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Airlift MBR at Municipal WWTP Terneuzen for Industrial Reuse

Pilot Research supports Full Scale Implementation



Introduction

- The municipal wwtp Terneuzen is operated by Water Authority 'Zeeuws-Vlaanderen' in the Netherlands.
- Present capacity of the wwtp is 77,500 Pollution Equivalents.
- The plant was built in 1990, several extensions took place over the years to meet stricter requirements for N- and P-removal.
- Since 2007 a volume of 5,000 m³ per day of effluent is treated by Evides Industry Water to produce demineralised water for reuse at Dow Benelux.
- It is the first example of a combination of industrial and municipal wastewater for reuse on a large scale in the Netherlands.



The wwtp of Terneuzen, including the projected upgrading with an airlift MBR

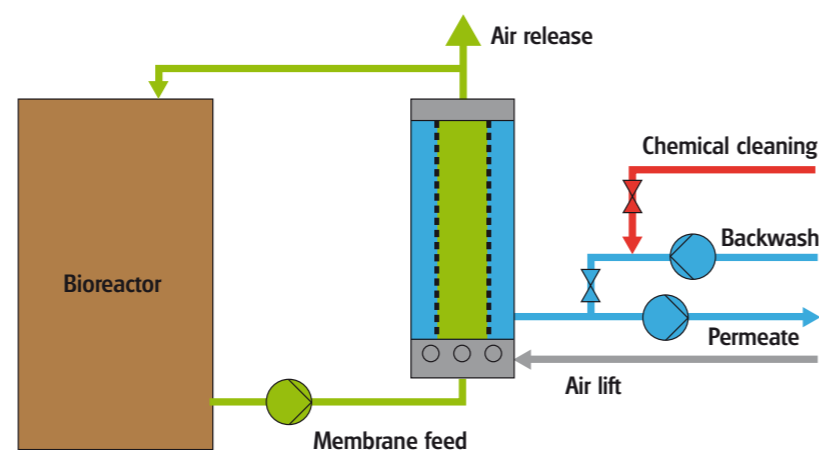
Project Scope and Objectives

- Upgrading is needed in the near future for improvement of the effluent quality.
- The volume of effluent reuse has to be doubled before in 2010.
- The Terneuzen wwtp will be upgraded with an MBR system in the year 2009.
- The MBR system will have a nominal hydraulic capacity of 400 m³/hr and a maximum hydraulic capacity of 620 m³/h.
- The permeate from the MBR will not be discharged into the environment, but fed to an RO membrane unit for further polishing and reuse as boiler feed water.
- To increase the hydraulic load to the MBR, clarifier overflow of the existing wwtp will be added to the MBR.
- Currently a NORIT MBR Airlift pilot plant is operated and generates process data to service the engineering for the full scale MBR plant.
- Objectives for the pilot scale research are determining the feasibility of different effluent addition schemes and the maximum and operational membrane flux.
- In relation to the production of demineralised water the requirements for the permeate are 10 mg/l for N-total and 2 mg/l for P-total.

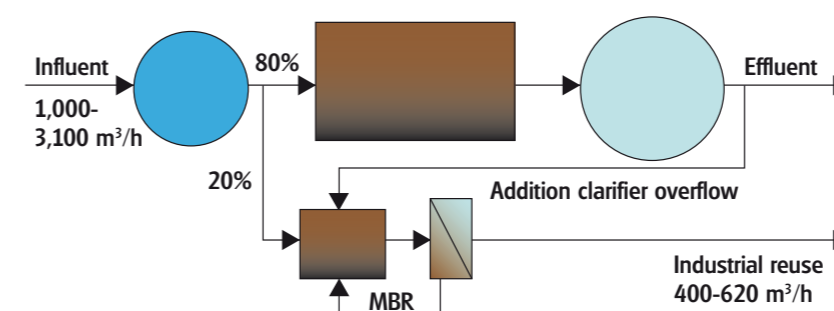
Materials and Methods

- Both the full scale and the pilot plant are equipped with Airlift MBR by NORIT Membrane Technology (Enschede, The Netherlands).
- The NORIT airlift has its first full scale application at the wwtp of the town of Ootmarsum, The Netherlands (Futselaar et al, 2007).
- The pilot plant has a hydraulic capacity of 3 m³/h.
- The maximum gross flux amounts to 50 l/m²*h.
- Iron(III)chloride is added to the MBR for chemical P-removal
- For determining the sludge quality the Delft Filtration Characterization Method (DFCM) method has been used (Evenblij et al, 2005)

Pilot plant



Principle of the NORIT air lift MBR



Future situation after upgrading the wwtp with the MBR

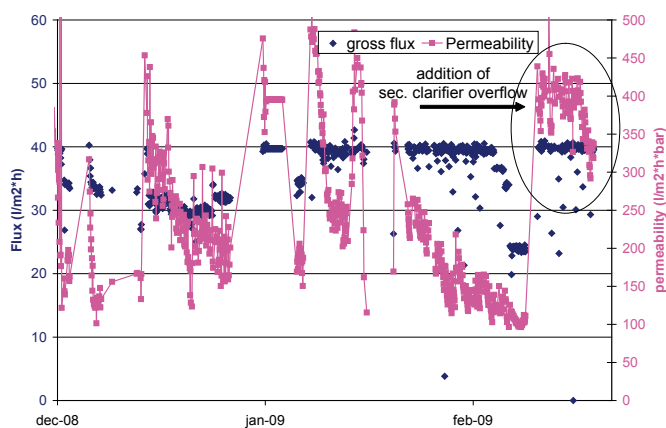


Results

- The sustainable continuous flux was 40 l/m²*h.
- No significant influence of clarifier overflow addition has been noticed.
- Sludge quality with the DFCM measurements was good in different ratios of addition of clarifier overflow. The average filterability was 0.2. Values below 1.0 should be considered as good filterable.
- The average concentration for P-total was 1.7. No optimization of P-removal had been carried out yet.
- Nitrification was almost complete.
- Denitrification was variable due to several problems with the process control.

	MBR influent	Permeate
COD (mg/l)	458	33
TKN (mg/l)	44	2.3
NO ₃ -N (mg/l)		7.8 (0.2–20)
PO ₄ -P (mg/l)		1.4
P-total (mg/l)	6.4	1.7

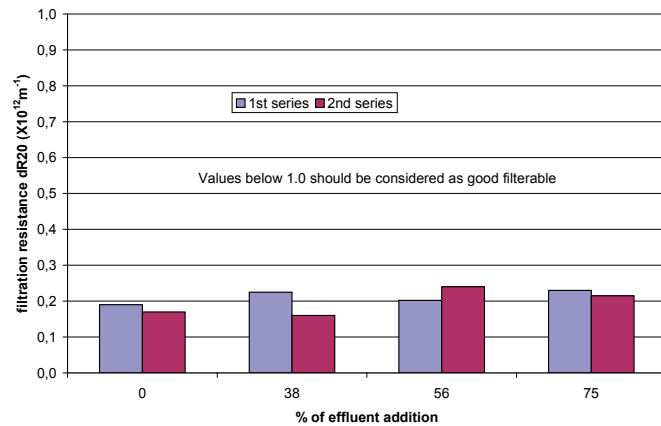
Average quality influent and permeate



Membrane performance

Discussion and Conclusions

The WWTP Terneuzen (The Netherlands) will be upgraded with an airlift MBR system in the year 2009. A pilot plant has been operated to generate process data. The airlift system in the pilot plant reached a high sustainable flux of 40 l/m²*h continuously. The inlet flow of the full scale MBR will be 200-620 m³/h. The required permeate production of 400-620 m³/h will be reached by addition of clarifier overflow. This concept has not been applied earlier and influences on the performance were unknown. After introduction of this addition no negative influences on the membrane performance appeared. This observation was supported by the DFCM measurements by the Technical University of Delft. In the future the permeate from the 620 m³/hr Airlift MBR will be exclusively used as feed water for the production of demineralised water for a local chemical industry. In the pilot plant the minimum requirements are almost met. However the process control in the bioreactor showed some instabilities. In the full scale plant a better permeate quality is expected.



Result sludge filterability measurements

References

Agtmaal J, Huiting H, de Boks PA, Paping LLMJ (2007) Four years of practical experience with an Integrated Membrane System treating estuary water, *Desalination* 205, 26-37.
 Evenblij, H., Geilvoet, S., van der Graaf, J.H.J.M., van der Roest, H.F. (2005) Filtration Characterisation for assessing MBR performance: three cases compared, *Desalination*, 178, 115-124.
 Futselaar H, Schonewille H, de Vente D, Broens I (2007) NORIT Airlift MBR: side-stream system for municipal waste water treatment, *Desalination* 204, 1-7.