CONSTRUCTED WETLANDS

(Reed bed technology)

Dipl.-Ing. Wolfram Sievert
Mizan Consult FZE

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- Introduction
- Reed bed technology for waste water
- Examples worldwide
- Reed bed technology for sewage sludge
- Reed Bed technology for sewage lagoons
- Discussion

Wolfram Sievert
w.sievert@mizanconsult.com

Company Profile

WOLFRAM SIEVERT

Degree:

University of Applied Sciences Suderburg, Germany

Dipl. Ing. (FH) Environmental technology:

Branches of study:
1. Waste management
2. Waste water management

Occupation:

6 Years Consulting Office Blumberg-Engineers, Germany

2 Years Waagner Biro Gulf LLC, Dubai

1 Year Bauer Emirates Environment, Abu Dhabi

Since 2008: Mizan Consult FZE, Dubai

Wolfram Sievert
w.sievert@mizanconsult.com

Reed bed technology, History

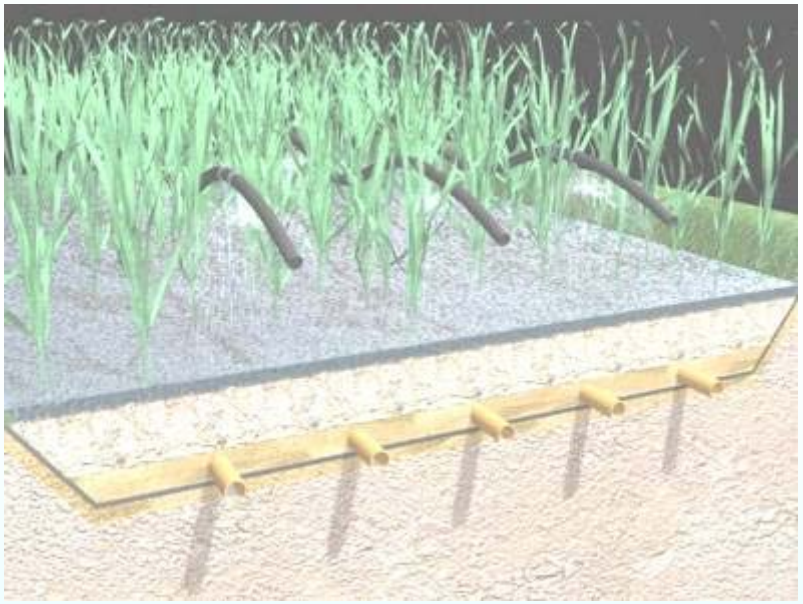
- Invented by Kaehte Seidel, Germany, 1950
- Started for single family houses in rural areas
- Technology spread over Europe and US
- Large municipality and industrial applications
- Nowadays more than 10.000 systems in Europe
- Since 2005 more than15 systems in Qatar, Oman, UAE

Content

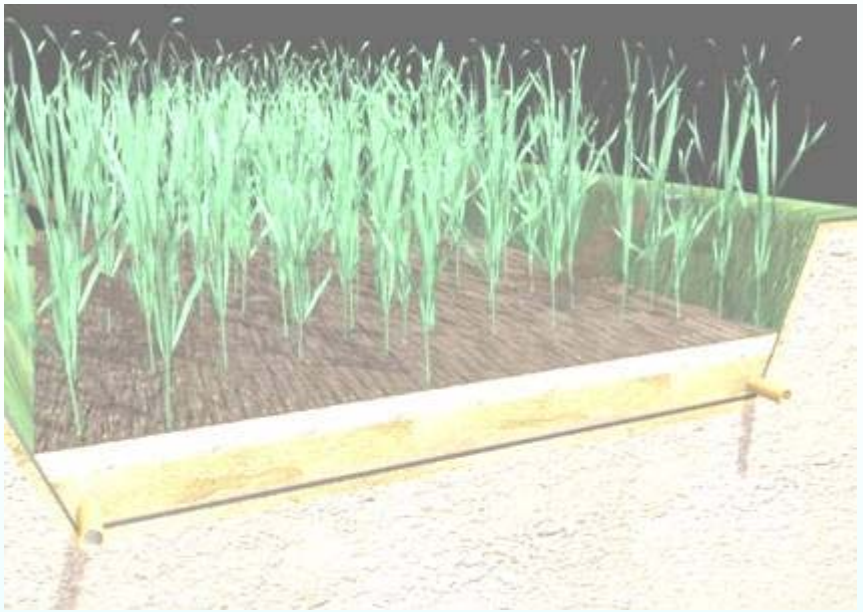
- Reed bed technology
- Sewage
- Sewage Sludge
- Lagoons

Technology

Constructed wetlands (Reed Beds) for treatment of sewage, storm water, sewage sludge, ponds, lagoons and pre-treatment of water works



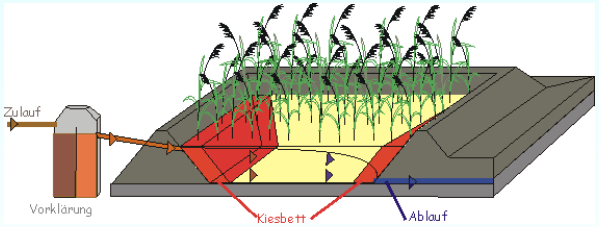
Reed Bed for sewage or storm water



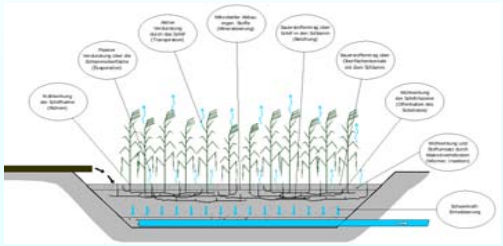
Reed Bed for sewage sludge

Reed bed technology

Self-preserving biozinose filter

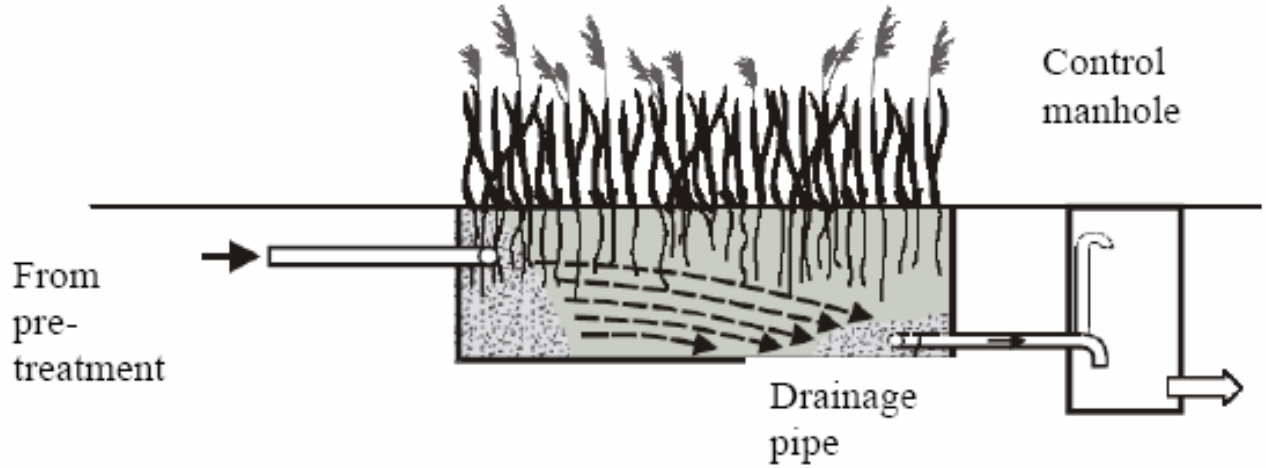


- Filtration processes (SS)
- Drying and mineralisation (SS, Parasites, Faecal Colif.)
- Microbial and fungal decomposition of organic matter (BOD, COD)
- Chemical and physical precipitation and adsorption processes (Phosphate binding)
- Aeration by the reeds, aerenchym (Nitrification)
- Anaerobic zones, water saturated (De-nitrification)
- Prävention of clogging effects by the continuous growth and decay of roots and stems

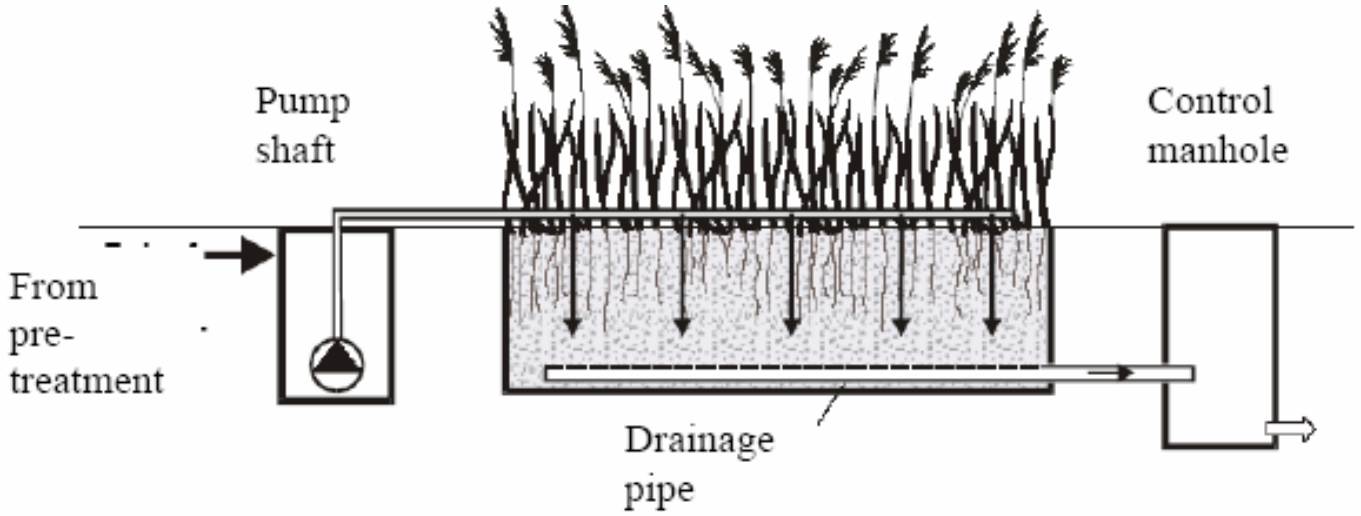


Overview of reed bed technology

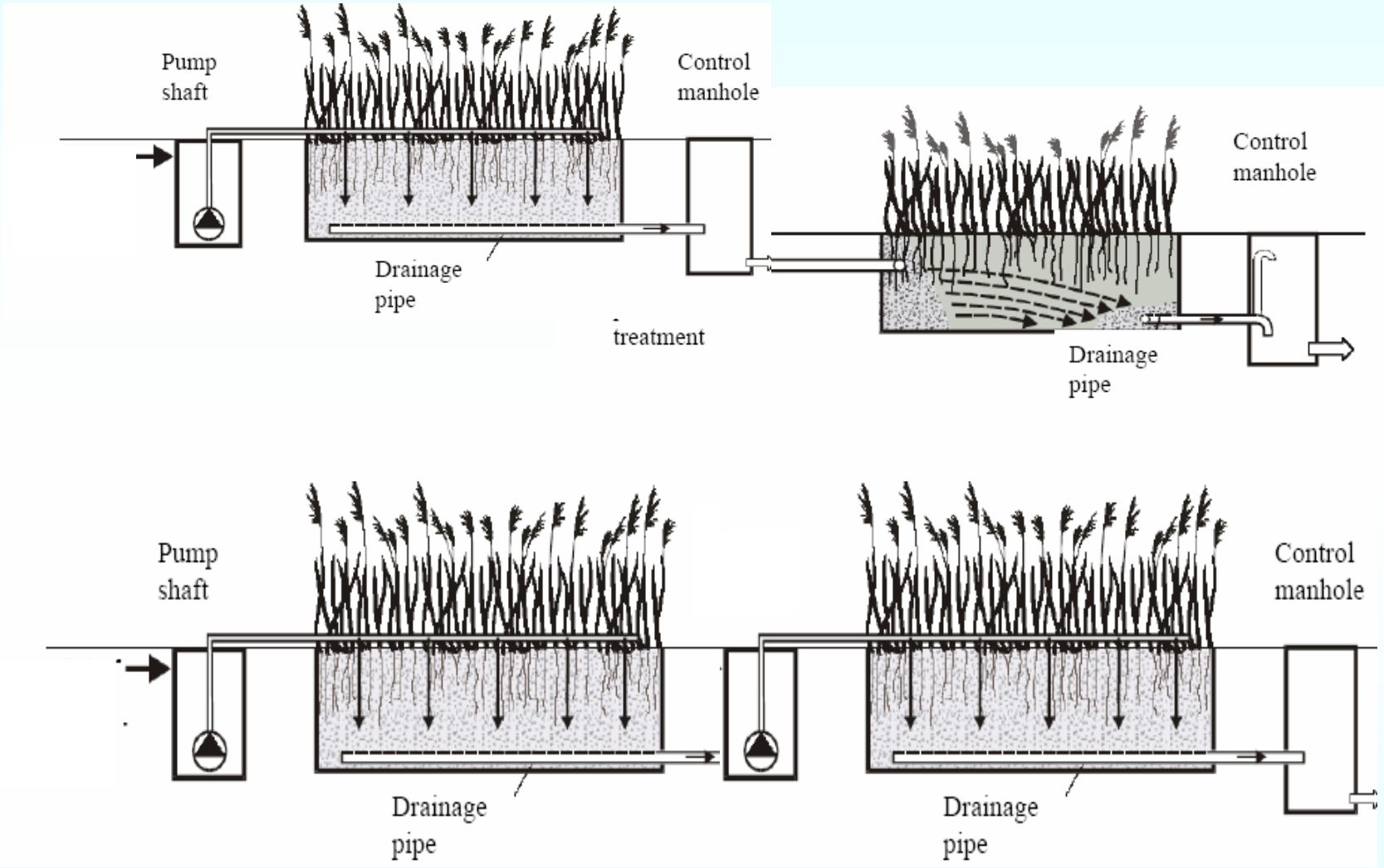
Horizontal subsurface flow Reed bed



Vertical subsurface flow Reed bed



Overview of reed bed technology



Reed bed technology, German design parameter

Reed bed for pre-treated sewage

	Design criteria	Design criteria
Horizontal filter	≥ 5 m²/person min. 20 m²	≤ 16 g COD/(m²*d)
	Flow ≤ 40 mm/d = 40 l/(m²*d)	depth ≥ 50 cm
Vertical filter	≥ 4 m²/person min. 16 m²	≤ 20 g COD/(m²*d)
	Flow ≤ 80 mm/d = 80 l/(m²*d)	depth ≥ 50 cm (better 80 cm as in former times)

Calculated influent: mechanically treated wastewater with a specific BOD of 40 g BOD/(P*d) and 100 l/(P*d)

Reed bed technology, design parameter raw sewage

	Design criteria	Design criteria
1. Step Vertical filter	≥ 2 m²/person	
	Flow ≤ 120 mm/d = 120 l/(m²*d)	depth ≥ 30 cm
2. Step Horizontal filter	≥ 3 m²/person	
	Flow ≤ 80 mm/d = 80 l/(m²*d)	depth ≥ 30 cm

Reed bed technology, raw sewage, grinder pump lift station (only mechanical equipment)

Reed bed technology, raw sewage, inflow

Top: Raw sewage inflow point before operation

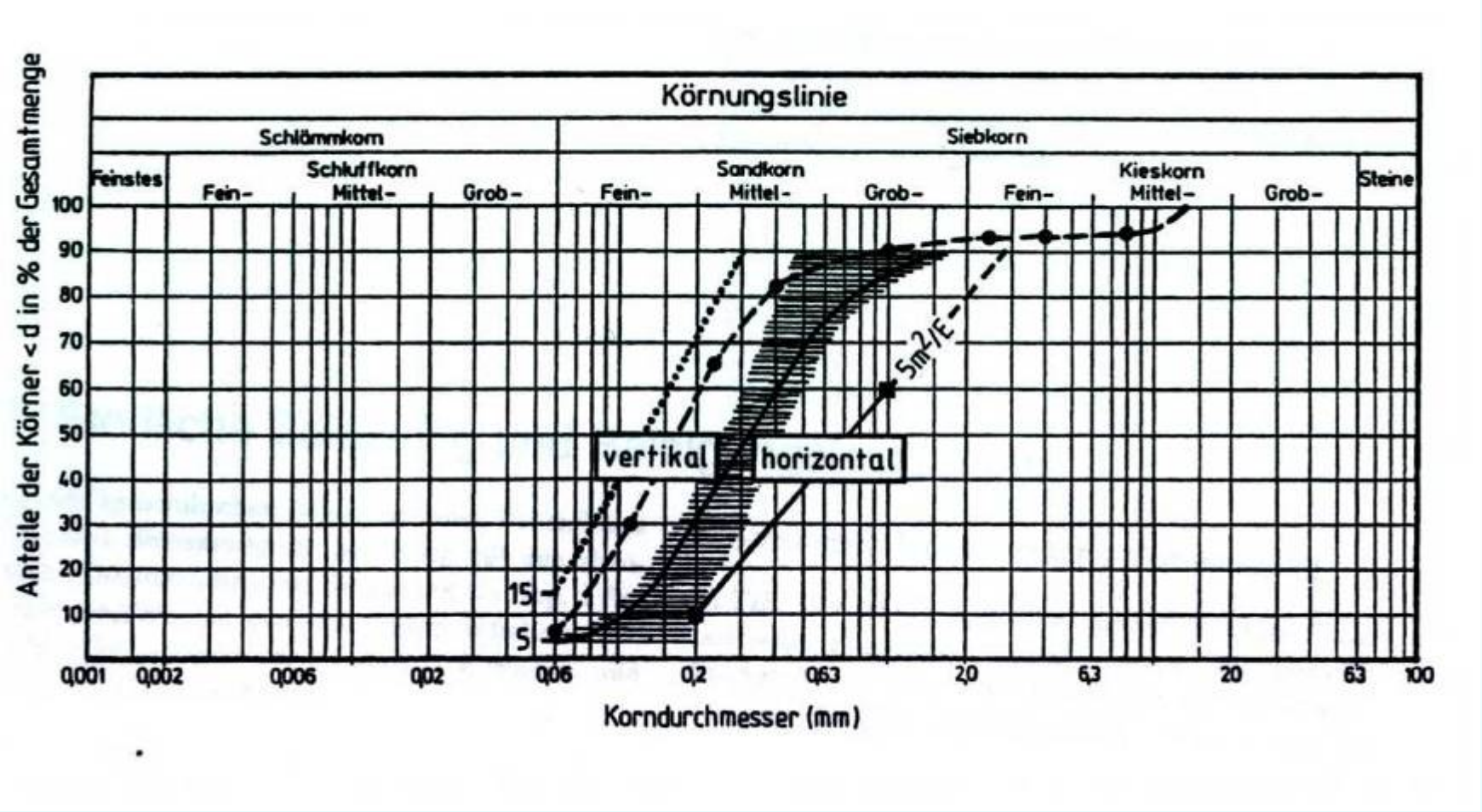
Right: Raw sewage inflow point after 2 years of operation

Reed bed technology, raw sewage, mineralized

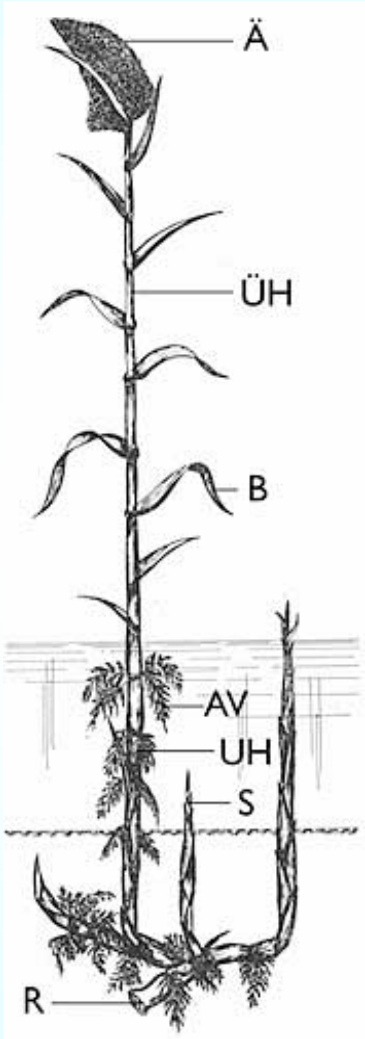
Reed bed technology, design parameter for ME

	Design criteria	Design criteria
Stage A Vertical filter	≥ 1.2 – 2.5 m²/person ≤ 50 [g SS/(m2*d)]	
	Flow ≤ 60 -120 mm/d = 60 -120 l/(m²*d)	depth ≥ 30 cm
Stage B Vertical filter	≥ 0.8 - 3 m²/person ≤ 20 – 40 [g COD/(m2*d)]	
	Flow ≤ 40 - 80 mm/d = 40 - 80 l/(m²*d)	depth ≥ 60 cm

Reed bed technology, filter material



Reed bed technology, reed plants



Phragmites australis
(common reed)

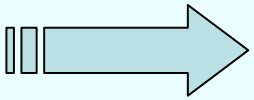
- Endemic species
- Sewage adapted

Advantages - Disadvantages

- Easy to maintain
- Long lasting system (>15 years)
- Use of local material
- Low or no energy consumption
- Reuse of the cleaned wastewater for irrigation or in the buildings as toilet flush water
- No problems by pause times or under loading
- No problems by short time overload
- BUT: 2-5 m²/PERSON

Green Buildings (LEED)

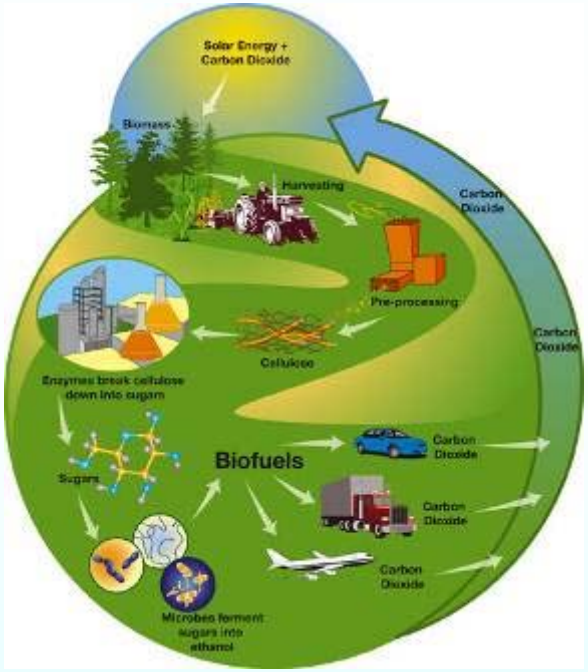
- Treatment of storm water
- Reduce storm water runoff (Stormwater in Reed Bed)
- Creation of habitate
- Biodiversity
- Reduce Water consumption (Reuse in Building)
- Reduce Fresh-Water for irrigation
- Use of local material



10 LEED points

Reed Bed Technology, Environmental benefits

- CO_2 capture and storage
- Protection of ground and sea from sewage discharge
- Mesoclimate enhancement
- improve and maintain biodiversity
- increase environmental complexity
- recharge of groundwater
- Increase ecological resilience



Reed Bed Technology, Human benefits

- Better Mesoclimate
- Green belt recreation areas
- Feeling of an eco-friendly country
- Additional leisure time resources
- Educational spaces for teaching sustainability
- New jobs in the biomass-economy

Reed Bed Technology, Economic benefits

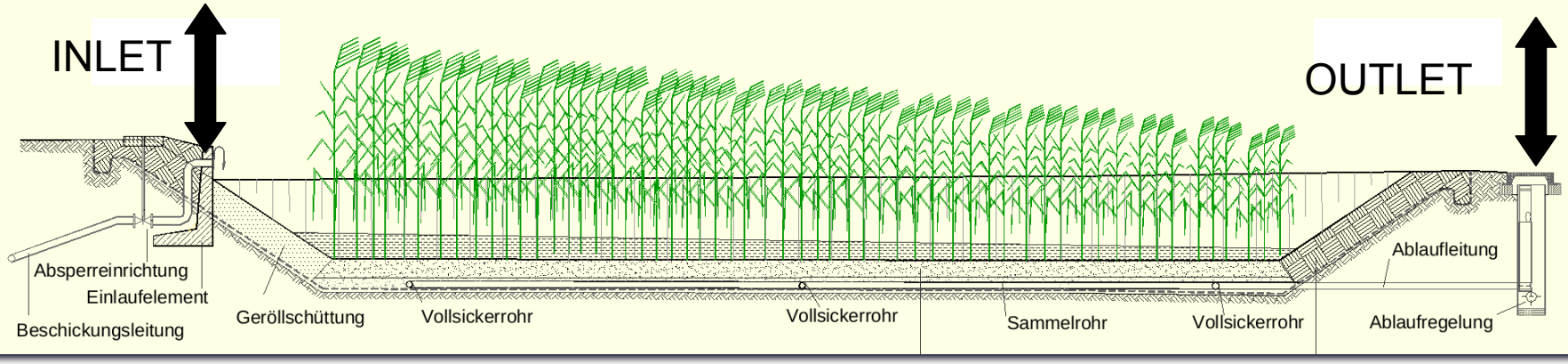
- Saving on water production and storage
- Creation of tourism facilities
- Improvement of farming
- Production of bio-fuel and eco-building materials from reed plants

Products from reed plants

Biofuel

Eco Building materials

Sewage Sludge Mineralisation



Sewage Sludge Mineralization, Utilization

- Watercontent 40 - 75%
- Carrier of nutrients with slowly nutrients delivery
- Stable structure and high waterstorage capacity (like humus)
- Use in
  - → Agriculture
  - → Landscaping
  - → Humusproduction

Disadvantage

- The definition of the product is still „sewage sludge“

Sewage Sludge Mineralization, Advantages

- No sludge disposal
- No energy
- Low maintenance
- No spare parts
- Stock of humus / fertilizer
- High value of product

Sewage Sludge Mineralization, Examples

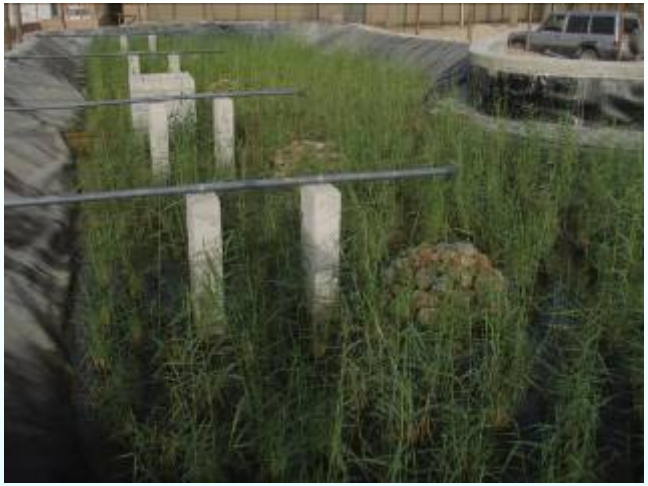
09/2003

07/2004

Sewage Sludge Mineralization, Examples

3 plants in the Middle East

- Qatar, Al Khor 10,000 p.e.
- U.A.E., Dubai 240 p.e.
- Oman, Zighy Bay, 1,400 p.e.



Reed bed technology, design parameter sludge

60 – 120 kg DS/m²x a

0.15 – 0.3m² / p.e.

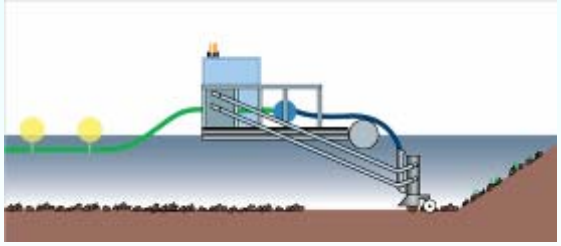
Enhancement of sewage lagoons

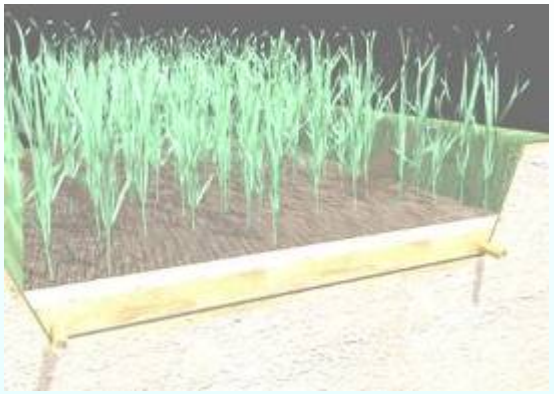
- Sludge evacuation boats
- Sludge drying reed beds
- Sedimentation reed basins (inflow)
- Reed bed as additional treatment step

Enhancement of sewage lagoons

Sludge removal

- Sludge suction boat
- Sedimentation and mineralization beds
- Sewage sludge humification

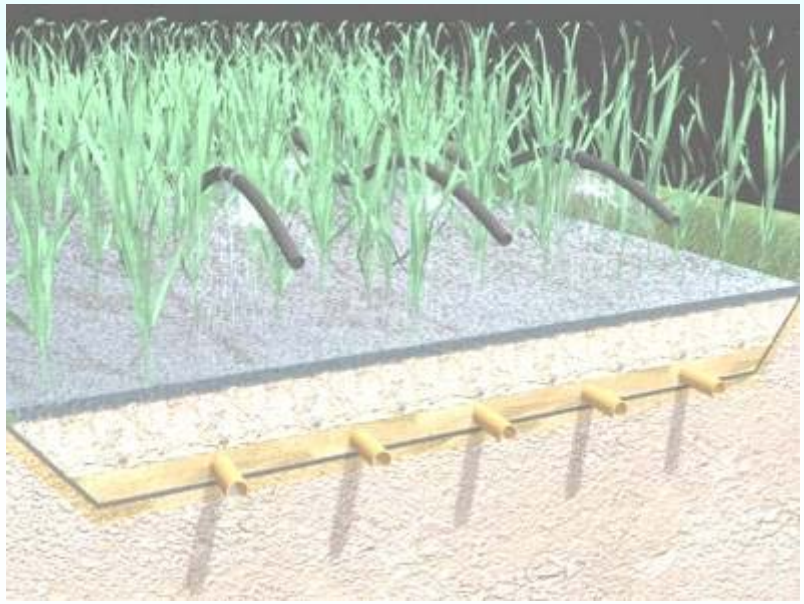




Enhancement of sewage lagoons

Enhancement of sewage lagoons

Reed bed filter at inflow



- SS removal and mineralization
- BOD/COD removal
- Nitrification
- DO enrichment

Conclusion

Sustainable and eco-friendly sewage treatment technologies are available and proven in the Middle East.

Mizan Consult provides the consultancy services to implement these technologies.

Thank you !