BELGIUM

Kickoff in Flemish wastewater treatment

Driving forces for MBR-application in sewage treatment in Flanders are footprint limitation and reuse necessity. Hybrid MACH 1 (MBR Activated sludge Cost-effective Hybrid) combining MBR-technology and classical activated sludge have been investigated for renovation of existing WWTP's. Two years membrane bioreactor pilot research on WWTP Schilde (Belgium) led to the scenario choice of renovating the plant using MBR. Another MBR case (under investigation) is situated at Heist (Belgium) where a 20.000 PE WWTP has to be upgraded to 60.000 PE including nutrient removal. One of the options is to reuse the treated sewage in the production of potable water. Future research will further focus on combining MBR-technology with other treatment technologies to further optimise investment and operational costs and small-scale MBR-technology.

Aquafin N.V. was founded in 1990 by the Flemish Government as the licence holder for the sewage treatment infrastructure in Flanders (six million population equivalent). The objective is to come to 85-90% treatment by 2010. Aquafin now operates 164 sewage treatment works, 578 pumping stations and 3139 km of piping, and each year realises an investment programme of US$ 150 million (December 1999).

Upon the introduction of the European Urban Waste Water Treatment Directive in 1994 in Flanders, all the WWTP's having a capacity of more than 10.000 PE had to be built or renovated toward nutrient removal. The yearly budget for renovation amounts to 25 million US$. At the moment of writing Membrane Bioreactor (MBR) technology is included in two technical plans (WWTP Heist and WWTP Schilde)

Current situation

MBR *wastewater treatment at Heist*

WWTP expansion with MBR and reusing effluent of WWTP Heist for production of more than four million m³ potable water per year is investigated (figure 1). Several scenarios were considered and evaluated toward cost-efficiency and maximum reuse of the existing infrastructure. A scenario comprising a MBR-reverse osmosis-infiltration technology train is under closer investigation. Ecological and financial aspects make MBR-renovation at WWTP Heist, including reuse preferably.

MBR *wastewater treatment at Schilde*

Expanding the current WWTP to 28.000 PE with nutrient removal using the existing shallow, large footprint and too small basins is difficult. Moreover, there is no extra land available for building additional tanks since the plant is surrounded by nature reserve. An option would be replacing current aeration basins by new deep tanks. This would however require demolition of larger part of the WWTP, make continuity of WWTP operations difficult and cost an estimated 5.2 million euro. Several scenarios were evaluated towards technical and economical feasibility. Ecological and financial aspects (full-cost: 3.7 million euro) make MBR-renovation at WWTP Schilde preferably (figure 2).

Two years of pilot-study on the WWTP show that MBR-effluent (table 1; summary of more than 100 samples) is of superior quality. Denitrification was shown to be only partial (due to low average BOD/N-ratio of influent: 2.0) during the major part of the testing. Dosing of additional carbon source can cure this drawback. Good operational experience during the pilot testing confirmed confidence in MBR-technology and the planned treatment of the major flow variations in the activated sludge lane.

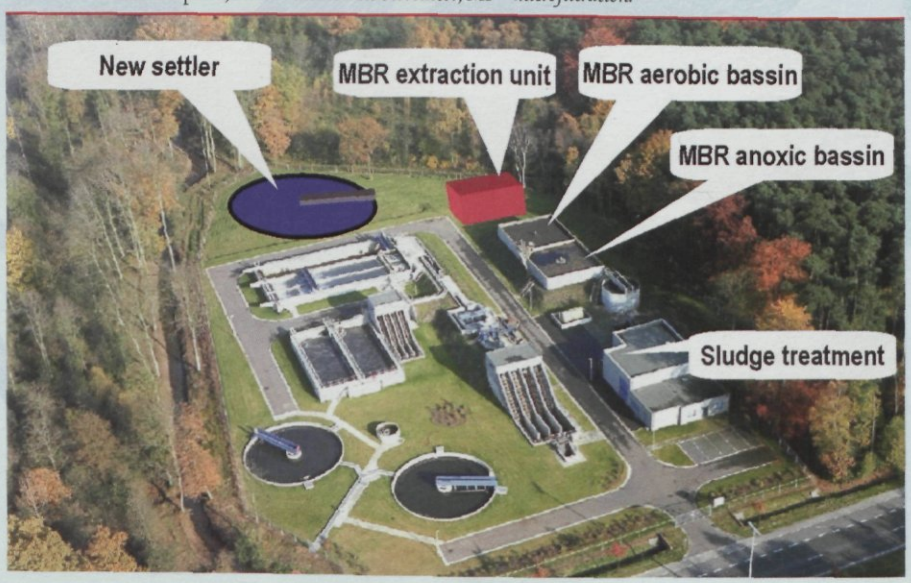
Future outlook

Need for minimal footprint

The extreme urbanisation of the whole of Flanders puts a serious stress on the available free area. Construction of new or expansion of existing WWTP is strongly limited by town and environmental planning. Evidently new large-scale WWTP are planned in industry zones or in so-called ut ility areas. Historically however many of the large Flemish WWTP have become entirely built-in by roads and housing, making the call for compact renovation or expansion (e.g. MBR-technology) acute. WWTP which are located in ecological valuable areas face the same problems.

A significant part of the Flemish sewage still has to be collected and treated on a more local scale (estimates go up to 1.200.000 P.E.). These small-scale sewage treatment works demand an optimal blend in of the WWTP in the surroundings. This may create a significant market for the compact MBR-technology, which can easily be integrated in e.g. existing structures, or be built underground.

Fig. 1: *Schematic representation of the planned renovation with MBR and planned reuse. WWTP = sewage treatment plant, MBR = membrane bioreactor, MF = microfiltration.*



Risk of noise and odour nuisance by WWTP in the urbanised Flanders is potential. In these cases (partial) covering of the installation is sometimes necessary. Use of compact wastewater technology - such as MBR - can result in decreased expenditure for covering.

Need for re-use

Although the climate in Flanders (Belgium) is of the moderate sea climate type, local water shortages have become apparent during the last decades. The amount renewable water per capita in Belgium in general is low (1.230 m^3), but becomes problematic in the Flemish area (less than 1.000 m^3). One of the main reasons is the dense population in Flanders. The need for integrated water management is now recognised and several actions are being taken in that respect. Where possible Aquafin tries to link MBR-technology to re-use applications, contributing both integrated and sustainable water management.

Improving cost-efficiency of MBR

Significant improvement of MBR-technology during the last decade resulted in lowered investment and operational costs. Several aspects of this topic addressed in literature mainly focus on MBR as a stand-alone technology. To our experience the combination of MBR with other treatment technology may well offer possibility to further increase MBR cost-efficiency and applicability. The WWTP Schilde renovation example shows such a cost-effective hybrid system, which we have given the name MACH 1 (MBR Activated sludge Cost-effective Hybrid).

Ongoing research for MBR sewage treatment

In ongoing research Kubota, Mitsubishi, Zenon and Nuon MBR-technology and their new developments are evaluated. Focus is put on further decreasing investment and operational cost by using MBR in a hybrid mode as e.g. in combination with classical activated sludge plants.

New research will investigate the possibility to apply MBR in a cost-effective way for small- scale sewage treatment.

Conclusion

In Flanders MBR technology is considered for the renovation of two full-scale WWTP (Heist: 60.000 PE and Schilde: 28.000 PE). MBR at WWTP Heist (60.000 P.E.) is under investigation, MBR at WWTP Schilde (18.000 PE) will be operational in 2002.

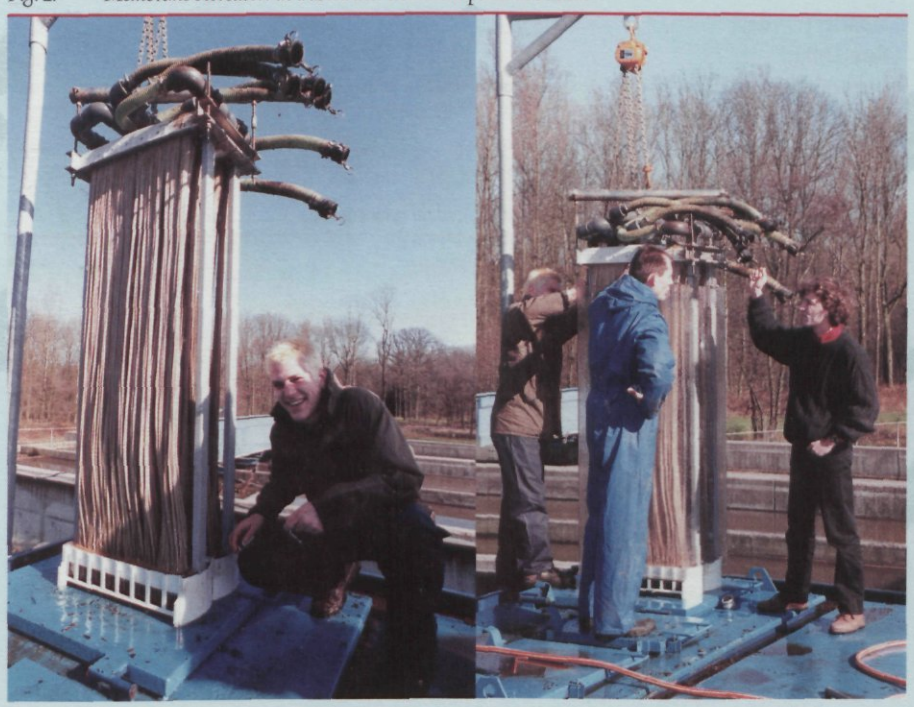
The main driving forces for the choice of MBR-technology for renovation at these sites are respectively the need for reuse of treated wastewater and footprint limitation. The membranes at WWTP Heist and Schilde will filter respectively 670 and 230 m^3/h dry wheather operation.

Extensive pilot testing showed good operational reliability and superior effluent quality. Both planned renovations involve a hybrid of MBR-technology and classical activated sludge technology (MACH 1 - MBR Activated sludge Cost-effective Hybrid): design of the MBR-technology for constant flow, combined with treating the surplus flow and the flow variations with classical (existing) activated sludge technology, which results in a cost-efficient renovation for WWTP Heist and WWTP Schilde.

Table 1: Representative average MBR-pilot showing good effluent quality.

parameter	MBR-effluent (Feed to MBR: pre-settled sewage) average	STD	MBR-effluent (Feed: raw sewage) average	STD
BOD (mg/l)	4	0.4	4	0
COD (mg/l)	33	5	29	6
SS (mg/l)	2.7	1.4	2.2	1.4
TN (mg/l)	10.0	1.3	11,37	3.6
TP (mg/l)	0.9	0.7	0.6	0.1

Fig. 2: Membrane bioreactor at wastewater treatment plant at Schilde.



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