

## Septage Treatment Using Reed Bed Filters

C. Kinsley<sup>1</sup>, A. Crolla<sup>1</sup>, K. Kennedy<sup>2</sup>

### 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].

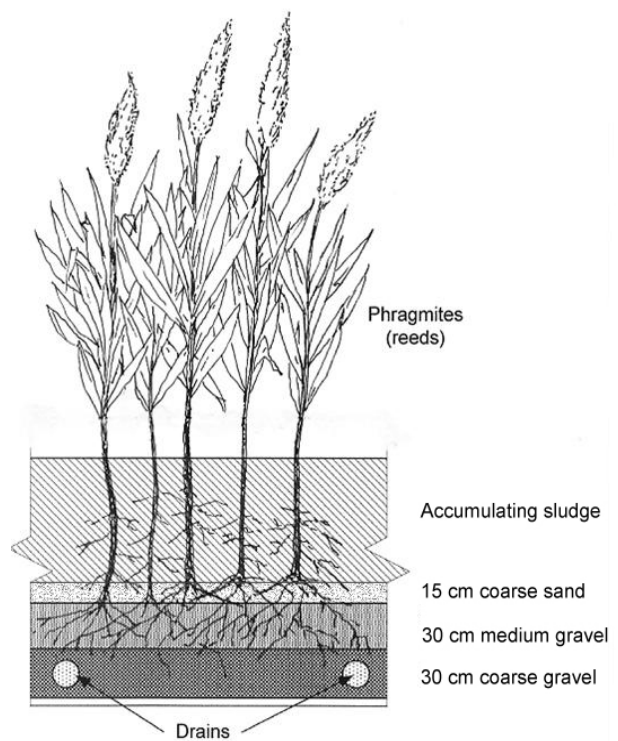


Figure 1. Schematic of a Reed Bed Filter

A pilot reed bed system was established at the René Goulet Septage Lagoon in Green Valley, Ontario in 2007.

## 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 30 cm layer of fine gravel, and a 15 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 4 inch perforated PVC pipe laid in the gravel layer at 4 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 native *Phragmites* at 9 plantlets or rhizomes/m<sup>2</sup>. 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 should be 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 bar screen filter. 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 drilling into the sand layer.

Filters can be dosed on average 7 cm per week (~100 kg TS/year). Either weekly dosing or several doses in a row followed by a longer rest period appears to work equally well. During winter months, a new layer is applied once the previous layer has frozen solid.

Before desludging, the dewatered solids are left to cure until *E.coli* numbers fall below the land application standard of  $2.0 \times 10^6$  CFU/g dry matter. Preliminary data suggests this will take several months.



Credit: ORWC

## Reed Bed Performance

### Filtrate Quality

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



Credit: René Goulet

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



Credit: René Goulet

Table 1. Filtrate Quality

Parameter	Raw Septage (mg/L)	Filtrate (mg/L)	Removal (%)
BOD <sub>5</sub>	6,200 ± 1,100	62 ± 9	99
TSS	18,300 ± 2,600	85 ± 14	99
TP	280 ± 50	4 ± 1	99
TKN-N	790 ± 106	36 ± 5	95

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

### Sludge Quality

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

The metals content of dewatered septage is described in Table 3. Metal concentrations are very similar to municipal biosolids, particularly for copper, which is often the limiting metal species for land application.

Table 3. Dewatered Septage Metals Content

Metal	Dewatered Septage (mg/kg)	Dewatered Biosolids (mg/kg) [4]
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

## Conclusions

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 nitrogen for crop production. Reed bed filters can be operated by independent septage haulers, as a regional treatment facility or as a dewatering technology at a municipal WWTP.

[1] Nielsen, S. (2003). "Sludge Drying Reed Beds" *Water Science and Technology* 48:5, 101-109.

[2] Martel, C.J. (1993). "Fundamentals of sludge dewatering in freezing beds" *Water Science and Technology* 28:1, 29-35.

[3] OMAFRA Agronomy Guide for Field Crops - Pub 811

[4] EPA (2006) Handbook of Septage Treatment and Disposal

<sup>1</sup> Ontario Rural Wastewater Centre, Université de Guelph-Campus d'Alfred, Alfred, Ontario, Canada

**Contact:** ckinsley@alfredc.uoguelph.ca

<sup>2</sup> Department of Civil Engineering, University of Ottawa, Ottawa, Ontario, Canada.

### **Support for this Study was Provided by:**

Ontario Ministry of the Environment

Ontario Ministry of Agriculture, Food and Rural Affairs

Eastern Ontario Water Resources Committee

Canadian Water Network

Canada Mortgage and Housing Corporation

René Goulet Septic Tank Pumping.

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