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33 WILLOW EVAPOTRANSPIRATION BEDS WITHOUT DISCHARGE FOR HANDLING OF HOUSEHOLD WASTEWATER & BIOMASS SHORT ROTATION WILLOW COPPICE FERTILISED WITH NUTRIENT FROM HUMAN URINE MIXTURE

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ABSTRACT

Storstrøm County and A & B Backlund ApS have been co-operating in a project collecting experiences and making investigations regarding the oldest evapotranspiration bed without outlet in Denmark situated in Storstrøm County. Results from the project Danish EPA M226-0025 "EXPERIENCES AND EXAMINATIONS FROM A EVAPOTRANSTIRATION BED WITHOUT DISCHARGE AT TAPPERNØJE" are presented in this paper. The bed has worked very stable since 1992. A water balance has been calculated estimating the evapotranspiration of the bed. Contents of nutrients in the wastewater and nutrients, heavy metal and organic compounds in the soil have been analysed. Steam production of the willows has been estimated. A & B Backlund ApS is engaged in further development of the systems.

A small part of an international project FAIR5-CT97-3947 (1998-2002) "BIOMASS SHORT ROTATION WILLOW COPPICE FERTILISED WITH NUTRIENT FROM MUNICIPAL WASTEWATER (BWCW) is dedicated fertilising willows with human urine mixtures. The experiences has up to now been very positive and efforts are made to prolong the project and establish further demonstration projects.

Willow evapotranspiration beds, willow vegetation filter, wastewater treatment, human urine fertiliser, no-mixing toilets, diverting toilets, separation toilets, ecological engineering, ecological sanitation

EXPERIENCES AND INVESTIGATION FROM THE OLDEST EVAPOTRANSPIRATION BED WITHOUT DISCHARGE IN DENMARK

There are 30 – 60 Willow Evapotranspiration Beds in Denmark primarily used for scattered houses. The oldest was established in 1992 by "Pilehuset" a shared living complex as a part of

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an institution for handicapped "Marjatta" situated in Tappernøje in Storstrøm County. The willow bed has since 1992 received and evapotranspirated approximately 1 m3 of wastewater a day from eleven people plus rainwater falling on the bed (1).

The construction of the willow evapotranspiration bed

In principle the bed is like a container planted with willows at the top and with a waterproof geomembrane 0,7 mm LDPE at the bottom and along the sides receiving wastewater from a sedimentation tank by gravity and spread at the bottom of the bed through a Ø 160 mm pipe with a Ø 100 mm hole every fifth meter .The surface is 707 m2 (64 m2/p) and the depth from 120 – 135 cm. The layers above the plastic membrane consist of 10 cm´s of sand, 10 cm´s of pebble gravel, 70 – 85 cm´s of raw soil by the inlet well and the outlet well with 30 cm´s of humus at the top. The raw soil and the distributing layer are separated by a fibre textile preventing roots to enter the pipe. The cubic content has been calculated to 690 m3 above the fibre textile and 150 m3 under the textile. The density of planted willows was about four plants/m2 (1).

Experiences and Examinations

*The establishment and construction of the bed and experiences with working stability and operating demands has been described.
*A mass balance for water has been worked out
*Contents of nutrient in the wastewater has been measured
*Contents of nutrient, heavy metals and organic compounds in the soil has been measured
*A budget for nutrients has been estimated
*Annual growth of the willows has been estimated
*The growth of different clones has been discussed (1).

Results

*The working stability of the bed is very good
*The evapotranspiration of the bed has been very good, 1310 – 1370 mm/year.
*Up to 60 percent of the stored and evapotranspirated water was rainwater.
*There are no indications that heavy metals will be a limiting factor for the future handling of the soil.
*Salt can be a limiting factor for growth and evapotranspiration but can be pumped out during low water levels summer time.
*Use of diverting toilets can reduce the amount of sodium chloride and surplus of nutrient directed to the bed (1).

Future R & D

*Use of breaded optimised growing willow clones with a even bigger evapotranspiration potential in order to minimise the surface and cost of the bed.
*Experiments with discharge of rainwater from the surface before contact with the wastewater in order to minimise the volume, the surface and the cost of the bed.
*Experiments with raising the pore volume in the beds from approximately 35 % to 80 %.
*Experiments with growth and evapotranspiration from willows growing under above conditions.
*Estimation of critical salt levels.

New Test Projects

Two beds have just been established due to the principles with discharge of rainwater and breaded clones. One is established in Denmark and one in Germany. A third one is planned for Gotland, Sweden.

BIOMASS SHORT ROTATION WILLOW COPPICE FERTILISED WITH NUTRIENT FROM MUNICIPAL WASTEWATER (BWCW)

Biomass short rotation Willow Coppice is a very interesting vegetation to close the loop and work as a vegetation filter for a more sustainable society. Many types of "wastewater"/rest products can be used to irrigate and fertilise the crop. In the R & D project **FAIR-CT97-3947 (1998 – 2002)** there are test sites in Sweden, Northern Ireland, Greece and France and different types of wastewater is used. In Northern Ireland and Greece the wastewater comes from big central waste water treatment plants, in France the willows can enjoy wastewater from a food processing industry and in Sweden the wastewater comes from a low technology wastewater pond system. All those concepts are good and reasonable end-of-the-pipe-solutions to transform potential problems for the water recipients into biomass resources (2).

BIOMASS SHORT ROTATION WILLOW COPPICE FERTILISED WITH HUMAN URINE MIXTURE COLLECTED FROM DIVERTING TOILETS

In Sweden an other concept is also tested and demonstrated in the above project. Using diverting/no-mixing toilet sanitation technology human urine from a school is collected separately and transported by truck to fields with willows. Here it is automatically mixed with water and irrigated through a drip irrigation system. The human urine could also very easily have been collected from waterless urinals in schools, sports facilities, offices, camping sites etc.

The final results with among others mass balances of nutrient and heavy metals will be reported in June 2002. The steam production of the willows has been very good on the areas fertilised with human urine mixture. In year 2000 a total of 80 kg N/ha (content in human urine, pure water and precipitation) resulted in an average growth of 13,24 DM t/ha (2).

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