Sludge Treatment Reed Bed Systems (STRB)

State of the art – 30 years of experience

WITH FOCUS ON:

- **METHOD**
- **QUALITY OF FILTRATE WATER AND SLUDGE RESIDUE AFTER TREATMENT**
- **EMPTYING AND RECYCLING**
- **OPERATION PROBLEMS**
- **TRIAL SYSTEM**
- **ENERGY**

Photo: Orbicon

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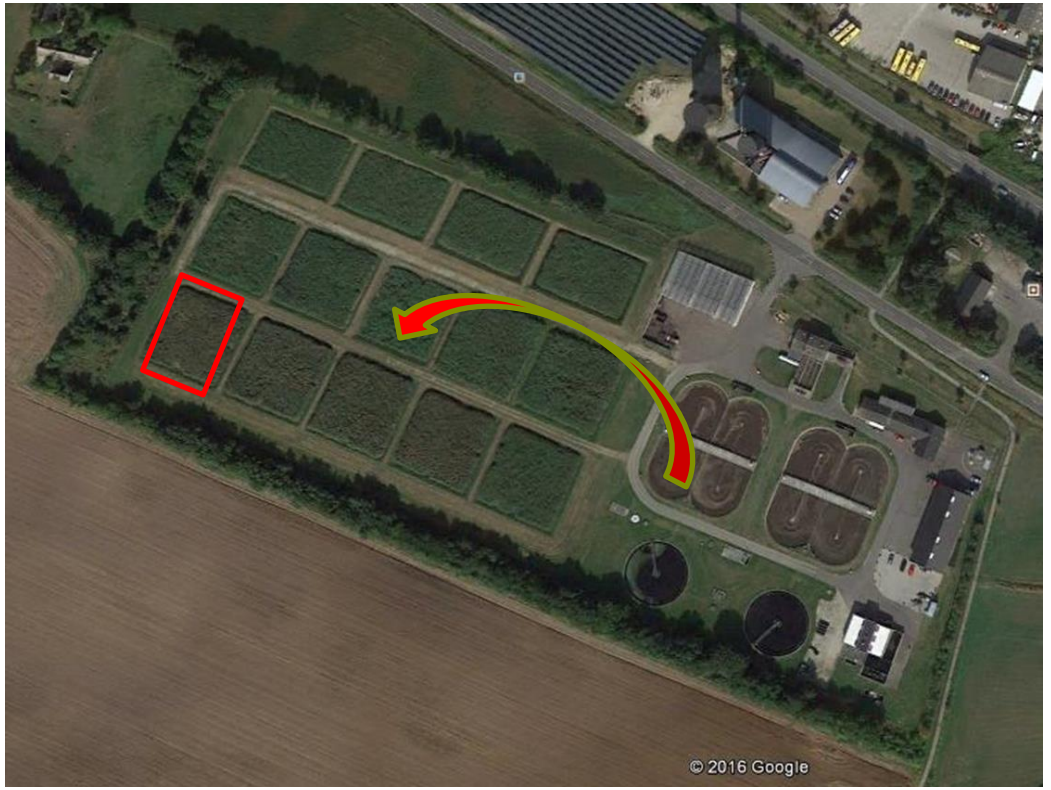
Sizing

- Sludge production (tonnes of dry solids per year)
- Sludge quality (fat-content, organic content)
- Sludge type (type of production)
- Climate (evaporation)
- Periods of operation
- Area loading rate (30 – 60 kg ds/m2/year)
- Number of basins and capacity

Helsinge Sludge Treatment Reed Bed Systems (STRB) – Denmark (1996 – 2017)

OPERATION

- STRB´s are devided into a number of basins
- 630 tons ds - activated sludge per year
- 14 Basins and Greenhouse stock pile area
  - 10 Basins (1996 into service)
  - 4 Basins (2013 into service)



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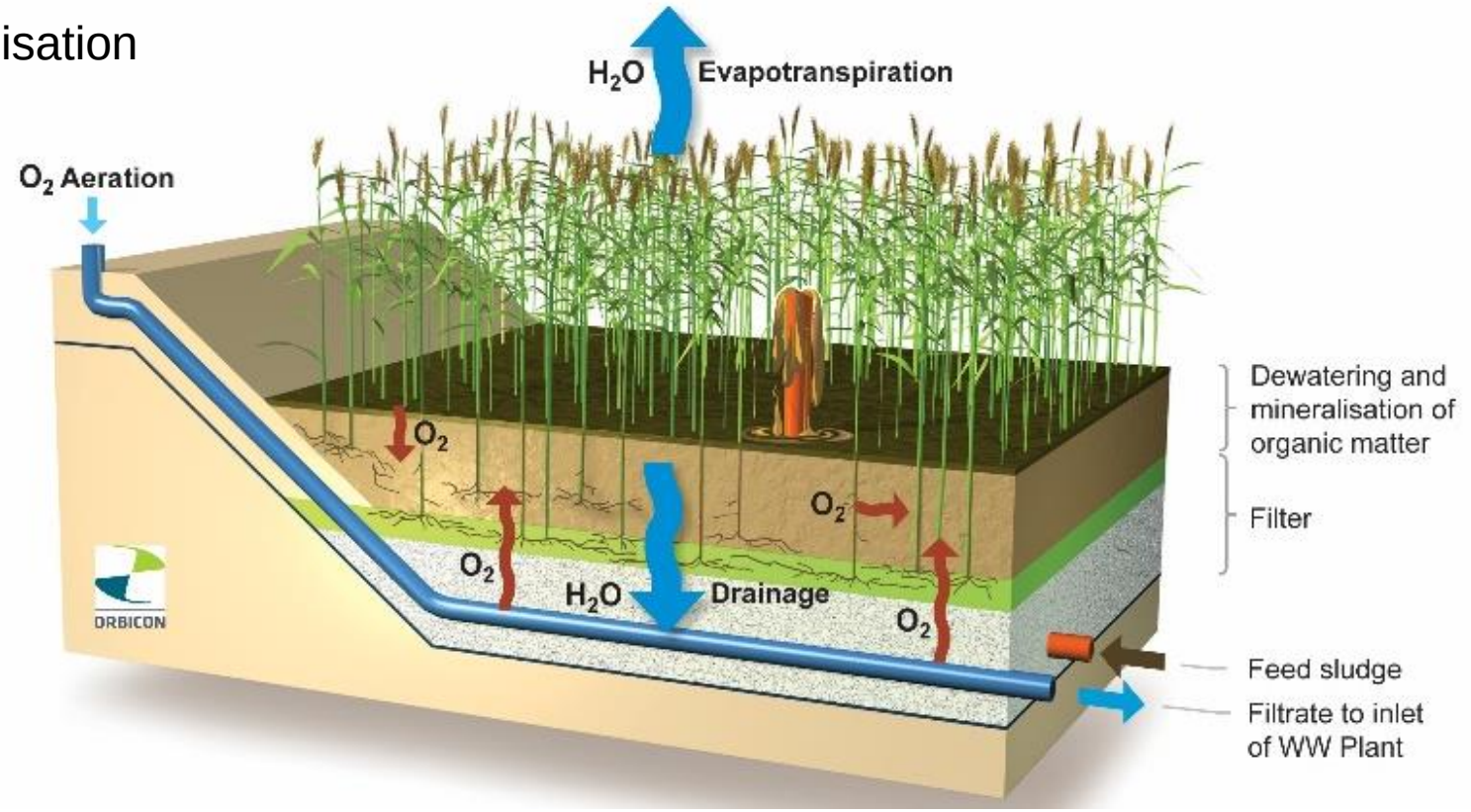
Long-term sludge reduction in reed beds

Method - Overall funtionality

- Dewatering
  - Draining
  - Evapotranspiration
- Aeration
- Mineralisation



System Proces and Product


Photo: Orbicon

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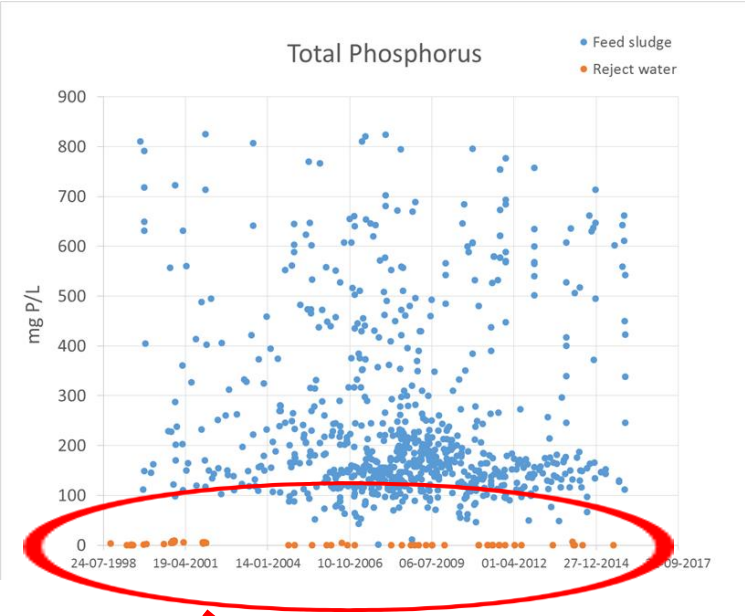
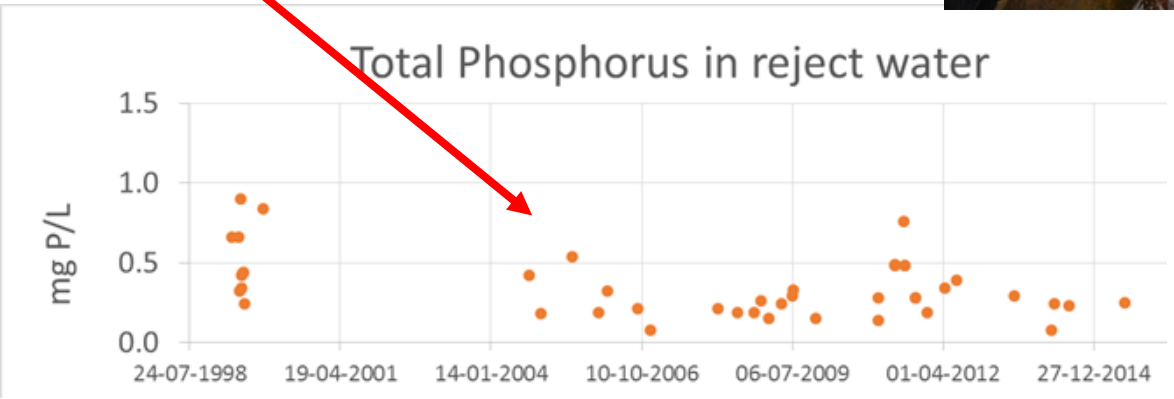
Filtrate quality

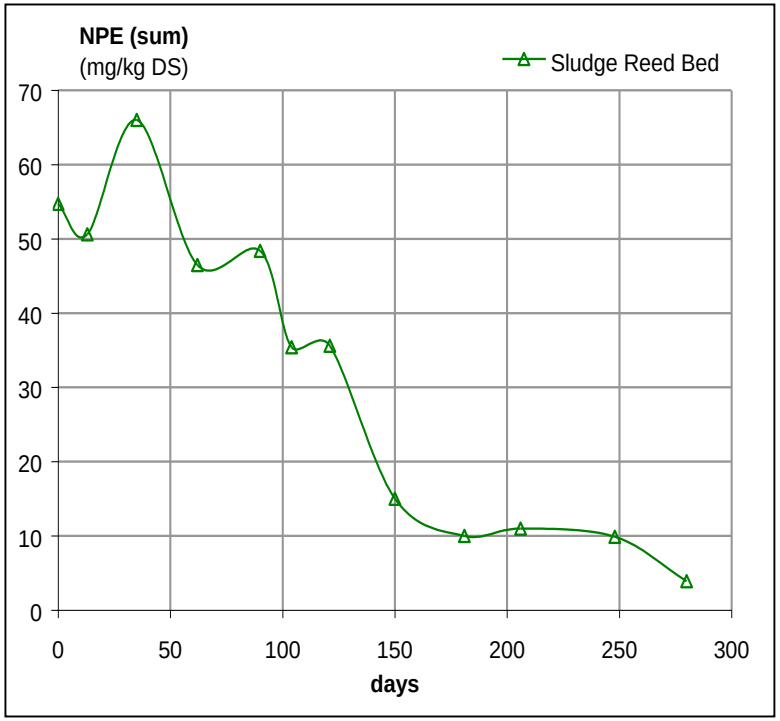
(Total P) from STRB systems treating activated sludge (1998 – 2017) – Chemical P removal (Ferric Sulfate) – Suspended solid





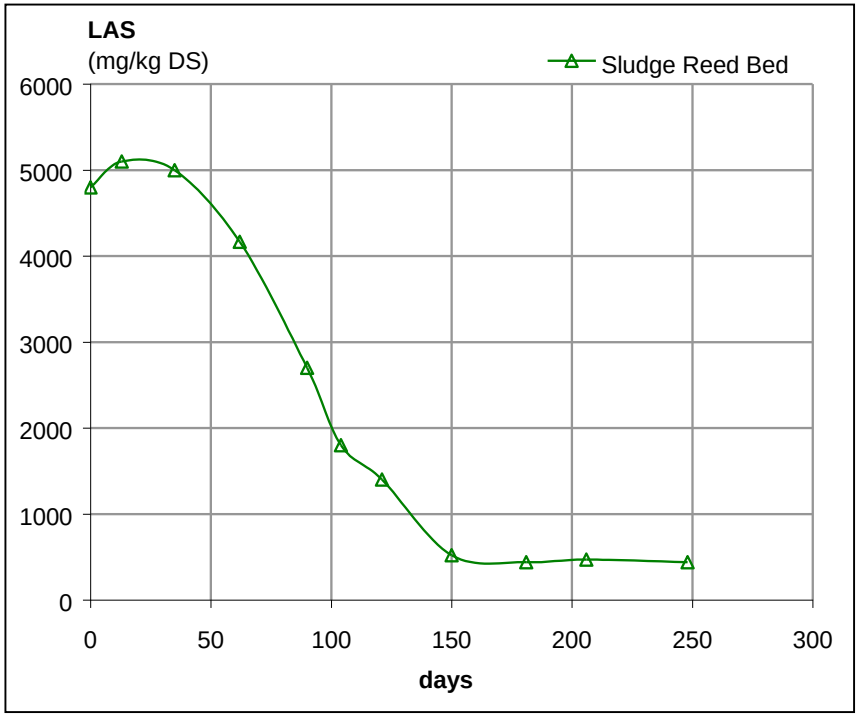
Quality of the sludge residue after treatment

Mineralisation of digested sewage sludge Kallerup STRB (Denmark)



NPE (Nonyl Phenol Ethoxylate)

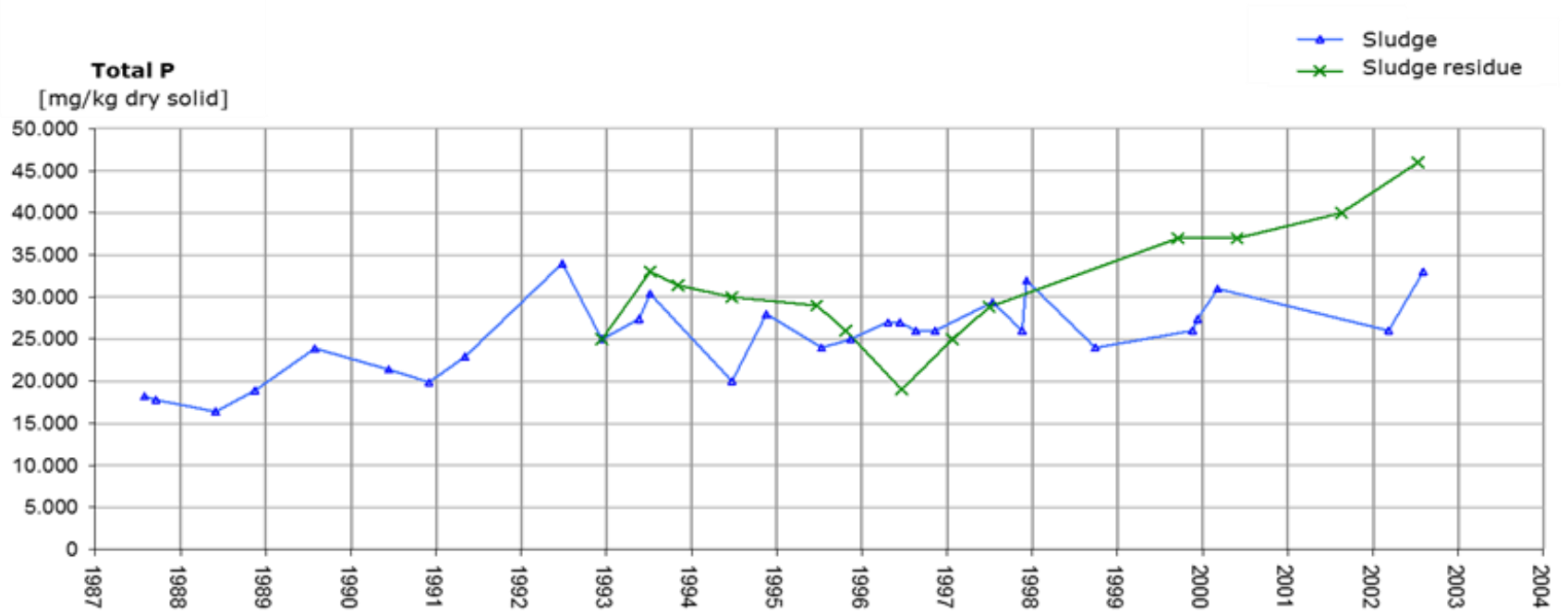
- Loaded mass (kg) 0.3
- Remaining mass (kg) 0.02
- Reduction (%) 94



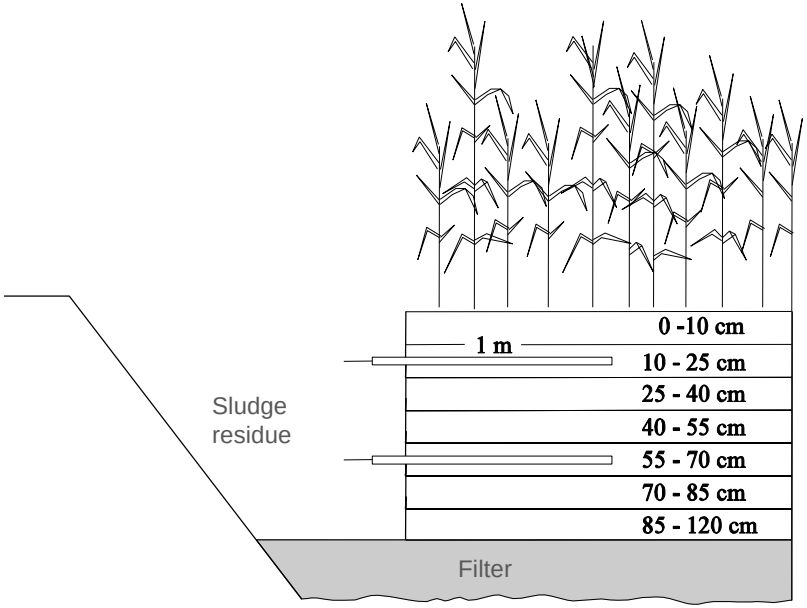
LAS (Linear Alkylbenzene Sulfonate)

- Loaded mass (kg) 24.5
- Remaining mass (kg) 0.4
- Reduction (%) 98

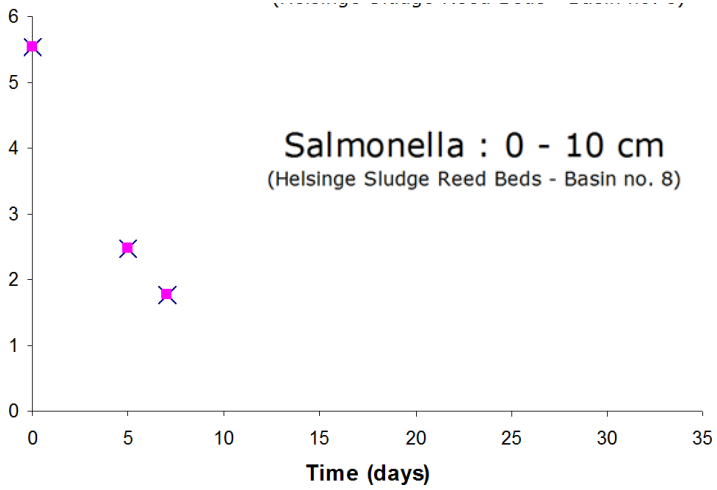
Accumulation of Total P in the Sludge residue (1997 – 2004)

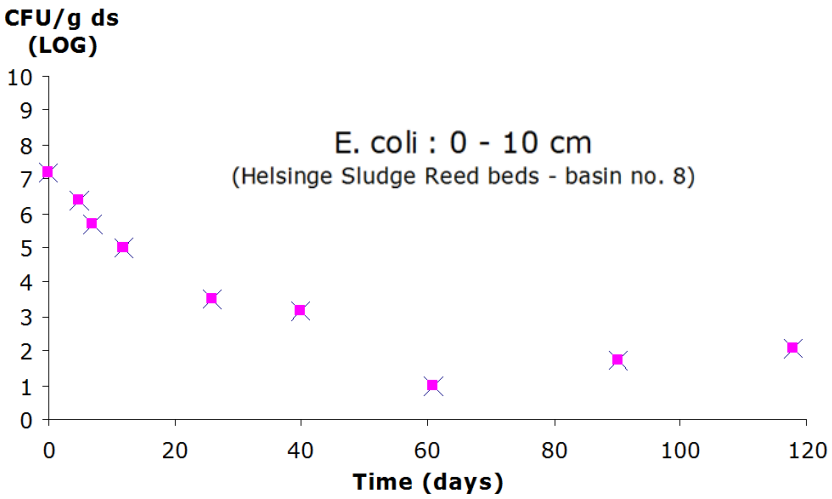


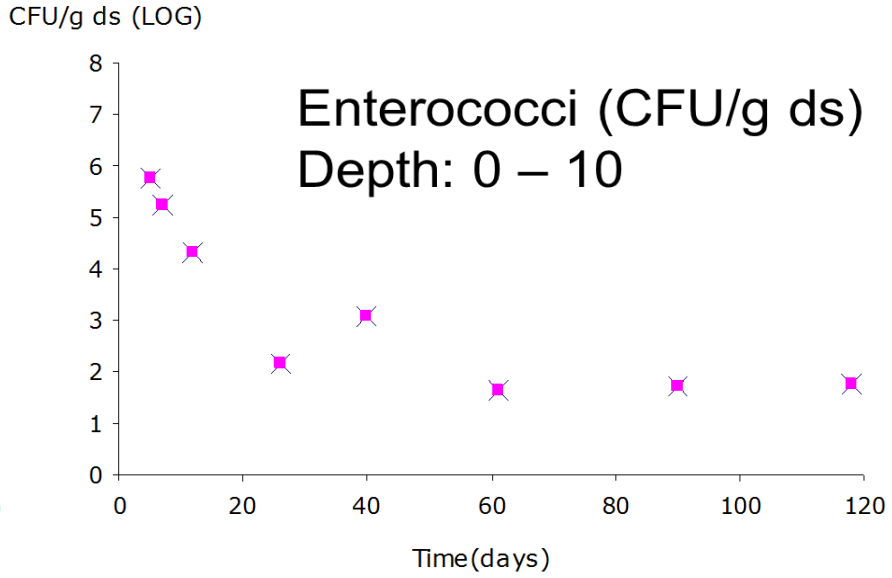
Reduction of pathogenic micro-organisms
Section of sludge residue and sampling sites



Reduction of pathogenic micro-organisms







Rudkøbing and Nakskov STRB (Denmark)

Emptying - Recycling


Photo: Orbicon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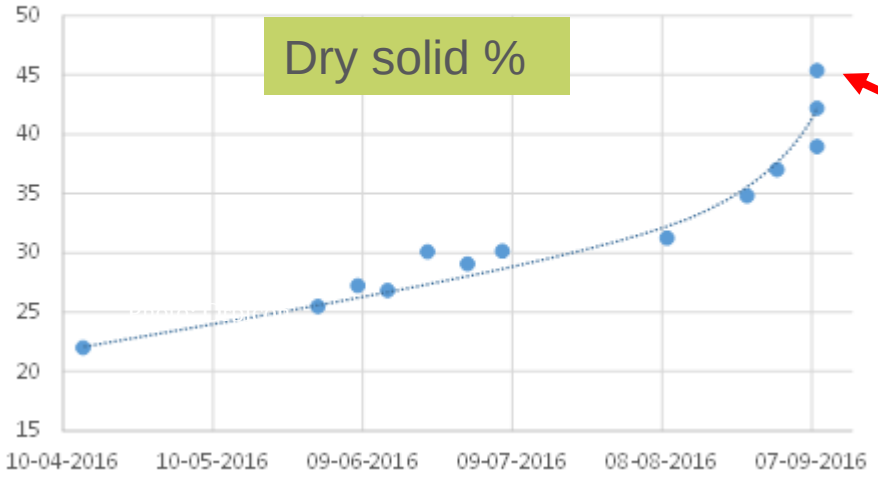
Helsinge STRB (Denmark) – Green house
Solar drying of sewage sludge from STRB (2016 and 2017)



Helsinge STRB (Denmark) – Stock Pile area **Recycling** (August/September)


Photo: Orbicon

More than 30 systems and 200 basins have been emptied

Over 130,000 tonnes of biosolids from STRBs have been spread onto nearly 10,000 hectares of Scandinavian agricultural land over the past 23 years.

No reports of disturbances to natural wildlife, fauna or agriculture (no regrowth of reeds)


Photo: Orbicon


Photo: Orbicon

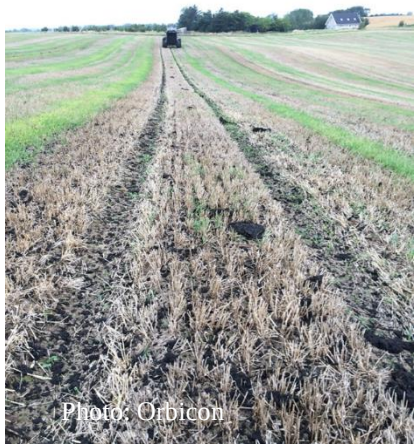


Photo: Orbicon

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Skovby STRB (Denmark): 1995 - 2015

Regrowth

Operations Problems

Category 1: Sludge Quality
Category 2: Design and dimensioning
Category 3: Construction
Category 4: Operation

Incorrect construction and operation

Operations, maintenance and emptying


Photo: Orbicon


Photo: Orbicon


Photo: Orbicon


Photo: Orbicon


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Overloading:

Overloading can be caused by:

- Too high areal loading in relation to Sludge type/ quality including fat (< 5000 – 7500 mg/kg ds) or organic content (< 65-70 Loss on ignition)
- Too few basins (Insufficient resting periods)

Overloading and insufficient draining of the residual sludge results in:

- Poor growth of reeds
- Insufficient root and rhizome development in the residual sludge layer leading to anaerobic conditions.

Sludge qualities – **Test systems**

Test purposes (Phase 1)

The main purposes:

Is to test whether the sludge would be suitable for further treatment in a STRB.

- To determine sludge quality and characteristics?
- How will the sludge behave (dry/crack up) in a trial bed?
- Is it possible to get the vegetation to grow in the sludge/Fertilizer?
- To ascertain the sludge residue characteristics including reaction after each loading period and any cumulative effects of sludge loading?
- To ascertain the dewatering efficiency of the sludge (l/sec./m^2)?
- To identify if there are any adverse or undesirable effects which would impact upon reed health/growth rates

Regstrup and Allerslev (Denmark)
Full scale Test STRB (1988 – 1992)


Photo: Orbicon


Photo: Orbicon

Kristianstad STRB (Sweden) – Trial System (2005 – 2008)


Photo: Orbicon

Photo: Orbicon


Photo: Orbicon


Photo: Orbicon

Gisborne Trial System (New Zealand) (2015 – 2016)

Lumley (England) – Alum Sludge (2009-2010)

Pre-Test - Sludge Treatment Reed Bed System


Photo: Orbicon


Photo: Orbicon


Photo: Orbicon

Photo: Orbicon

Whitacre (England) - Pre-test system (2015)

Wacol Trial (Australia) Sludge residue (2016 – 2018 - ?)

Hanningfield Water Work (England)
2008 – 2013, Trial (Water Works sludge - Iron)

Photo: Orbicon

6 basins / total 120 m²

(Planted in February 2008)


Photo: Orbicon

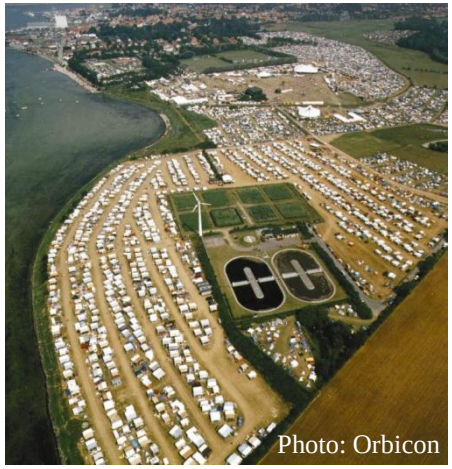

Photo: Orbicon

REFERENCES (Selected)

Sludge Treatment Reed Bed Systems

Kolding (1998)
2000 tonnes of dry solids per year

Skövde (2003)
1200 tonnes of dry solids per year



Rudkøbing (1992)
250 tonnes of dry solids per year

Greve (1999)
1000 tonnes of dry solids per year

Winter Operation
Tidaholm STRB (Sweden)

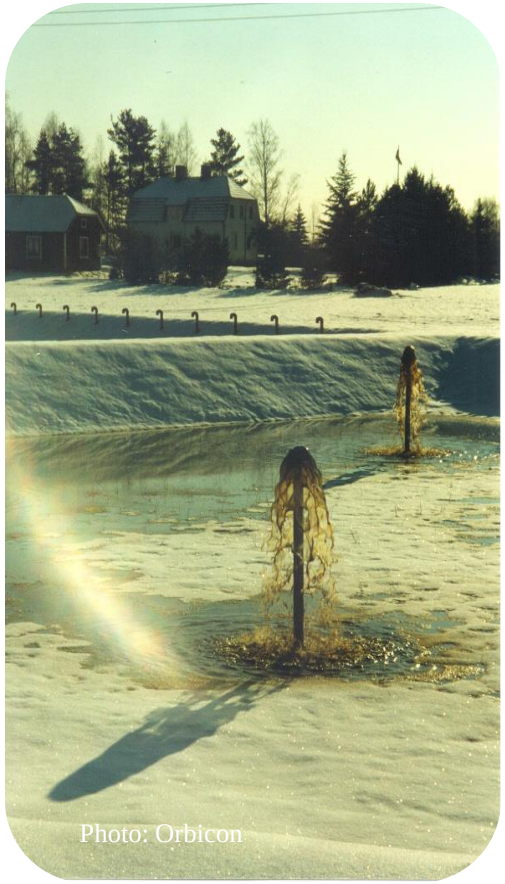


Photo: Orbicon

- Physical frames
- Operation
- Effect of frost


Photo: Orbicon

Hanningfield STRB (United Kingdom)
1,275 tonnes of dry solids per year (16 basins (4.2 Ha)

Photo: Orbicon

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Esbjerg STRBs (Denmark)

Environmentally friendly operation

- Operational reliability
- Long-term sludge solution
- Flexible operation


Photo: Orbicon

- No problems with winter operation
- Very low operational costs and low energy

- Release of waste water treatment capacity
- No use of chemicals (polymers) for dewatering

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Environmentally friendly operation

- Better working environment
- Non-polluting dewatering
- Reduction of CH_4 and NO_2 emission
- Reduction of transportation costs
- Mineralisation of Hazardous Organic Compounds
- Good reduction of the Pathogenic micro-organisms
- Recycling of the sludge residue

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Final remarks

- Sludge quality – Climate - Testsystem
- Area load (Kg ds/m2/year or kg org. Matter/m2/year)
- Filtrate measurement (L/sec/m2)
- Number of basins - Ratio between loading- and resting days
- Large scale systems
- Emptying
- Environmental impact of the sludge treatment methods
- Emissions and Energy

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Energy and fertilizer quality (savings)

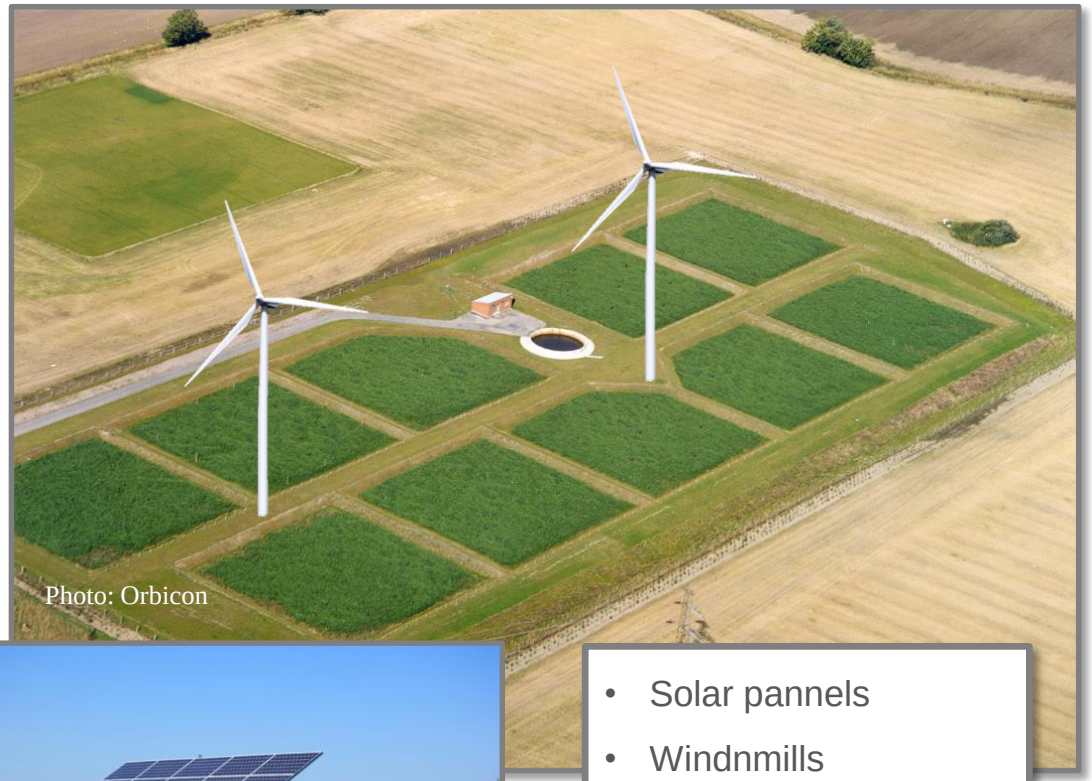
Photo: Orbicon


Photo: Orbicon

- Solar pannels
- Windnmills
- Recycling on agricultaral land


Photo: Orbicon

Thank you for your attention

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