Wastewater Treatment in Filter beds

onsite treatment wastewater

The "Wastewater treatment in filter beds" project was undertaken during the period 2002 – 2005. The project was partly funded by the Nordic Innovation Centre. The countries involved were Norway, Sweden, Finland and Denmark. Iceland contributed with an observer.

In the Nordic countries we have areas with scattered housing and holiday homes. It is often very expensive to construct sewers running to central treatment plants due to the long distances involved. Good onsite treatment solutions for scattered sewage systems do exist, but despite this the municipalities have on several occasions built expensive traditional systems with pipes that run for long distances, possibly due to a lack of knowledge about alternative solutions.

The objectives of this project were as follows:

- To develop and to improve the performance of filter bed solutions by adapting them to suit Nordic conditions.
- The cross-border transfer of local and national experience.
- Better acceptance for the use of filter bed solutions in scattered settlements without a sewage net work and central treatment plants.
- To develop Nordic guidelines on filter beds.

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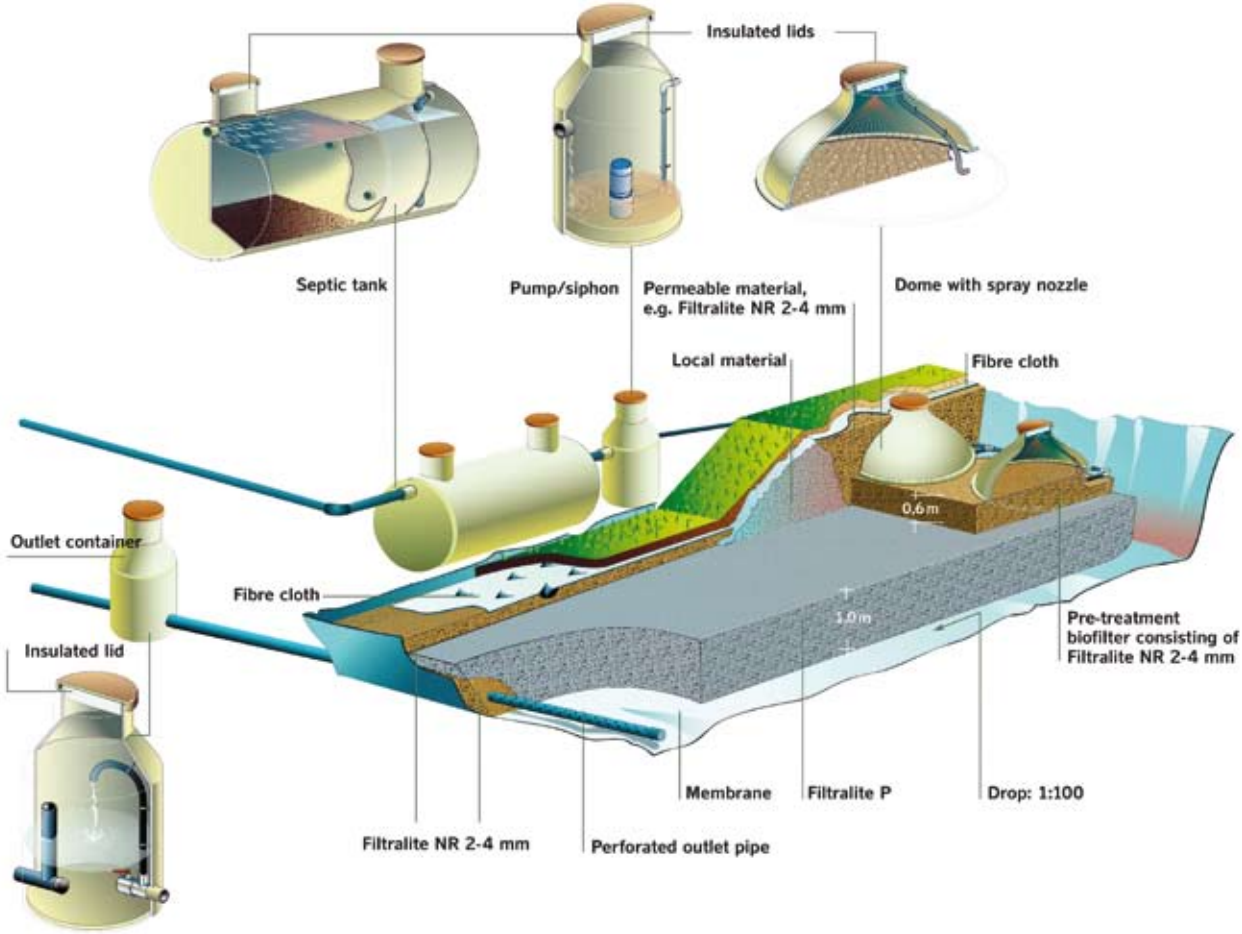

Onsite treatment systems for rural areas were developed during the middle of the 1990's and the performance of the filter bed solution was improved by adding a pre-filter before reaching the actual filter bed. The solution, which has an aerobic pre-filter and filter bed with Filtralite®P, provides a robust treatment system that requires little maintenance and no added chemicals. The treatment effects of these systems are very good.

In this project, "Wastewater treatment in filter beds", the treatment solution was developed further. Two full-scale treatment plants were constructed in each of the four Nordic countries involved. Most of these plants were constructed with large filter beds, but in order to test more compact solutions, three of the plants were constructed with smaller filter beds.

The project participants from the different countries were directly involved in the construction work and during operation they have been responsible for taking samples in order to check the treatment results of the respective plants. HACO has been responsible for the design and construction management in all the countries except Norway.

The sub-projects were run by:
- SYKE (FEI) in Finland
- Stockholm Vatten in Sweden
- Bioforsk and the University of Life Sciences (UMB) in Norway
- The University of Århus in Denmark

Please see last page for contact details.

The project reports are written in English and can be downloaded on the website: **www.filtralite.com**
under **Wastewater treatment in filter beds.**

The reports on the pilot plants are as follows:

- Report from the pilot plants in Finland, Riikka Vilpas (SYKE), Matti Valve (SYKE), Satu Räty (maxit Oy)
- Wastewater Treatment in Filter Beds – Evaluation of two onsite treatment plants, Daniel Hellström and Lena Jonsson (Stockholm Vatten)
- Wastewater Treatment in Filter Beds, Report from pilot plant Hvitsten, Norway, Trond Mæhlum and Jens Chr. Køhler (Bioforsk)
- Results and experiments from the two pilot plants at Norderås in Norway, Lasse Vråle, Arve Heistad and Petter Jenssen (UMB)
- Wastewater Treatment in Filter Beds, Results from the pilot plant DK1 at Mørke, Denmark, Carlos A.Arias and Hans Brix (University of Aarhus)
- Wastewater Treatment in Filter Beds, Results from the pilot plant DK2 at Friland, Denmark, Carlos A.Arias and Hans Brix (University of Aarhus)
- Common report from all pilot plants, Magnhild Føllesdal (maxit Group)

Pilot plant

Nine full-scale pilot plants were constructed during the early phases of the project period and were designed in accordance with the number of houses connected to the individual plants. The plants were primarily constructed as shown in the illustration above with the exception of the compact plants. The compact plants have a pre-filter in separate tanks with recirculation possibilities and tanks containing Filtralite®P instead of filter beds. These plants are located in Kuusankoski in Finland and at Norderås (Ås) in Norway.

Follow-up has been undertaken at all the plants by taking monthly samples and inspection of the plants.

Photo 1
Showing the construction of a compact plant for two households in Kuusankoski, Finland. The picture shows the septic tank, two pre-filter tanks on the left and two tanks for phosphorus removal with Filtralite®P in the middle of the photo. The pre-filters are constructed with a recycling system.

Photo 2
The pilot plant at Talby outside Stockholm. This plant treats sewage from Stockholm Vatten's office building at Bornsjön. The red shed contains sampling equipment used for taking daily and weekly samples.

Results obtained from the plants

The average treatment effects in respect of all the pilot plants during the project period, including the start-up period, are as follows:

Total phosphorus	~ 99 %
Total nitrogen	~ 50 %
Organic materials	~ 85 % (*)

(*) The treatment effect of organic materials will be better if the start-up period are omitted. This is due to the fact that the biofilm in the pre-filter needs some time to establish. Start-up of the plant during the winter is less optimal then start-up during the summer.

Nordic design guide

A Nordic design guide has been prepared that provides information about how the different treatment stages should be designed. This is available on the following website: **www.filtralite.com.**

Reuse of phosphorus from saturated Filtralite®P material

The Filtralite®P material in the filter beds will have a certain technical lifetime before it needs to be replaced. Its technical lifetime is dependent on the load the filter beds are exposed to. With the compact plants, one should expect to have to replace the material more frequently.

MTT in Finland have carried out growth trials using Filtralite®P material on two occasions, the first time using media from an existing plant and the second time using artificially saturated materials. Both growth trials were carried out as potted trials where all the conditions and fertiliser values were controlled. The results of these trials show that phosphorus from saturated Filtralite®P produced equally good plant growth as that produced by artificial fertiliser. In order to reuse saturated filter material on agricultural land, the heavy metal and bacteria content need to be lower than the given limits.

UMB in Norway have carried out tests on used filter materials from five old plants and no values have been detected in this survey that exceeded the limits.

The titles of the detailed reports issued by MTT and UMB are as follows:

- Wastewater Treatment in Filter Beds: Reuse of filter material, Anna-Mari Nyholm, Markku Yli-Halla, Pekka Kvistö (MTT, Agrifood Research Finland)
- Heavy metals accumulation and hygienic indication in subsurface flow constructed wetlands, Adam M. Paruch, Tore Krogstad, Petter D. Jenssen, Gunnar Stensen (UMB)

Future development of filter material

A study has been carried out to investigate the future development of the filter material, Filtralite®P, and this work is described in the following report:

- Material Development, Torgeir Saltnes, Magnhild Føllesdal (maxit Group)

Table 1 Treatment effects at all the pilot plants in respect of phosphorus, total nitrogen, chemical oxygen demand (COD) and biological oxygen demand (BOD). The results include the start-up periods.
[1] average value with start-period, median BOD value for Talby was 83.3%.

Pilot plant		Total phosphorus reduction (%)	Total nitrogen reduction (%)	COD reduction (%)	BOD reduction (%)
Norderås, small filter bed	Norway	98	40	94	96
Norderås, compact plant	Norway	99	56	92	96
Hvitsten	Norway	99	39	82	81
DK 1 Mørke	Denmark	94	50	90	90
DK 2 Friland	Denmark	99	57	90	90
Sipoo	Finland	99	46	90	95
Kuusankoski, compact plant	Finland	95	46	90	96
Talby	Sweden	99	43	73	37[1]
Fågelsta	Sweden	99	66	89	82

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