# Septage Treatment with Reed Bed Filters

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## Introduction

Septage, the solids accumulated in septic tanks, has traditionally been applied to agricultural land without treatment. However, septage is increasingly being regulated as a biosolid, requiring treatment. Wastewater treatment plants in small communities often do not have the capacity to accept septage, therefore alternatives are required.

Reed bed filters are simple technologies which have been used extensively in Europe for sludge dewatering [1]. Reed bed filters are similar in design to conventional sand drying beds only planted with common reeds (*Phragmites*) and the dewatered solids are left to accumulate in the bed over a period of 7-10 years, greatly reducing operating costs.

The plants play two important roles: firstly, the growing rhizomes and movement of the stems in the wind break apart the accumulating sludge layer and permit continuous filter drainage, and secondly, plant evapotranspiration increases sludge dewatering.

Canadian winters also play an important role in sludge dewatering as the freeze-thaw cycle acts as an effective solid-liquid separation process during the winter months when the plants are dormant [2].

A pilot reed bed system was established in 2007 at the René Goulet septage lagoon in Green Valley, Ontario, Canada (45.32°N 74.64°W) and was monitored for 5 years.

This Fact Sheet outlines system performance and design recommendations for septage treatment using reed bed filters in cold climate regions.

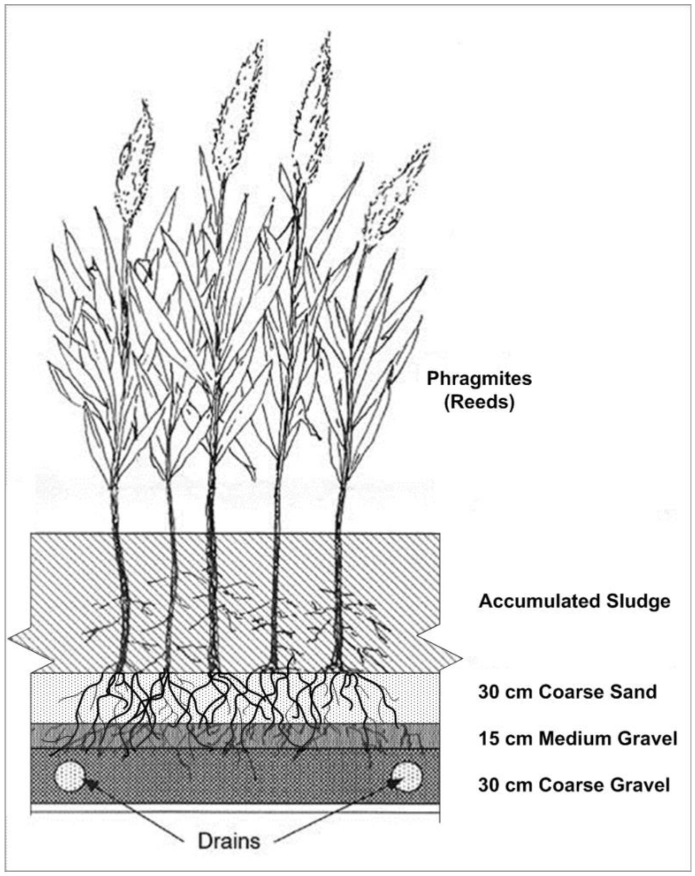


**Fig. 1. Schematic of a Reed Bed Filter (Credit: E. Brunet, ORWC)**

## Reed Bed Filter Design

The cross section of each filter, from bottom to top consists of: a felt liner, a 30 mil PVC geomembrane, a 30 cm layer of coarse gravel, a 15 cm layer of medium gravel, and a 30 cm layer of coarse sand. Berms are constructed around each filter to achieve 2.0 m of freeboard above the filter surface. The effluent drainage system is comprised of 10 cm (4') diameter perforated PVC pipe laid in the gravel layer at 1.5 m centres draining to a collector pipe at the toe of each filter. Passive aeration standpipes are installed and connected to the drainage network.

## Plant Establishment

The reed bed filters are planted with *Phragmites* at 9 plantlets or rhizomes/$m^2$. Initial plant development is important as it is easy to kill the young reeds with excessive septage application. The *Phragmites* should be planted in the spring and irrigated with dilute septage, wastewater or irrigation water until the plants have become well established. Design loading can commence during the first winter.

## Filter Operation

The filters can be dosed directly from the septage truck after passing through a 1.0 cm bar screen. Even distribution of the sludge across the filter is important. Multiple standpipes or a moveable dosing pipe can be used. Splash plates are necessary to avoid eroding the sand layer.

The recommended annual loading rate to each filter is 3.2 m $y^{-1}$ (~83 kg $m^{-2}$ $y^{-1}$). Dosing frequency can vary from 1-3 weeks (6-18 cm per dose) with no impact on system performance observed. During winter months, a new sludge layer is applied once the previous layer has frozen solid.

At the end of the operating cycle, the reed beds are left for several months to completely dewater and to ensure *E.coli* numbers have fallen below the land application standard. Once dewatered sludge samples have been analysed for *E.coli* and metals, the dewatered sludge can be removed from the beds and land applied to agricultural fields following local regulations.

# Reed Bed Performance

## Filtrate Quality

The reed bed filters are very effective at removing almost all organic matter, solids and nutrients (see Table 1).

**Table 1. Filtrate Quality**

| Parameter | Raw Septage (mg/L) | Filtrate (mg/L) | Removal (%) |
|---|---|---|---|
| $BOD_5$ | 6200 ± 1100 | 62 ± 9 | 99 |
| TSS | 18300 ± 2600 | 85 ± 14 | 99 |
| TP | 280 ± 50 | 4 ± 1 | 99 |
| TKN-N | 790 ± 106 | 36 ± 5 | 95 |

The filters produce an effluent comparable to a low strength domestic wastewater which can be stored and land applied as irrigation water, treated by an onsite wastewater technology or discharged at a WWTP.

## Sludge Quality

Sludge quality is described in Table 2. Dry matter increases from 2.6% to 23% with nitrogen and phosphorus levels comparable to solid dairy manure; demonstrating that dewatered septage can provide a valuable source of nutrients for crop production.

The metals content of dewatered septage is described in Table 3. Metal concentrations are very similar to municipal biosolids and meet N. American limits for land application [4]

**Stabilized dewatered septage**

**Raw septage and filtrate**

**Filtrate irrigation of hybrid poplar plantation**

**Table 2. Dewatered Sludge Quality**

| Parameter | Raw Septage | Dewatered Septage | Solid Dairy Manure [3] |
|---|---|---|---|
| Dry Matter (%) | 2.6 ± 0.4 | 23 ± 3 | 20 |
| TKN-N (kg/tonne) | 0.8 ± 0.1 | 3.7 ± 0.3 | 5.7 |
| TP (kg/tonne) | 0.3 ± 0.04 | 2.2 ± 0.1 | 1.6 |

**Table 3. Dewatered Septage Metals Content**

| Metal | Dewatered Septage (mg/kg) | Dewatered Biosolids (mg/kg) [5] |
|---|---|---|
| As | 3 ± 1 | 7 |
| Cd | 3 ± 1 | 3 |
| Co | 5 ± 1 | - |
| Cr | 35 ± 20 | 83 |
| Cu | 607 ± 324 | 569 |
| Hg | 0.002 | 1.3 |
| Mo | 9 ± 4 | 17 |
| Ni | 26 ± 14 | 53 |
| Pb | 62 ± 34 | 80 |
| Se | 5 ± 3 | 7 |
| Zn | 1031 ± 410 | 1029 |

## Summary

Reed beds have been shown to be a low-cost and low-maintenance technology to dewater and treat septage under Canadian climatic conditions. Filtrate quality is similar to a low-strength domestic wastewater. Dewatered septage meets regulatory guidelines for biosolids application to agricultural land and can provide a valuable source of nutrients for crop production. Reed bed filters can be established at municipal WWTPs with the filtrate discharged to the plant headworks or can be operated as a stand-alone system with post treatment for the filtrate.

## References

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