Registered project of the world exposition

ECOTECHNOLOGICAL WASTE WATER TREATMENT IN LAHSTEDT

*NATURNAHE ABWASSERBEHANDLUNG IN LAHSTEDT**

Ecotechnological methods for the treatment of waste water and sewage sludge using reed and pond biotopes in Lahstedt- Gadenstedt

Naturnahe Abwasser- und Klärschlammbehandlung durch Schilf- und Teichbiotope in Lahstedt - Gadenstedt

I Reed bed treatment system

I Schilfkläranlage

II Combined waste water treatment using unaerated ponds and planted soil filters

II Mischwasserbehandlung durch unbelüftete Teiche und bepflanzte Bodenfilter

III Sewage sludge dewatering and mineralisation in reed beds

III Klärschlammvererdung in schilfbepflanzten Trockenbeeten

Federal Republic of Germany - Federal State Lower Saxony - District Peine

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*official project title of EXPO 2000

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Ecotechnological waste water treatment in Lahstedt

EXPO2000 HANNOVER

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Technical summary

The council of the municipality of Lahstedt has decided to renovate its remaining three conventional sewage treatment plants with sustainable and ecologically sound methods in order to limit the consumption of natural resources.

Artificial wetlands for waste water treatment, which have low operational costs, are established in various forms as a pilot project in the village of Gadenstedt (2.600 P.E.). The project is divided into three parts: polishing biotope (reed bed treatment system); combined waste water biotope (cascade of ponds and reed beds); reed planted dry beds for sewage sludge.

Polishing biotope

The processed sewage effluent from the existing trickling filter undergoes polishing treatment. The total area required is 1,1 ha. of which 7.300 m^2 is covered by reeds (Phragmites) in four vertically percolated soil filters. These filters are sealed with a lining. When the existing trickling filter treatment plant becames dilapidated in years to come, the reed beds should function as the main biological purification step. This application will be piloted during the course of the project.

The purification performance of the existing sewage treatment plant is improved by advanced nitrification, phosphate elimination and reduction of pathogens, easily fulfilling the existing authority limits.

Combined waste water biotope

The impact on the receiving river from combined water discharge is reduced (in terms of pollutant load per hectare of paved area) far below the legal requirements. This will be achieved through an innovative cascade of unaerated ponds (8.820 m^2 net)and a final soil filter planted with reeds (1.330 m^2 net).

The construction and operational costs are below those of concrete storm water tanks with overflow.

A secondary wetland complex with valuable biotope functions has been created.

Sewage sludge dewatering and mineralization in reed beds

The scarcely known method of dewatering and stabilising sewage sludge in dry beds planted with reeds has been in practice in Lahstedt for nine years at two other treatment plants. Dry matter content of over 50 % is currently achieved. In the future, all of the sewage sludge deriving from the four treatment plants in the villages of Lahstedt will be dewatered and stabilised with the same energy- saving method.

A build-up of surplus sludge which cannot be put to agricultural use in the winter months is avoided. Transport costs are lowered by volume reduction and new

options for utilisation and recycling of this valuable nutrient source in landscaping, horticulture and recultivation can be explored.

The total project „Ecotechnological treatment of waste water and sewage sludge in Lahstedt“ will be presented as a registered and officially sponsored project at the world exhibition EXPO 2000 in Hanover.

Key-words:
- constructed wetlands for waste water treatment
- vertical subsurface flow reed bed treatment system
- advanced treatment of domestic waste water
- Phragmites australis
- open lagoons and planted soil filter basins for detention and treatment of combined sewer owerflows
- sewage sludge dewatering and mineralization in reed beds

1. General project description

Introductory remarks

The municipality of Lahstedt is situated in the district of Peine, 52 km away from Hannover, capital of the federal state of Lower Saxony in Germany.

The municipal area consists of 43 km^2 with 5 villages and a total of 10.100 inhabitants. Currently there are four technical sewage treatment plants from the early sixties (trickling filters), one of which was completely reconstructed (activated sludge process) in 1993.

This new conventional sewage treatment plant achieves purification limits far above the legal requirements. Running costs are, however, very high (specialist staff, energy costs).

It is the aim of the municipality of Lahstedt to introduce and demonstrate sustainable, ecologically sound, new sewage treatment processes which conserve resources.

It was decided to use treatment processes requiring extensive land (soil filter, open lagoons) as this resource is cheaply available in the rural area.

As the majority of the German population (> 90 %) is linked to sewerage and sewage treatment plants, the current main impacts on receiving rivers consist of the remaining pollution loads of the cleaned waste water (project part I) and, in combined waste water sewage systems, the storm water overflow discharge (project part II). In addition, the safe and cost efficient treatment and disposal or exploitation of sewage sludge has become a critical problem in many areas (project part III).

The innovative, appropriate reconstruction concept of the municipality of Lahstedt-Gadenstedt includes all three project components.

Project part I

Polishing biotope

1. Task description

The village of Gadenstedt in the municipality of Lahstedt has an old trickling filter sewage treatment plant dating from 1959.

Instead of demolition and conventional reconstruction, the most important parts of the old sewage treatment plant should continue to be used. The remaining pollution of the treated waste water should be minimised. The treatment capacity will in the future be extended from 2.600 to 3.000 P.E. (person equivalents).

An analysis of the performance data of the existing technical treatment plant gives an initially positive impression: near-total degradation of organic carbon constituents (BOD_5, COD) and good nitrification performance within the legal limits.
The changes in inflow water volume from 500 m^3 / day during summer up to more than 2.000 m^3 / day in winter result, however, in differences in pollution load efficiency from >90 % in the summer to <80 % in winter. This problem of the impact of high sewer infiltration water is very common in sewage systems and can be solved only on a long term basis.

Short term solutions generally fail due to the huge financial cost. Legal and administrative factors often present additional obstacles, for example in renewal of a large number of domestic sewage pipes.

Tackling the root cause of high volumes of sewer infiltration water in sewerage systems is both desirable and necessary. However, in this particular case the environmental quality can be improved by using end-of-the-pipe technology, which can remedy the situation more effectively, more rapidly and more cheaply.

Because of the eutrophication problems in the North Sea and the Baltic Sea, an advanced level of treatment of the nutrients phosphorus and nitrogen is also desirable for sewage treatment plants under 5.000 P.E. The existing conventional treatment plant shows unsatisfactory degrees of efficiency with regard to P-elimination and denitrification.

Furthermore the elimination of pathogens by technical sewage systems is known to be low compared to planted soil filters.

The project shows that old trickling filter systems don't need to be replaced by new activated sludge systems, but can be cheaply modernised by adding planted soil filters. The operational period of the existing system could potentially be extended in this way.

2. Planned construction

- Construction of a new sewer from the old sewage treatment plant to the nearby polishing biotope.

- Construction of a pumping station for intermittent waste water loading of the polishing biotope by a low pressure distribution system.

- Construction of a reed bed treatment system within an area of 1,1 ha, divided into four vertical flow soil filters planted with phragmites communis syn. australis. The drained basins are lined with a polyethylene membrane and are 1,4 metres deep. The planned freeboard allows storage of a volume up to 2.000 m^3 above the filter substrate. The four different filter substrates are used for research purposes. Besides local topsoil material, coarse-grained filter materials and organic mixture compounds are used.

- Construction of an automatic discharge outlet weir with electromechanical control to adjust variable through-flow conditions.

Project part II

Combined waste water biotope

1. Task description

Receiving rivers are damaged by storm water overflow in combined waste water sewage systems.

Combined waste water transports (in diluted form) raw sewage and pollutants which originate from deposits on paved areas.

Hydraulic discharge peaks increase the drift of aquatic species. Conventional concrete storm water tanks with overflow discharge through the sewage treatment plant, leading to a prolonged time of reduced performance and efficiency.

The former method of combined waste water treatment in Gadenstedt did not conform to legal requirements. The permissible pollutant overflow rate of 250 kg COD / ha A_{red} * a was clearly exceeded with a figure of 372 kg COD / ha A_{red} * a.

2. Planned construction

- Construction of a cascade of 2 unaerated lagoons (8.820 m^2) and a final treatment step with a reed planted soil filter (1.330 m^2).

Project part III

Sewage sludge treatment by reed planted dry beds

1. Task description

The current agricultural practice of recycling raw sludge as fertilizer for farming is endangered, increasing restrictions imposed by the mill industry and others, which prohibit the use of products from fields fertilized by sewage sludge.

Sludge processing in Lahstedt should result in securing the agricultural use of the composted sludges on a long term basis. The utilisation of raw sewage sludge in agriculture is expensive in terms of transport costs and hygiene can be a critical problem.

During the winter months, agricultural use is prohibited. This leads to surplus sludge which must be stored.

2. Planned construction

The treatment of sewage sludge in reed planted dry beds has been successfully implemented in two other village treatment plants within Lahstedt and is now extended to the treatment plant in Gadenstedt. The drained and stabilised sewage sludge thus achieves a dry matter content of above 50 %.

2. Expected results

2.1 Polishing biotope

2.1.1 Prolonged use of an existing trickling filter plant with a treated volume from 25 l/s at maximum.

2.1.2 Enhancement of the performance of the existing sewage treatment plant. Reduction of the pollutant loads of the processed sewage effluent in accordance with existing legal standards (COD, BOD_5,N,P, pathogens, filtrable solids). Increase of the buffer capacity of the existing plant with regard to peaks in pollutant load and hydraulic flow peaks under storm water conditions. Extension of the treatment capacity to 3.000 P.E. (person equivalents).

2.1.3 Use of the polishing biotope (artificial wetland) as the main biological cleaning step following future demolition of the conventional treatment plant. This can be piloted in the period leading up to presentation at EXPO 2000.

2.1.4 It is expected to save energy and maintenance costs of more than 70 % in comparison with a conventional technical treatment plant.

2.2 Combined waste water biotope

All combined waste water is now being at least mechanically cleaned; the majority also biologically. The emptying of the storm water tank with overflow no longer occurs through the treatment plant but directly to the receiving river „Fuhse“.

The specific overflow load will be below 64 kg COD / (ha A_{red} * a), well within the limit in Lower Saxony. This system is therefore far superior in efficiency to conventional combined waste water treatment systems with concrete basins. Construction and maintenance costs are clearly lower.

Hydraulic stress impacts on the receiving river are avoided.

A secondary environmental complex with valuable biotope functions is established. This is particularly significant for insects and birdlife. In addition to the adjacent polishing biotope the total area reaches nearly 3 ha.

2.3 Sludge treatment by reed planted dry beds

- Diversification of methods to make use of sludge.
- Reduction of pollutants in sewage sludge.
- Reduction of the transport volume for agricultural distribution to 1/6 of the raw sludge volume.

- Sludge evacuation intervals which correspond to agricultural requirements.
- Natural sludge dewatering and stabilisation at reasonable investment and maintenance costs.

Besides the agricultural use of the final product, new applications for use should be sought in the sectors of landscaping, recultivation, tree nurseries, horticulture and private gardening.

3. Realized results

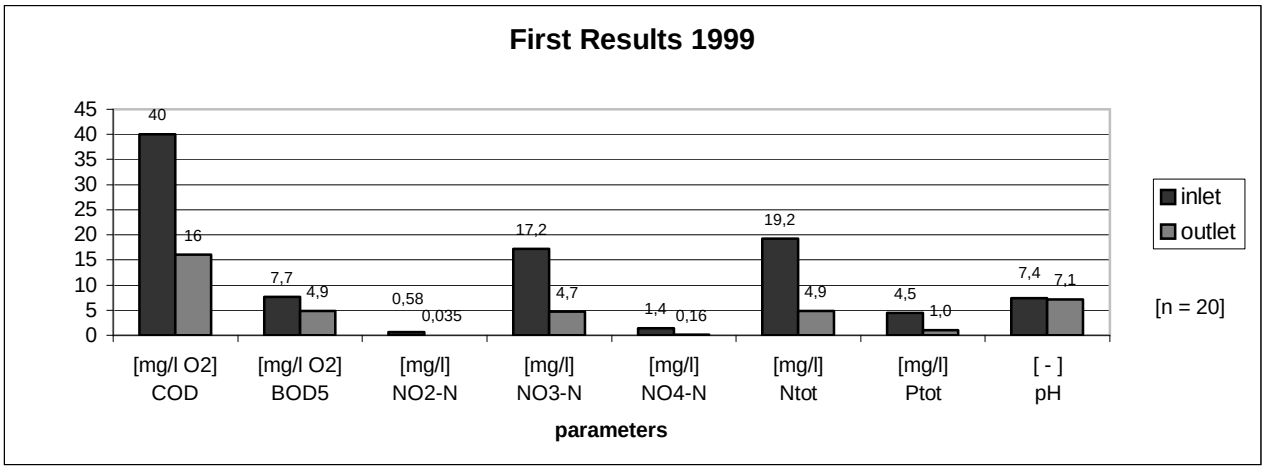

Fig.: Reed bed treatment system

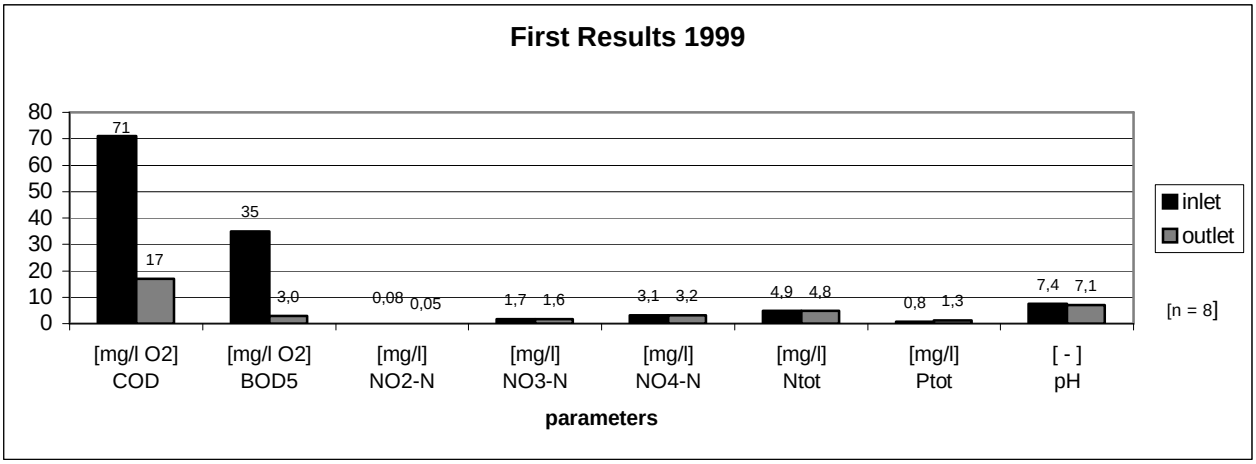

Fig.: Combined waste water treatment

4. General interest and innovative relevance of the project

The project has a pioneering aspect for the comprehensive use of sustainable, low-input ecotechnologies in sanitary engineering. The implemented methods of ecological engineering correspond to the latest technical research results, but are currently not generally accepted technical norms.

The project includes three of the most common problems of domestic sewage treatment.

4.1 Polishing biotope

4.1.1 Reed bed treatment systems have been developed in Germany. Their use consists mainly of rather small systems in rural areas. The project should extend the application of this ecotechnology* on a larger scale.

4.1.2 The use of planted soil filters as a polishing step following existing conventional treatment plants is also comparatively rare. The superiority of planted soil filters in comparison to commonly used polishing lagoons is demonstrated.

*Ecotechnology is defined as the construction and use of complete , natural ecosystems for sustainable production and /or environmental protection purposes.

4.1.5 Natural wetlands are widely regarded to be beyond technical steering mechanisms. This structural disadvantage of reed bed treatment is partially compensated by new automatic steering devices for flow control which can be controlled by staff. A new waste water distribution system is also be dedemonstrated.

4.1.3 The project uses five different filter substrates (including the reed bed section within the combined waste water biotope complex). New research results are expected with regard to this important component of artificial wetlands.

4.1.4 A low energy treatment system is demonstrated, which could make a significant contribution to the reduction of carbon dioxide emissions if wider use in and beyond the European Union is achieved.

4.2 Combined waste water biotope

The increasing legal restrictions on storm water overflow rates have recently resulted in the new construction of concrete storm water basins with overflow.

Such storm water basins show a very inefficient cost-benefit relationship. In contrast, reed-planted soil filters and combinations of final effluent lagoons with artificial reed beds have demonstrated their superior performance in initial pilot plants in the federal states of Baden- Württemberg and Lower Saxony.

- The new plant not only conforms to legal limits (overflow discharge rate of 250 kg COD per hectare of paved area (A_{red}) and year) but actually achieves a much higher performance level than required. The majority of the discharged combined waste water is treated by sedimentation and biological processes and channeled directly to the receiving river „Fuhse“.

- Hydraulic peak loads on the receiving river are buffered.

- Instead of a conventional concrete storm water overflow basin a complex of artificial wetland has been created.

4.3 Sludge treatment by reed planted dry beds

Sludge treatment in reed planted dry beds is well documented in a number of research projects. This proposal promotes wider awareness of this method as part of the project as a whole.

5. Further implementation of the project

The efficiency of the demonstrated ecotechnology is increased under warm climate conditions. This large- scale ecotechnology is expected to be implemented in the European Union and overseas because of the very limited technical equipment required.

These methods are based primarily on land area as a resource, which is more readily available in rural areas of other geographic regions than in Germany, where it is also more expensive.

6. Dissemination of results

Registration as a decentralised project of the world exhibition EXPO 2000 has already led to a high demand for information. During the operation period brochures, videos, workshops and guided tours will be organised.

Of great importance for the presentation of the project within the Union and worldwide is the EXPO 2000 exhibition, 01. June to 31. October 2000.

Scientific papers will be given at several conferences and in technical journals in the period following EXPO 2000.

7. Feasibility and economic aspects

The feasibility of the project as a whole is secure. The necessary approval has been given by all national water authorities. Financial support from the federal state of Lower Saxony and the EXPO 2000 GmbH Hannover has been granted.

A direct financial comparison of the project with a newly constructed, conventional technical sewage treatment plant in the area, which was built three years ago on the same scale*, shows that the expected investment costs are reduced by approximately one third. The operational costs are expected to be consistently 70 % lower.

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