First certified small-scale treatment system based on a wetland, according to EN 12.566/3

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Abstract There is an increasing demand from the side of governments and government-agencies for some form of certification to make sure that small-scale wastewater purification systems work properly. In response to this and the increasing need to have a unified European market for smallscale treatment systems, a European norm was created: EN 12.566/3. In 2008 RietLand submitted a design for a vertical flow wetland, followed by an optional second stage horizontal subsurface flow type to the test procedure to acquire the CE-label according to this norm. The test procedure involvs 38 weeks of testing at a normalised test platform by a European notified body. For RietLand this was Certipro in Mol, Belgium. Over the course of the 38 weeks a sample system is tested under different circumstances. Periods of nominal load are alternated with periods of peak load (150%) and low load (50%). Furthermore, a 24 hours power failure is simulated as well as a holiday stress test (14 days of zero load). The influent and effluent are both monitored throughout the entire period. A test report is produced by the notified body, which can be checked against national regulations. The RietLand system passed the test procedure with success, even though there were external problems during the winter, caused by rabbits.
Keywords Vertical flow wetlands, Certification, EN 12566/3

INTRODUCTION

RietLand bvba is a small Belgian firm that is specialised in the designing and building of small-scale wetland systems for wastewater treatment. Since 1994, about 250 wetlands, ranging from 0.1 to 280 PE have been built in the Netherlands and Belgium. Most of them treat domestic waste water of family homes in remote areas. In 2005 the European Commission approved a certification process, *EN 12566-3: Small wastewater treatment systems for up to 50 PT - part 3: Packaged and/or site assembled domestic wastewater treatment plants* . The purpose of this certification process is to establish a uniform way of evaluating small scale wastewater treatment systems across the EU and thus ease export of systems to other EU countries. It is important to note here that the EN 12566/3 prescribes a testing procedure only. The results obtained from the tests still have to be compared to national legislation. Many EU memberstates have already incorporated the EN 12556/3 in their national legislation in some way. Several institutes across the EU are EU approved as a 'notified body', which means they are approved for carrying out the testing procedures according to the European guidelines. RietLand submitted a vertical flow constructed wetland with an optional horizontal subsurface flow wetland as second stage to the procedure at *Certipro,* located in Mol Belgium. Both (sub)systems were monitored individually in the procedure.

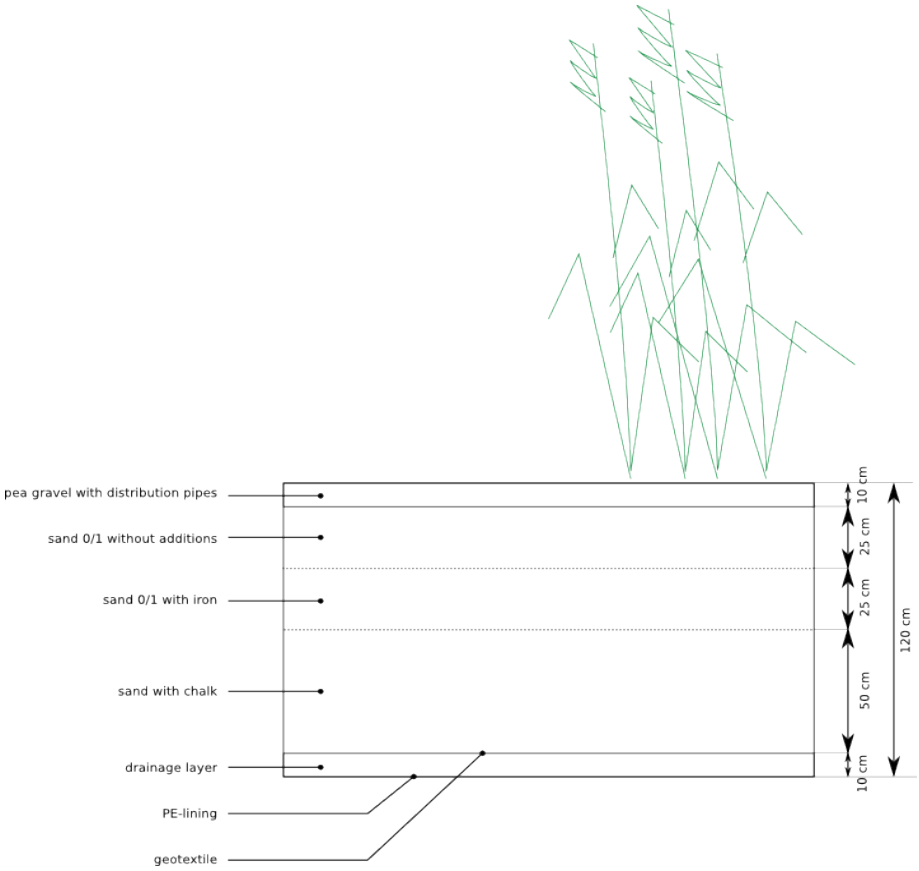
SYSTEM DESCRIPTION

An important subgoal of the certification process is to establish a clear unambiguous description of the system. To achieve this goal, the system being submitted needs to be standardized. To this end, RietLand submitted several typical capacities of wetlands, for 4, 5, 6, 8, 10 etc. PE. Each capacity can have a limited number of different length-width ratios. A 4 person system can thus be laid out as 3.00 x 4.00 m but also as 2.00 x 6.00 or as 1.00 x 12.00 metre. The certification procedure is then carried out on the smallest system which is considered as a 'worst case' setup. In this case that meant a 4 PE system was submitted to the procedure.

The first stage is of the vertical flow type with intermittent flow. The wetland is dimensioned with a surface area of 3 m^2 per PE and dimensions of 3.00 x 4.00 metres. It consists of a main substrate layer of uniform, fine grained sand (0/1 mm) of 1.00 metre thickness into which additions of limestone ($CaCO_3$; lower layer) and iron (Fe; upper layer) are mixed (figure 1). The purpose of the limestone addition is to stabilise the pH value of the wastewater and to remove some phosphorus. The purpose of the iron is to bind phosphorus.

A drainage layer is present at the bottom of the system, consisting of a layer of pea gravel 8/16 mm, of 10 cm thick in which drainage pipes (PE) of 80 mm are embedded. The drainage layer is covered with a geotextile to prevent sand from the substrate entering the layer of pea gravel. On top of the substrate layer, a second layer of pea gravel of the same grain size is laid out in which a system of distribution pipes is embedded. Typically those pipes are laid out in at distances of 1 metre. The pipes are holed with 6 mm holes at each metre, facing downward. Finally the constructed wetland is planted with reeds (*Phragmites Australis*) at 6 plants per m^2.

Figure 1: cross section through layers of the vertical flow stage



Horizontal flow stage

The second stage of the setup consists of a horizontal flow subsurface flow wetland with the same type of sand as the first stage, without any additions. The substrate thickness was 60 cm in the test setup and the surface area was 4 m^2 (1 m^2 per PE). The system was planted with various helophytes: *Phragmites Australis, Iris Pseudacorus, Typha angustifolia, Carex nigra, Mentha aquatica* and some other species.

Operation
Presettled wastewater (from a septic tank 500 litres/PE) is collected in a concrete container with a capacity of the total expected wastewater production of one day. From this container, the wastewater is pumped to the constructed wetland twice a day. A submersible pump is used, with a capacity that guarantees quick flooding of the surface area to form a layer of several centimetres of wastewater in the top layer of gravel. The pump is operated by means of a timer.

The effluent of the first stage flows through a PVC monitoring shaft for taking samples, towards the horizontal flow wetland and exits that system at the other end, again through a monitoring shaft.

The system is fed with normalised wastewater at a daily rate that is prescribed in the EN procedure. In addition to periods of nominal load, there are special periods in which the system is loaded with 50% of the nominal load and 150% of the nominal load. Furthermore a 'holiday stress test' (2 weeks without any feed) and some 'power failure tests' (24h no electric power) are performed. In total the testing period takes 38 weeks.

Results

The overall results of the entire testing period are summarized in table 1.

Table 1. Overall treatment results from tested wetlands. The figures are to be interpretated as efficiency stage 1 and efficiency stage 1 + 2.

4 PE system removal%	n=samples: 20	
	Stage 1	Stage 2
mg/l		
BOD	98.3%	98.7%
COD	95.7%	95.8%
Susp. Solids	97.6%	98.1%
Total-P	81.4%	90.8%

The results show a very high removal of organic matter and organic nitrogen. There is also a significant removal of total phosphorus. The horizontal flow wetland only leads to a slight improvement of the results over the vertical stage alone. Only its contribution to the total-P removal is significant.

The trial period included a period of frost. Normally the purification efficiency of a vertical flow reedbed does not suffer much from frost. However in this particular case rabbits had eaten the reed plants on the vertical flow wetland, which left it with no protection against frost when winter started. This led to partial frost of the entire top layer and ponding of wastewater in and above the gravel, which subsequently froze. The treatment results show a slightly lower efficiency during those 3 months of the full 10 months testing period, but even so the effluent concentrations stayed well within the Belgian regulations (BOD < 25 mg/l) The overall results were so good that hardly any negative influence of the frost period is noticeable. The next year new samples were taken during the same winter period, again with frost. The reedplants had grown normally then and no adverse effect of frost was observed.

CONCLUSION

The vertical flow wetland tested at Certipro proved to be a very efficient and robust system for treating domestic wastewater and was the first wetland system in Europe to be certified according to the EN 12566/3 annex B certification.