# Natural Treatment of sewage sludge in Reed planted mineralization beds

## Description of the Reed Bed Sludge Dewatering Technology:

Domestic sludge is dispersed onto reed beds. The origin of the sludge can be septic tanks, anaerobic digester, aerobic waste water treatment plants with or without sludge stabilisation. There is no need of thickening of the sludge before it is dispersed onto the sludge dewatering reed beds. The main amount of water from the sludge is trickling vertically through the sand filter layer into a drainage system on the bottom of the sealed basins (polyethylene liner) by gravity, like in conventional sludge drying beds. The reed plants grow through the overlying sludge and develop numerous roots and shoots in the substrate. This leads to a forced dewatering and mineralization of the gravity dewatered sludge. The further dewatering is driven by evapotranspiration. The sludge volume declines to about 10 % of the initial volume. The gravity dewatering of new dispersed sludge through old below sludge layers is possible dew to the existence and continous growth of rhizomes and stems which increase the permeability of the deeper sludge layers. The reed planted sludge dewatering reed beds work for a period of 4 to 12 years without sludge removal. During this period the sludge layer increase slowly to a thickness of up to 1.2 m. The resulting product of the dewatering and mineralization 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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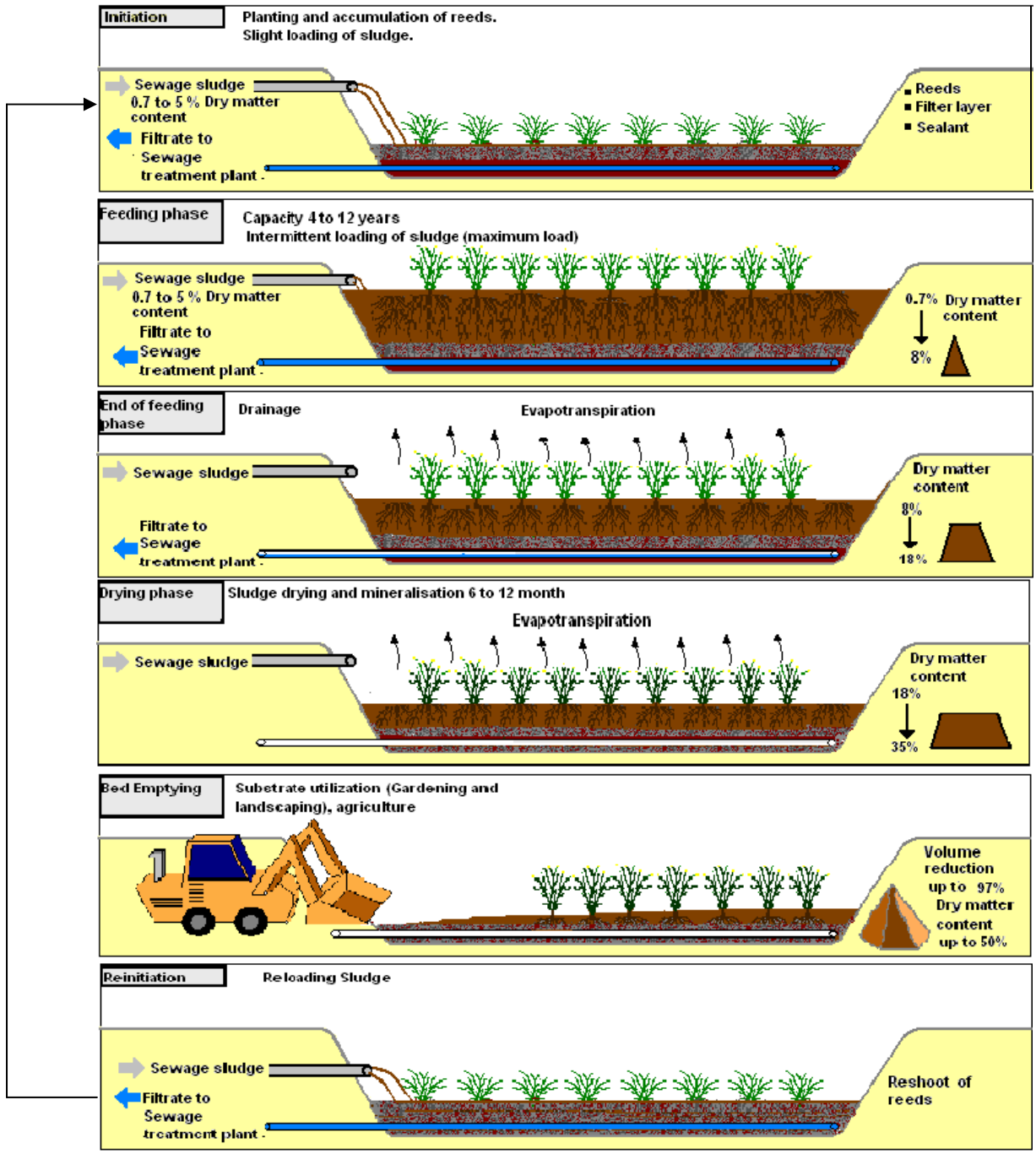
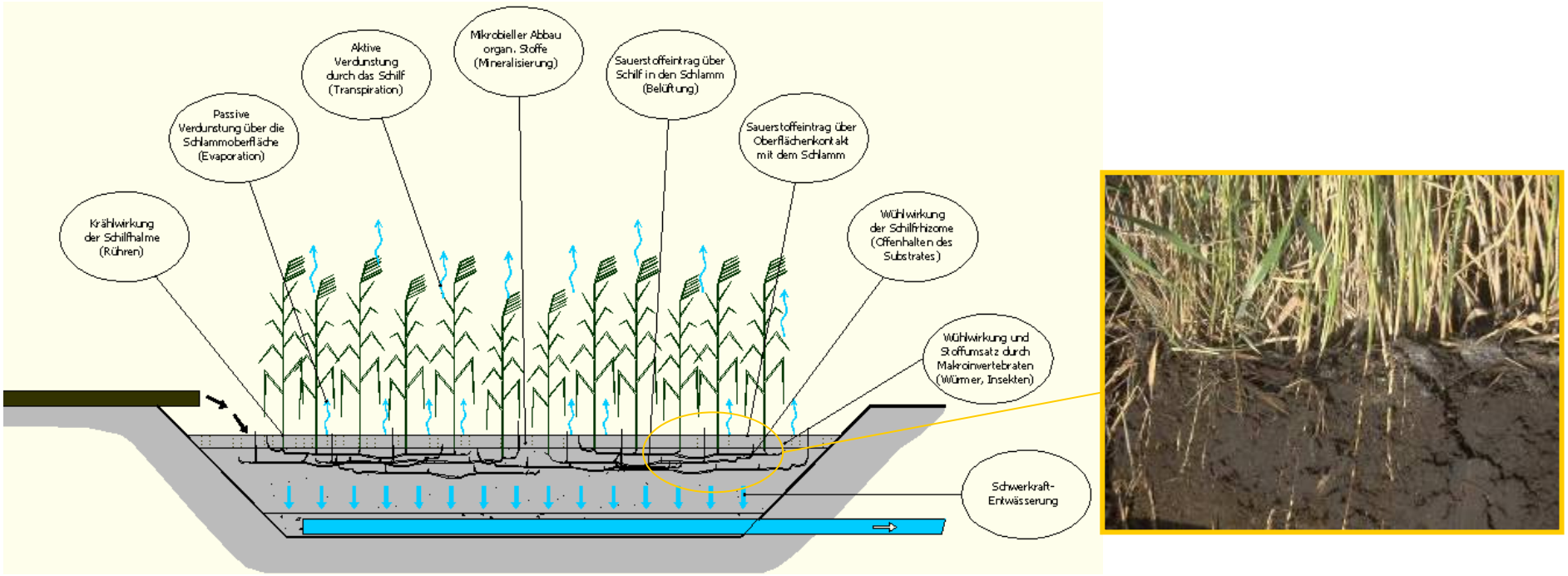
# Flowscheme of operation



# Characteristics of sludge conditioning in reed beds

- Periodically loading following a specific schedule
- Load depending on the dry matter content, degree of stabilisation and climate
- Sludge removal after 3 to 7 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)




Relevant Processes:
Stiring of the blades, evaporation, transpiration, microbial dismantling of organic matter, aeration by the reeds and over the surface, burrow by rhizomes and worms, gravity dewatering

# 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 sludge humus. It is well dewatered and has a crumbly structure.

# Goals of reed bed sludge dewatering and mineralisation

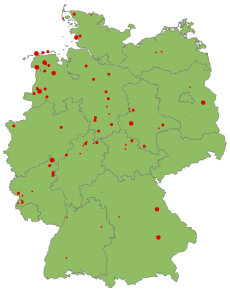
1. Dewatering of raw sludge to a dry matter content of about 50 %, while the volume is reduced to 10 %.
2. Reduction of costs for electricity, maintenance, repairing, personnel, and operation (analysis of soil and sludge, tankering etc.)
3. Sanitising of the sludge humus by composting it for another year after an operation period of 4 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.

## Potentials of the technology

The sludge of 2 to 6 inhabitants (person equivalents) can be dewatered per m² reed bed area depending on the specific sludge quality (watercontent, method and degree of stabilisation) and climate. A dry matter content of about 30 % can be achieved within a short period, making the reed bed dewatering a real alternative to thickener and chamber filter press and wire press. After a longer operation dry matter contents over 60 % are possible. The resulting sludge humus is completly stabilised (non-smelling) and has a crumbly earthy structure and a high waterstorage capacity (like humus), which can be used as garden mould without additional costs. Thus the cycle of nutrients can be completed. Complete sanitising can be reached by storing the sludge humus for a period of one year outside the reed beds. Following applications are possible for reuse of the mineralized sludge:

- Agricultural recycling
- Gardening
- Recultivation
- Thermal recycling

# Exisiting plants



Actually > 100 plants running in Germany with a complete capacity of more than 1 Mio PE

Sewage sludge dewatering in Al Salt, Jordan, Pilot System 4 x 160 m², 2011-2013

*Tests in hot climate (Aegypt, Thailand, Jordan and U.A.E.) have proved that this technology has a much higher efficency under hot climate conditions then in Europe, because of higher evapotranspiration, faster microbial dismantling, longer period of vegetation and the faster and stronger groth of the reeds.*

Sludge mineralization reed bed for Six Senses Resort in Zighy Bay, Oman (300 cbm sewage per day)

## 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 4 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.

No sludge storage or thickening required.

No odor will arise, because the dewatering and mineralization process is running completely under aerobic conditions.

Wildlife enhancement is an important secondary goal of reed bed treatment systems.

# Implementation in the Middle East

Mizan Consult FZE has already designed and supervised construction and operation of 5 sludge mineralization reed beds in the Middle East over the last 8 years (U.A.E., Bahrain, Oman, Jordan). The performance of these systems confirmed that this sludge treatment technology has a higher efficency in the ME compared to Europe.
Limitations of this technology are most importantly the required area to locate the reed beds. Where sufficient land is available this technology gives better performance over decades of activity at considerable short and long-term savings, as well as providing significant additional environmental benefits.

Mizan Consult FZE can support consultant and decision makers during the decision process with data and information about the sludge mineralization reed bed technology compared to conventional solutions (drying bed, filter press, belt press, centrifuge) or can do a complete feasibility study with comparison of investment and running costs. The complete design and tendering of the reed bed system and construction supervision can be provided by Mizan Consult FZE. The STP operators can be trained and later supported to run the system by themselves without any additional costs for chemicals, energy, spare parts and work force.