STRICTER EFFLUENT QUALITY AT WATERBOARD RIVIERENLAND

Feasibility of MAR-quality at the WWTP Maasbommel

As the requirements for discharge on surface waters are becoming stricter, waterboards have to put more effort in optimising their wastewater treatment plants. For the Dutch case, the maximum allowable risk (MAR) quality is gradually being incorporated in the released permits. This quality implies for example an effluent with a maximum of 2.2 mg/l for N_{total} *and 0.15 mg/l for* P_{total}*. For the Waterboard Rivierenland several WWTPs have to comply with these requirements before the year 2010. Based on a study performed by Royal Haskoning, continuous sand filtration as effluent-polishing technique was chosen for the WWTP Maasbommel. However, it was decided that a membrane bioreactor demonstration plant was to be built for comparison. The company Zenon in Holland was chosen to supply the MBR for a maximum of 20* m^3/h *and with 440* m^2 *of capillary ultrafiltration membranes.*

The Waterboard Rivierenland in the Netherlands is responsible for the water quality within its region of approximately 135,000 ha. At the moment it is operating 28 wastewater treatment plants (WWTPs), treating over 950,000 population equivalents (p.e.). Ten of these need to comply with stricter effluent criteria by the year 2010. The so-called maximum allowable risk (MAR) quality that has to be achieved imposes severe requirements for most importantly nitrogen (N_{total} below 2.2 mg/l) and phosphorus (P_{total} below 0.15 mg/l). The main parameters of the MAR-requirements are summarised in table 1.

Table 1: *Main parameters for the maximum allowable risk quality.*

parameter	maximum concentration	unit
N_{total}	2.2	mg/l
P_{total}	0.15	mg/l
Cd	0.4	µg/l
Cu	1.5	µg/l
Ni	5.1	µg/l
Pb	11	µg/l
Zn	9.4	µg/l
As	25	µg/l
naphtalene	1.2	µg/l
parathion(-ethyl)	2	ng/l
aldrin	1	ng/l
dieldrin	9	ng/l

For some of the treatment plants effluent polishing will be sufficient, but for a few installations extension is also necessary to comply with the MAR-requirements. The WWTP Maasbommel is one of the sites in which both extension and effluent polishing are needed.

A feasibility study was performed by Royal Haskoning in order to compare effluent polishing by continuous sand filtration and switching to a MBR system. Even though the operational costs were nearly similar, the waterboard decided to install sand filtration because of the widespread experience with this technique. This decision was strengthened by the fact that references of large-scale MBR systems in the Netherlands could not be produced.

The Waterboard Rivierenland however, wants to investigate the possibilities of the MBR technology in practice. For this purpose, a demo-plant MBR will be placed at the WWTP Maasbommel in order to have a comparison between both sand filtration and MBR-technology on reaching MAR-quality.

In January 2001 Royal Haskoning and the waterboard drew up a Terms of Reference for this MBR demo-plant. The Terms of Reference was then sent to the suppliers Zenon, Kubota, Grontmij/Mitsubishi and Nuon/X-Flow. These are the four participants of the recently finished research that has taken place at the WWTP Beverwijk in the Netherlands.

The tendering procedure was finished in June, and resulted in selection of Zenon B.V. as the most favourable supplier.

The total research is part of the overall MBR research programme of the Netherlands Water Research Board (STOWA), and is therefore also partially financed by this institute.

Configuration

As the research at the WWTP in Beverwijk focused on the practical issues of MBRs for domestic wastewater treatment in general, the applied configurations were not optimised for reaching a MAR-quality effluent. Therefore, the MBR-configuration for the MBR Maasbommel was drastically changed. The resulting process design for the MBR Maasbommel is shown in figure 1 together with the applied system of 'Beverwijk'.

As figure 1 indicates, a cascade-concept will be used for the MBR at Maasbommel, implying biological phosphorus removal according to the UCT-concept. Compared to the Beverwijk configuration, this means that an extra aerobic and anoxic reactor will be implemented, and recirculation will be increased up to a factor of eight. In this way the total nitrogen concentration in the effluent should be lowered to 2.2 mg/l. The possibility of methanol dosage in the second anoxic reactor is incorporated in the demo-plant design.

Phosphorus removal will be achieved by biological P-removal with additional chemical dosing. The compounds will be added in the first anoxic stage.

The proposed research programme also monitors the remaining criteria as given in table 1, but it is focused on nitrogen- and phosphorus removal. For the remaining MAR-criteria, the dosing of powdered activated carbon can easily be implemented, if necessary.

The final aerobic stage and the combined membrane compartment (indicated as AM) form the actual membrane bioreactor. Because the membranes are aerated in order to prevent fouling, the oxygen level in the membrane compartment can reach up to 6 mg/l. This level is too high for recirculation to an anoxic reactor. Therefore the water is brought back to the previous aerobic reactor. From there recirculation will lead to the first anoxic compartment.

The main reason for the small aerobic