”

produced by
Rietland bvba

BES/1410095/CZ/pp/16.003
Translated version

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Rapporteur	Signature	Date
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Contents

1 Introduction

Rietland bvba developed several ranges of packaged and/or site assembled domestic wastewater treatment plants.

This document is the initial type test report for the "secondary treatment efficiency"-test according to standard EN12566-6 for a range of small wastewater treatment systems developed by Rietland bvba, more specifically, for the range of small wastewater treatment systems "FytoCube"

The FytoCube is a compact treatment system for wastewater, developed by Rietland bvba. It allows treatment of domestic wastewater.

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Certipro is Notified Body N° 1476 to conduct conformity assessment for small wastewater treatment systems under the Construction Products Regulation (N° 305/2011).

The initial type test "***Secondary treatment efficiency***" was carried out according to:

- EN 12566-6: Small wastewater treatment systems for up to 50 PT Part 6 : prefabricated treatment units for septic tank effluent, annex A: Secondary treatment efficiency test procedure
- Regulation no. 305/2011 "Construction Products"

The prototype/plant was manufactured and delivered by the applicant.

This test report only covers the characteristics of the object submitted for testing and does not prejudge the characteristics of similar products.

The applicant is responsible for the choice of plant tested.

2 Product description

2.1 Prototype

The tested prototype consists of mainly two cubic shaped tanks, containing 3 main volumes:

- A septic tank pre-treats the wastewater (first volume). A second chamber that serves as a hydraulic volume buffer, is integrated in this septic tank (second volume). The pre-treated wastewater is pumped by an airlift into the reactor-chamber.
- The FytoCube compact reactor chamber (third volume) consists of an open container filled with filtering media. The filter media consist of Argex®. Argex® is a trade name for light expanded clay aggregates. The wastewater from the septic tank is distributed by means of an airlift and distribution pipe, buried just below the substrate surface of filter media. The compact reactor has an open top to allow the growth of reed (Phragmites australis). An air blower injects air into the bottom of the Argex®bed and air is bubbled up through the media in order to saturate the water with oxygen and thus to support the growth of bacteria.

  The purified water is collected through a collector pipe at the bottom of the reactor chamber and leaves the system by gravity flow. Only the top layer is not saturated with water.

Note: Argex® is a protected trademark of light expanded clay aggregates.

2.1.1 Scaling rules used by the manufacturer

Pre-treatment :

- dependent on local/national rules.

Reactor volume

- Ratio = PT/m^3 = Constant

3 Secondary treatment efficiency test according to EN12566-6

3.1 Preparation of the test

The FytoCube, 2 PT model was installed on Mars 27th 2014 by Rietland bvba, in accordance with the manufacturer's assembly and installation instructions, in Certipro®'s test facility.

The selection, the delivery and assembly of the tested model/prototype was carried out by and under the responsibility of Rietland.

No serial number was found on the tested unit.

The plant subjected to testing complies with the specifications supplied by the manufacturer before the test.

Annex 1 shows a technical drawing as recorded by the manufacturer.

Most important features:

Description	Process and plant design specifications according to Rietland bvba (cm)
Pre-treatment	
Internal	Length :100 Width :100 Water :96
Partition wall	yes
Forced bed aeration reactor	
Internal	Length :100 width :100 Height :100

Specific components and settings

- Transfer of pre-treated wastewater to aerated reed-bed : airlift
- Time settings :
  - aeration aerated reed-bed : 15 minutes on/15 minutes off
  - hydraulic supply to the aerated reed-bed :
    - only if "low level" is not active
    - 6 minutes per hour
- Argex® type 8/16 round
- Note : the top of the aerated reed-bed is 12 cm higher than the top of the pre-treatment tank (without shaft).

3.2 Test schedule

From March 28, 2014, the FytoCube 2 PT was subjected to a nominal hydraulic load of 2 PT (150 litres/PT). This report reproduces the results of the secondary treatment efficiency test according to EN12566-3+A2 for this domestic wastewater treatment system.

Sequence	Characteristic	Start of period
1	Biomass establishment Nominal flow	28/03/2014
2	Normal load Nominal flow	03/04/2015
3	Underload(1) 50% of nominal flow	15/05/2014
4	Normal load, power supply breakdown(3) Nominal flow	29/05/2014
5	Low occupation constraint(4)	10/07/2014
6	Normal load Nominal flow	24/07/2014
7	Overload 150% (2) For 48 hours at the start of the sequence	04/09/2014
8	Normal load, power supply breakdown(3) Nominal flow	18/09/2014
9	Under load(1) 50% of nominal flow	13/11/2014
10	Normal load Nominal flow	27/11/2014

Peak flow discharge was applied once per week, exclusively during nominal load sequences.
In addition to the daily flow, a peak flow discharge corresponds to a volume of 200 litres of influent, over a period of 3 minutes, at the start of the period where the flow corresponds to 40% of the daily flow. A peak flow discharge was not applied on the day effluent was sampled.

(1) Under-load constraint
The daily hydraulic flow was adapted during the “under-load” test to 50% of nominal flow.

(2) Overload constraint
An overload (150% of nominal flow) was applied for 48 hours at the start of the sequence.

[3] Power breakdown/machine breakdown (PBD = Power Break Down)
A power breakdown lasting 24 hours takes place 2 weeks after the start of the sequence.
During this power cut, the influent input to the plant must be maintained. This test is not carried out on a day used for "peak flow".

[4] Low occupation constraint
The low occupation test simulates the complete absence of influent for 14 days. The hydraulic flow is equal to zero litres per day.

3.3 Characteristics of water entering the plant

The FytoCube 2 PT was subjected to a nominal hydraulic load of 300 litres/day (2 PT), distributed according to the table below (EN 12566-6 A.2.3).

Period	*Percentage of daily flow*
3 hours	30
3 hours	15
6 hours	0
2 hours	40
3 hours	15
7 hours	0

During the test, raw domestic wastewater was used. The wastewater was sampled proportionally to the flow for 24 hours. The average characteristics of input influent shown below must be achieved to comply EN 12566-3+A2 Annexe B.3.2. demands :

- BOD_5: 150 - 500 mgO_2/l or COD: 300 - 1000 mg O_2/l
- SS (suspended solids): 200 - 700 mg/l
- Kj-N: 25 - 100 mgN/l or NH_4-N: 22 – 80 mgN/l
- P_T: 5 - 20 mg/l

The average characteristics of input effluent during the test:

- BOD: 340 mgO_2/l
- SS: 303 mg/l
- NH_4-N:70 mgN/l
- P_T: 10.7 mgP/l
- Kj-N: 88 mg N/l

The organic nominal daily load was 111 gBOD/day during the test.

Note: All the samples (raw wastewater, pre-treated wastewater and effluent) were analysed under BELAC accreditation. BELAC is the accreditation body for Belgium and Belgian member of EA (European Accreditation).

3.4 Samples

Raw wastewater		15/04/14	29/04/14	7/05/14	14/05/14	21/05/14	26/05/14
		Sequence 2 : nominal flow				Sequence 3 : underloading	
pH		7.24	7.68	7.17	7.33	6.92	7.55
SS	mg/L	160	240	200	245	190	175
Set. S	mL/L	1.1	9.5	2.0	6.0	2.0	2
NH4-N	mg N/L	45	72	71	100	77	87
Pt	mg P/L	7.48	11.2	11.0	15.3	11.2	11.6
Kj-N	mg N/L	64	88	82	130	96	100
BOD	mg O_2/L	200	230	260	350	280	240
COD	mg O_2/L	410	565	590	855	655	615
Tinfluent	°C	14.2	14.5	14.5	15.0	15.4	15.9
Air temperature							
Taverage	°C	6.2	13.2	12.8	9	17.7	16.2
Tmin/Tmax	°C	11.7/-0.2	15.5/11.0	17.0/9.1	15.2/2.6	21.8/12.5	20.2/13.1
Septic tank effluent							
pH		7.30	7.49	7.47	7.25	7.29	7.71
SS	mg/L	92	72	130	135	78	55
Set. S	mL/L	<0,1	<0.1	<0,1	0.2	<0,1	<0,1
NH4-N	mg N/L	50	54	74	87	73	90
Pt	mg P/L	8.15	7.90	10.1	12.6	9.55	11.4
Kj-N	mg N/L	72	65	85	110	89	100
BOD	mg O_2/L	160	120	140	240	120	120
COD	mg O_2/L	395	335	400	675	370	390
T	°C						
Treated water							
pH		7.29	7.44	7.35	7.31	7.38	7.42
SS	mg/L	2	<2	<2	<2	<2	<2
Set. S	mL/L	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1
NH4-N	mg N/L	5.6	2.1	4.9	6.6	0.6	1.3
NO2	mg N/L	0.77	0.39	0.62	0.46	0.16	0.33
NO3	mg N/L	29	17	25	28	24	32
Nox	mg N/L	30	18	26	28	24	32
Pt	mg P/L	4.01	4.73	4.77	5.43	4.3	4.71
Kj-N	mg N/L	7.4	4.2	6.3	8.1	<2,0	2.7
BOD	mg O_2/L	4	<3	<3	<3	<3	<3
COD	mg O_2/L	42	36	36	34	30	26
Ntot	mg N/L	37	22	32	37	24	35
Teffluent	°C	14.0	14.5	14.8	14.3	14.8	14.1

Raw wastewater		4/06/14	11/06/14	18/06/14	25/06/14	9/07/14
		Sequence 4 : nominal flow, power breakdown				
pH		7.46	7.11	7.00	7.19	7.12
ZWS	mg/L	185	350	315	335	392
Bez	mL/L	5.0	*	5.5	4.4	7
NH4-N	mg N/L	95	76	42	82	76
Pt	mg P/L	12.9	10.8	8.88	11.6	10.6
Kj-N	mg N/L	120	98	57	93	87
BOD	mg O_2/L	310	340	280	350	330
COD	mg O_2/L	630	635	700	780	520
Tinfluent	°C	16.5	17.8	19.0	19.5	20.0
Air temperature						
Taverage	°C	14.3	18.1	15.2	15.4	14.7
Tmin/Tmax	°C	18.2/10.7	23.8/11.0	20.6/7.7	20.9/9.5	17.1/12.6
Septic tank effluent						
pH		7.46	7.23	7.30	7.30	7.32
ZWS	mg/L	88	100	75	76	71
Bez	mL/L	<0,1	0.1	<0,1	<0.1	<0.1
NH4-N	mg N/L	92	100	71	90	78
Pt	Mg P/L	12.1	12.0	9.60	11.6	10.7
Kj-N	Mg N/L	110	110	84	95	88
BOD	mg O_2/L	170	120	110	110	160
COD	mg O_2/L	415	385	325	370	345
T	°C					
Treated water						
pH		7.38	7.26	7.26	7.43	7.38
ZWS	mg/L	<2	<2	<2	<2	2
Bez	mL/L	<0,1	<0,1	<0,1	<0.1	<0.1
NH4-N	mg N/L	6.5	9.1	2.1	4.2	gest
NO2	mg N/L	0.82	0.91	1.1	2.0	2.9
NO3	mg N/L	34	43	32	19	25
Nox	mg N/L	35	43	33	21	27
Pt	mg P/L	6.45	6.56	5.45	6.16	5.33
Kj-N	Mg N/L	8.3	9.9	2.9	5.4	gest
BOD	mg O_2/L	<3	<3	<3	<3	<3
COD	mg O_2/L	20	31	30	30	34
Ntot	mg N/L	43	54	36	26	110
Teffluent	Teffluent	15.2	17.5	18.0	18.1	18.3

Raw wastewater		30/07/2014	20/08/2014	03/09/2014	9/09/2014	17/09/2014
		Sequence 6 : nominal flow			Sequence 7 : Overloading	
pH		7.21	7.71	7.16	6.94	6.66
SS	mg/L	305	335	340	350	355
Set. S	mL/L	5	1	1.8	5.0	16
NH4-N	mg N/L	68	49	58	76	56
Pt	mg P/L	8.3	7.34	8.81	12.5	10.2
Kj-N	mg N/L	85	60	72	110	81
BOD	mg O_2/L	320	330	330	430	340
COD	mg O_2/L	780	620	775	950	865
Tinfluent	°C	20.2	21	21	20.9	20.9
Air temperature						
Taverage	°C	18.2	11.7	16.9	13.4	17.4
Tmin/Tmax	°C	23.7/11.0	19.7/6.1	22.7/12.0	19.7/7.9	25.8/9.5
Septic tank effluent						
pH		7.23	7.58	7.48	7.18	6.81
SS	mg/L	86	81	86	120	120
Set. S	mL/L	0.1	<0.1	<0.1	<0.1	0.1
NH4-N	mg N/L	56	48	63	79	58
Pt	Mg P/L	9.12	6.84	8.62	10.2	7.62
Kj-N	Mg N/L	69	56	75	94	69
BOD	mg O_2/L	160	190	92	220	180
COD	mg O_2/L	430	420	335	505	450
T	°C					
Treated water						
pH		7.80	7.42	7.25	7.42	7.42
SS	mg/L	<2	3	4	6	4
Set. S	mL/L	<0.1	<0.1	<0.1	<0.1	<0.1
NH4-N	mg N/L	1.7	6.9	1	4.9	5.3
NO2	mg N/L	0.65	2.0	0.31	0.81	0.40
NO3	mg N/L	13	25	24	22	15
Nox	mg N/L	14	27	24	23	15
Pt	mg P/L	4.29	4.31	4.71	4.93	4.59
Kj-N	mg N/L	3	8.5	2.3	6.7	7.1
BOD	mg O_2/L	<3	<3	<3	3	<3
COD	mg O_2/L	28	28	25	29	30
Ntot	mg N/L	17	36	24	30	22
Teffluent	°C	18.5	19.5	19.8	19.6	19.2

Raw wastewater		25/09/2014	1/10/2014	15/10/2014	22/10/2014	29/10/2014
		Sequence 8 : nominal flow, power breakdown				
pH		6.81	7.65	7.23	7.29	7.30
SS	mg/L	315	325	290	290	300
Set. S	mL/L	6.0	2.0	4.0	4.0	3.0
NH4-N	mg N/L	91	65	64	64	62
Pt	mg P/L	13.0	16.6	10.5	10.5	8.49
Kj-N	mg N/L	110	77	82	82	73
BOD	mg O_2/L	350	320	280	280	340
COD	mg O_2/L	675	590	720	720	570
Tinfluent	°C	20.3	20.0	19.6	18.1	16.3
Air temperature						
Taverage	°C	13.3	15.7	13.6	9.8	10.6
Tmin/Tmax	°C	18.8/9.1	22.1/9.4	17.8/10.7	13.1/7.1	12.7/9.0
Septic tank effluent						
pH		7.19	7.51	7.19	7.19	7.22
SS	mg/L	115	78	100	115	135
Set. S	mL/L	0.1	0.4	<0.1	0.1	0.1
NH4-N	mg N/L	73	71	68	60	66
Pt	mg P/L	9.78	9.64	9.87	8.60	8.49
Kj-N	mg N/L	84	83	73	71	73
BOD	mg O_2/L	170	140	130	140	170
COD	mg O_2/L	430	360	355	450	400
T	°C					
Treated water						
pH		7.59	7.35	7.13	7.25	7.36
SS	mg/L	7	6	8	6	6
Set. S	mL/L	<0.1	<0.1	0.4	<0.1	<0.1
NH4-N	mg N/L	5.5	8.3	7.8	6.5	10
NO2	mg N/L	0.38	0.44	0.28	0.31	0.34
NO3	mg N/L	20	29	42	30	28
Nox	mg N/L	20	29	42	30	29
Pt	mg P/L	3.69	4.41	6.05	5.73	6.14
Kj-N	mg N/L	7.7	9.5	7.9	7.2	12
BOD	mg O_2/L	4	5	<3	<3	<3
COD	mg O_2/L	28	30	33	28	33
Ntot	mg N/L	28	39	50	38	40
Teffluent	°C	19.5	19.3	16.4	15.0	14.5

Raw wastewater		5/11/14	12/11/14	19/11/14	27/11/14	16/12/14
		Sequence 9 : underloading		Sequence 10 : nominal flow		
pH		6.96	7.29	6.52	7.30	6.98
SS	mg/L	290	365	260	355	420
Set. S	mL/L	3.0	5.0	6.0	10	22
NH4-N	mg N/L	59	79	57	72	71
Pt	Mg P/L	8.21	9.02	9.15	11.3	10.4
Kj-N	Mg N/L	70	99	73	89	92
BOD	mg O_2/L	310	470	360	350	650
COD	mg O_2/L	640	1040	870	815	1270
Tinfluent	°C	15.8	15.0	14.0	12.0	10
Air temperature						
Taverage	°C	6.7	9.4	7.7	8.3	5.8
Tmin/Tmax	°C	11.8/3.7	13.3/4.3	10.2/3.4	10.1/7.5	8.0/2.7
Septic tank effluent						
pH		7.26	7.37	7.01	7.31	7.26
SS	mg/L	100	160	125	97	175
Set. S	mL/L	<0.1	0.2	0.1	<0.1	<0.1
NH4-N	mg N/L	61	75	63	56	72
Pt	Mg P/L	8.39	10.4	8.99	8.46	9.89
Kj-N	Mg N/L	73	86	76	68	86
BOD	mg O_2/L	130	180	170	180	180
COD	mg O_2/L	335	445	470	425	485
T	°C					
Treated water						
pH		7.22	7.06	7.32	7.42	7.50
SS	mg/L	3	2	8	27	40
Set. S	mL/L	<0.1	0.1	<0.1	1.5	2.5
NH4-N	mg N/L	2.3	2.5	12	8.1	21
NO2	mg N/L	0.21	0.23	0.38	0.30	0.80
NO3	mg N/L	39	44	26	19	16
Nox	mg N/L	39	45	26	19	17
Pt	mg P/L	4.77	4.86	6.02	5.45	6.31
Kj-N	Mg N/L	4	3.6	13	11	23
BOD	mg O_2/L	<3	<3	4	10	11
COD	mg O_2/L	22	24	36	52	67
Ntot	mg N/L	43	48	39	30	40
Teffluent	°C	12.5	10.4	9.3	9	6.2

Table : chemical analyses

Note : gest = disturbed analysis or analysis does not meet the quality requirements

3.5 Evaluation

The average value of effluents during the secondary treatment efficiency test during nominal sequences:

pH_{avg} = 7.37; Median = 7.36
Set. $S._{avg}$ = <0.1 ml/l; Median = <0.1ml/l
SS_{avg} = 6.7 mg/l; Median = 2.5 mg/l
Pt_{avg} = 5.3 mg/l P; Median = 5.4 mg/l
BOD_{avg} = 4.0 mg/l O_2; Median = 3.0 mg/l O_2
COD_{avg} = 34 mg/l O_2 ; Median = 32 mg/l O_2
NH_4-N_{avg} = 6.8 mg/l N; Median = 6.5 mg/l N
Kj-N_{avg} = 8.2 mg/l N; Median = 7.9 mg/l N

Secondary treatment efficiency was determined using 20 measurements corresponding to samples taken over 24 hours, obtained during the nominal load sequences:

$BOD_{red\ gem}$ = 97.4 %
$COD_{red\ gem}$ = 91.6 %
$ZWS_{red\ gem}$ = 94.0 %
$P_{red\ gem}$ = 44.5 %
$NH_{4red\ gem}$ = 90.4 %

The individual values of yields in periods of 150% overload:

Parameter	**Sample 1**	**Sample 2**
$BOD_{red\%}$	98.6 %	98.3 %
$COD_{red\%}$	94.6 %	93.3 %
$SS_{red\%}$	95.0 %	96.7 %
$NH_{4\ red\%}$	93.8 %	90.9 %
$P_{t\ red\%}$	51.7 %	39.8 %

The individual values of yields in periods of 50% under-load:

Parameter	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 4**
$BOD_{red\%}$	97.5 %	97.5 %	97.7 %	98.3 %
$COD_{red\%}$	91.9 %	93.3 %	93.4 %	94.6 %
$SS_{red\%}$	97.4 %	96.4 %	97.0 %	98.8 %
$NH_{4\ red\%}$	99.2 %	98.6 %	96.2 %	96.7 %
$P_{t\ red\%}$	55.0 %	58.7 %	43.1 %	53.3 %

3.5.1 Outline of interventions / information on variations compared to the test procedure method

On March 28, it was found that the local distribution of air in the Argex®-media was out of balance : a part of the surface became less agitated by the air-bubbles. On March 30 this defect was repaired, there appeared to be a pipe burst in the distribution grid for the compressed air at the bottom of the basin. This failure occurred at the beginning of sequence 1 (see chapter 3.2 Test Schedule).

No other breakdowns were found during the test.

No sludge was removed from the pre-treatment/septic tank during the test.

3.5.2 Electricity consumption

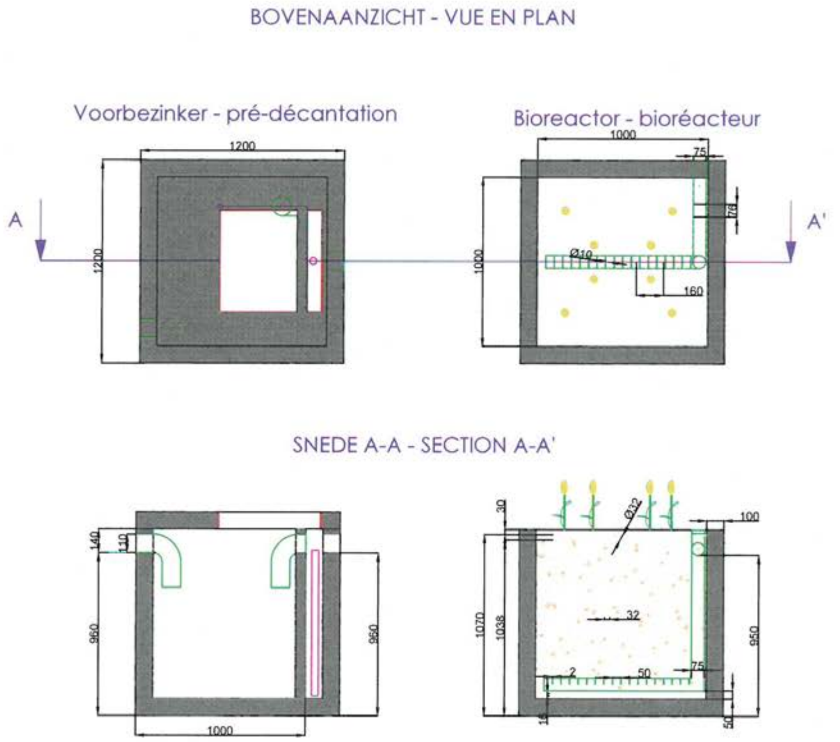
Average electrical consumption during the test was 120 kWh/year (230VAC/50 Hz).). No difference in energy consumption was detected between periods with nominal hydraulic flow and the other periods.

4 Conclusions

The "FytoCube 2 PT"-plant of Rietland bvba was evaluated according to EN 12566-6, Annex A.

Annex 1: Technical drawing of the treatment unit (using manufacturer data)

type	Oppervlakte/Surface [m²]	Hydraulische belasting/charge hydraulique [L/d - L/j]	Organische belasting - charge organique [g BZV/d - g BDO/j]	Gewicht - poids
Q-FYT 2 IE	1	300	120	2400 -)



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CE EN 12566-3

ecobeton water technologies	Q-FYT 2 IE	versie / version	02
		datum / date	30/04/2015
		bestand / fichier	Q-FYT.dwg
schaal échelle 1:30	**ecobeton water technologies** nv/sa | Hasseltsesteenweg 119 | B-3800 Sint-Truiden bijkantoor / succursale: Avenue Rogier, 22 | B-4000 Liège http://www.ecobeton.be | info@ecobeton.be	Q-FYT	A4