Blumberg-Engineers

Natural Treatment

of sewage sludge in

Reed Planted Dewatering Beds

Short description of

Reed Bed Sludge Dewatering Technology:

Domestic sludge is dispersed onto reed beds. The reed plants grow through the overlying sludge and develop numerous roots in the substrate. This leads to a forced dewatering and mineralization of the sludge. The dewatering is driven by evapotranspiration and particularly by a drainage system on the bottom of the sealed reed beds (polyethylene liner). The sludge volume declines to about 10 % of the initial volume. Usually the reed beds work for a period of 8 to 12 years without sludge removal. The resulting product of the dewatering is a earthy organic material. The sludge humus can be used for further composting, for fertilisation, for thermal recycling, for recultivation, gardening and landscaping.

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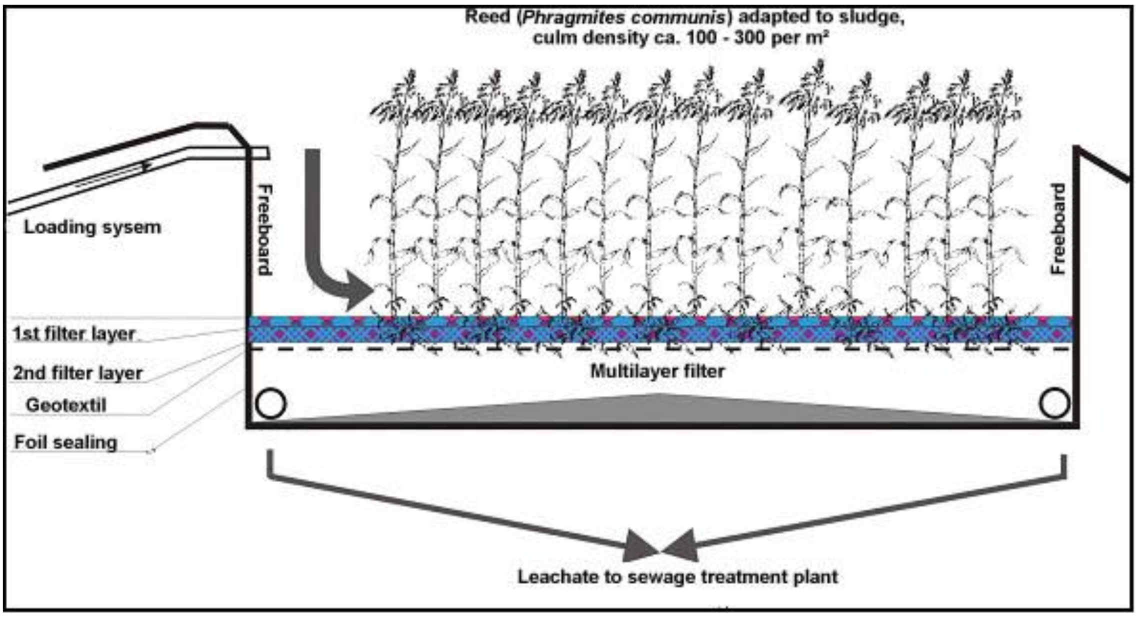
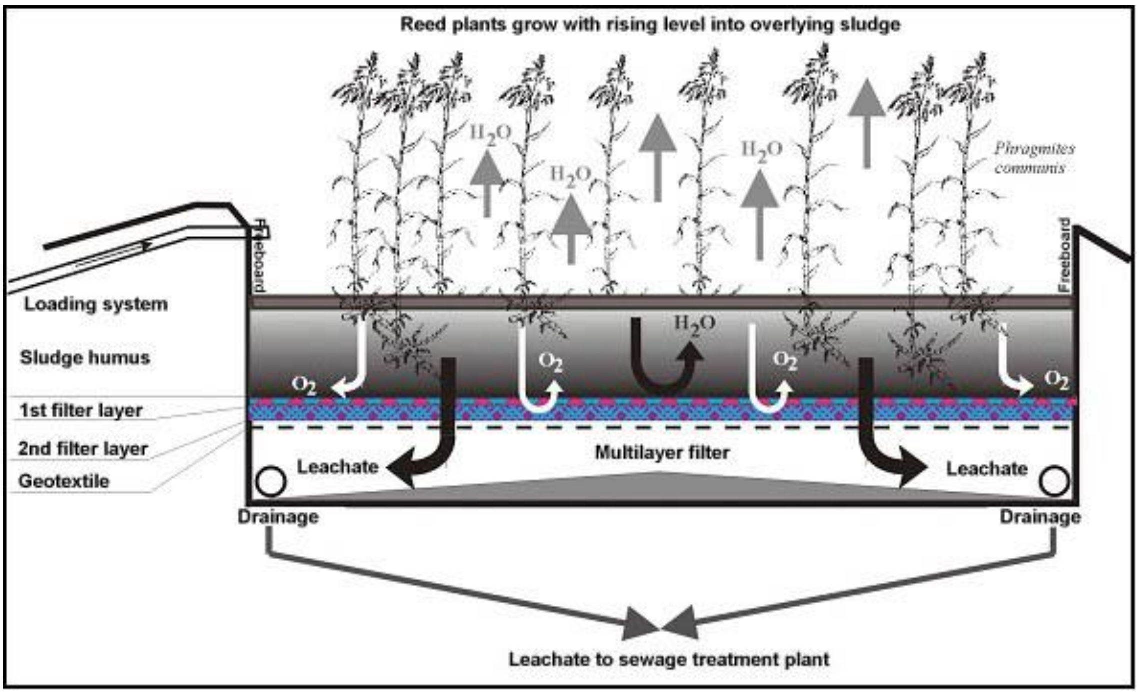
Characteristics of sludge conditioning in reed beds

- Periodically loading following a specific schedule
- Load depending on the dry matter content (DM)
- Sludge removal after 8 to 12 years, depending on height of freeboard, subsequently reloading for the following period
- Further composting of the sludge humus inside or outside the reed beds
- Material recycling of the final product (>40 % dry matter content)



A. Inital state at beginning of operation



B. State after several years of operation

Infiltration · Percolation · Evapotranspiration · Oxygen input and mechanical conditioning by reed roots · Mineralization

The role of the reed plants

The domestic sewage sludge gradually underlies a fundamental and constant conversion into earthy substances. The following processes in the rhizosphere of the reeds are responsible for this conversion:

- The reed plants transport oxygen via the culm into the root space, inducing a rich bacteria community. Bacteria are responsible for a partial mineralization of organic substances. The reed planting doubles the microbiological activity (degradation and conversion of organic substances) compared to unplanted sludge dewatering beds.
- The plants are able to dewater the sludge at high osmotic pressures and transpirate water by their leaves.
- The reed increases the water conductivity of the rooted sludge thus supporting its selfdewatering to the drainage system.
- The permanently growing rhizomes and roots lead to a continuous conditioning and restructuring of the settled sludge. While the overlying sludge layer is still black by the precipitated iron sulphide and is still of a muddy consistence the underlying layer already has turned into brown non-smelling sludge humus. It is well dewatered and has a crumbly structure.

Goals of reed bed sludge dewatering and mineralisation

1. Dewatering of wet sludge to a dry matter content of about 50 %, while the volume is reduced to 10 %.
2. Reduction of costs for electricity, maintenance, repairing, personnel, and operation (analysis of soil and sludge, carriage etc.)
3. Sanitising of the sludge humus by composting it for another year after an operation period of 8 to 12 years.
4. Increasing independency of municipalities concerning political decisions connected with agricultural sludge recycling.
5. Producing a dewatered material, which has a great variety of applications and recycling alternitives.
6. Formation of a secondary biotope consistent of marsh plants (helophytes) and of associated wildlife.

Rhizosphere of *Phragmites communis (reed)*

Potentials of the technology

The sludge humus has been removed from our first reed bed sludge dewatering plant in the municipality of Lahstedt (Sewage treatment plant Münstedt and Adenstedt) after 6 years of operation. The dry matter content rose after one year of sanitising (outside the reed bed) from 40 % to 50 %. The resulting sludge humus was completly by stabilised (non-smelling) and had a crumbly earthy structure, which was used in the municipality as compost without additional costs. Thus the cycle of nutrients has been completed. The second sludge removal occurred in 2001. The sludge humus has been used in the municipality comparably cost effective by an application within the construction of a combined sewage biotope, which is a natural alternative for stormwater treatment in concrete basins.

The sludge of 2 to 4 inhabitants (person equivalents) can be dewatered per m² reed bed area depending on the specific sludge quality and amount. A dry matter content of about 30 % can be achieved within a short period, making the reed bed dewatering a real alternative to chamber filter press and wire press. After a longer operation dry matter contents over 40 % are possible. Complete sanitising can be reached by storing the sludge humus for a period of one year outside the reed bed. Following applications are possible:

- Agricultural recycling
- Gardening
- Recultivation
- Thermal recycling

Costs of investment and operation

Costs of investment and particularly of operation are comparably low, which is the main advantage to mechanical sludge dewatering technologies. Economic efficiency calculations demonstrate in most cases a considerable potential for economisation.

Summary

The reed bed dewatering sewage sludge technology leads after 8 to 12 years operation to a sludge humus, which offers many applications for an economically resonable recycling of the earthy material.
The reed bed dewatering contributes new ways of medium-term and long-term disposal possibilities giving the municipalities or industrial operators certainty considering growing restrictions by legislation for agricultural reuse.

This natural sludge processing method offers ecological advantages like gravity dewatering, reed induced mineralization and evapotranspiration, which positively influence the energy balance.

The method works without chemical additives like polymers as conditioner.

The reed bed treatment is economically efficient compared to conventional mechanical technologies.

Wildlife enhancement is an important secondary goal of reed bed treatment systems, which create habitats for birds, amphibians and invertebrates.

Project examples

1) **Ilsede-Gadenstedt, Niedersachsen (registered project of the Expo 2000 Hanover, Germany) and Ilsede-Groß Lafferde**

   Start of operation: 1998

Gadenstedt, reed bed 1, with trickling filter plant in the background

Start of operation: 1998

Groß Lafferde, reed bed 1- 6, 6.655 m²

2) Bad Emstal (Hessen)

Start of operation 2002

One of four reed beds at sewage treatment plant Bad Emstal (6,000 m^2 in total)

3) Naumburg (Hessen)

Start of operation: 1999

Reed bed dewatering Naumburg, Germany (2.400 m²)
Height of the reeds up to 4 m; culm density up to 320 per m²

Reed bed dewatering Naumburg, beds 1 and 2, activated sludge treatment plant in the background

4) Fronhausen (Hessen)

Start of operation: 2006

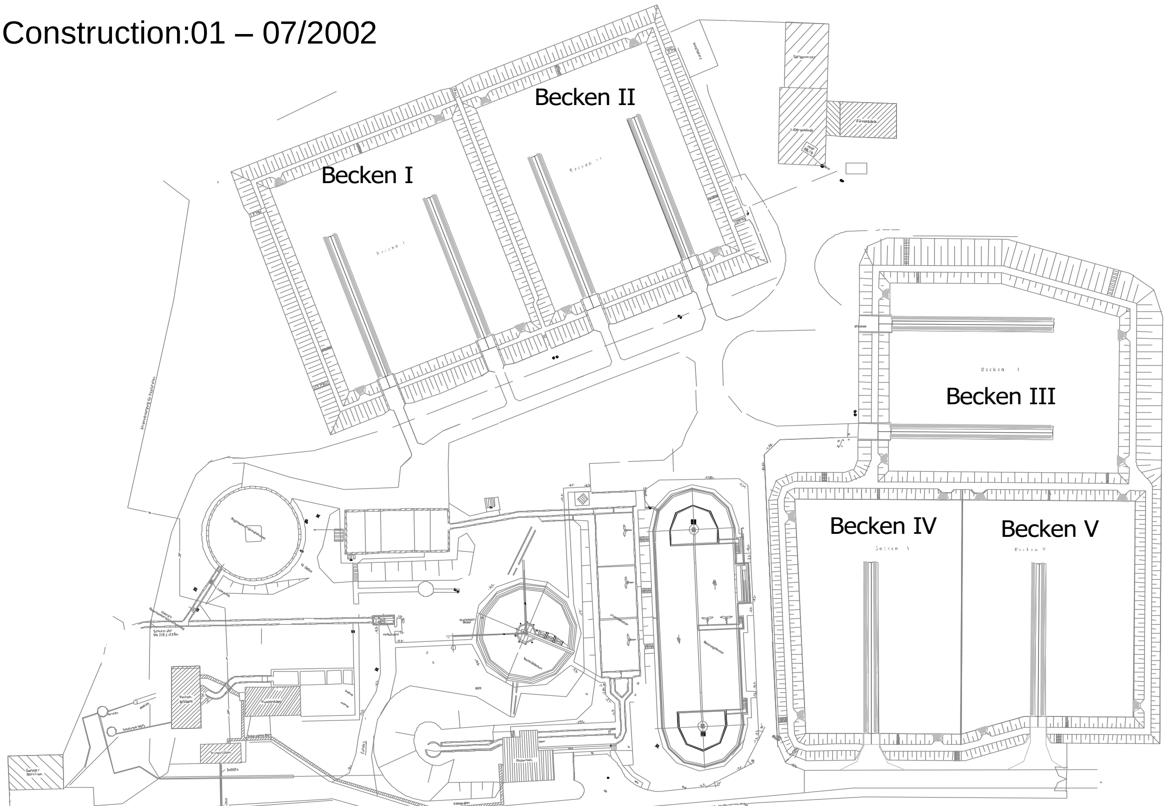
Sludge drying reed beds Fronhausen (2.000 m²)

5) Gräfenhainichen (Sachsen-Anhalt)

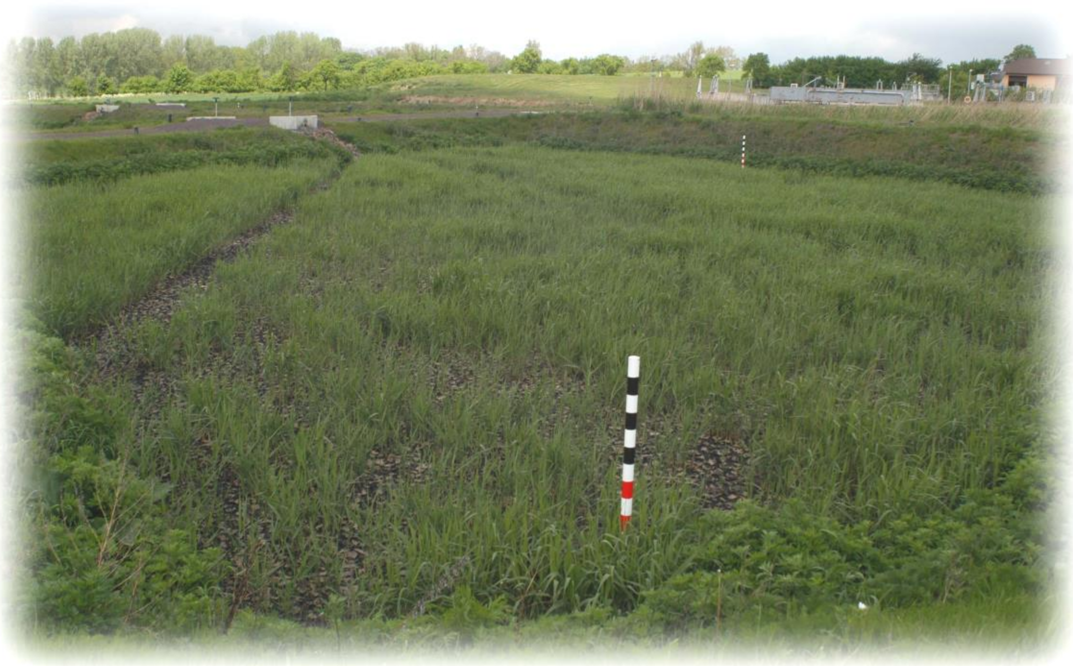
AZV Mühlgraben, surplus sludge treatment of a sewage treatment plant by activated sludge process and simultaneous sludge stabilisation

Population equivalent 15.000 PE,   Planning: 09 – 12/2001

Construction:01 – 07/2002



6) Eilsleben (Sachsen-Anhalt)



WAV Bördekreis, surplus sludge treatment of a sewage treatment plant by activated sludge process and simultaneous sludge stabilisation

1. Expansion stage (Bauabschnitt)

Person equivalent 2.750 PE
Planning: 1996
Construction: 1997

2. Expansion stage (Bauabschnitt)
Person equivalent 8.500 PE
Planning: 2000
Construction: 2002