Industry is ready for MBR

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In the Netherlands about twenty highly diverse industrial MBRs have been realised in the past ten years. This respectable number could have been even higher if the water policy of Dutch authorities had given more support to the industrial initiatives. Why do companies consider investing in MBR and does governmental policy hinder them? VEMW, the Dutch Association of non-domestic water users, pleads for clear guidelines on fees and market conditions to enable investment in MBR. Industry is ready for innovation; an active approach from the water authorities is called for.

At Water Quality Europe (the annual Dutch conference for industrial water), the central issue was how to boost Dutch innovation in the water sector. Due to the new European Water Framework Directive demands on wastewater discharge and a continuing motivation to improve cost performance, there is a permanent drive for innovation in industry. MBR was one of the most promising technologies discussed at the conference.

Important criteria for investment in water technology in the process industry are the contribution to the continuity of the operations (the so called 'license to operate'), cost minimisation and customer satisfaction, local stakeholders included. Under what circumstances can MBR meet these criteria? Companies have different reasons to consider an investment in MBR. As in the case of treatment of wastewater from households, a stable quality of the effluent is an important argument and the compact design of MBR is attractive. However, the most promising seems to be the application of MBR for water reuse. Last year, most of the respondents to a VEMW questionnaire saw the future for MBR in industry in in-process applications. Companies still need more information about operational costs of MBR and about expected developments in energy consumption and sludge reduction. Although compact and flexible systems have the future, not all questions have been answered. Industry however, is confident that suppliers will come with sufficient solutions in coming years.

Johan Raap of CSM comments on the website of the Dutch Ministry of Economic Affairs on innovation in the water sector that companies experience "a gap between what the industry develops and what is permitted by the authorities." There is tension between the implementation of solutions and discharge permits. "There is a lack of reason behind many water rules: these rules might even prove to be contra-productive to their initial aim." In his view a critical flaw in the current water policy is a lack of an overall vision on the so-called water chain. This water chain extends from intake of water to discharge after treatment. Industrial water usage, with its practice of reuse and (process) water treatment, forms an essential element of the water chain. In legislation and discharge permits, the contribution of industry to the water system should be recognised in full.

In a water chain orientated approach, the use of more flexible and cost oriented instruments is essential. In the existing legislative framework real barriers to such an approach are the rigid and non-transparent financing schemes of municipal sewers in combination with a narrow view in the discharge permit, focussing on the receiving sewer service. A cost oriented fee should accommodate an environmental and economic beneficial option, where pre-treatment of industrial wastewater occurs. In these cases current restrictions to further treatment of 'thin' or diluted industrial wastewater should be mitigated in order to encourage treatment facilities. A cost oriented fee contributes to the predictability of tariffs and fees and therefore improves the investment climate.

Cargill

In Bergen op Zoom in the southern part of the Netherlands, Cerestar, a Cargill company, operates a factory where both maize and wheat are used as raw material to supply customers with food and non-food products. Their MBR came online in 2001 with a capacity of 35 m^3/h and is used to upgrade process water for cooling purposes, and lead to a water saving of 270,000 m^3/year, or 20 % of the total water usage. The total projects costs were about one million Euro.

Subsidies turned out to be a real incentive to the project, and the Dutch authorities financed about 30 % of the investment costs. On the other hand, a problem is the requirement in the discharge permit for what is called 'thin' or diluted water, where the treated wastewater should not be diluted further than 350 l/pollution equivalent (p.e.) and limits the back up-provision for the MBR-facility. At the moment, the company has to bypass the MBR if there is no or reduced

Cerestar.

demand for cooling water in the production process. Although the MBR has both a higher efficiency and a better environmental performance than the receiving communal wastewater treatment plant Cerestar is forced to bypass contaminated wastewater.

Due to the presence of salts, the treated water cannot be directly discharged into receiving waters. Cerestar would like to consider replacing the existing aerobic treatment plant with a second MBR-facility.

This investment should contribute to lower costs; due to higher efficiency and saving of the fee per discharged population equivalent payable to the water board, a lower sludge production and a better performance on COD-reduction, where the energy balance has to be considered. However, this option will be blocked by the discharge requirement for thin wastewater and therefore Cerestar have not prepared an investment decision until now.

Recently Cargill constructed a MBR at the oil seed crushing plant in Saint Nazaire (France). Cargill started the MBR last January. It is a submerged MBR with tubular PVDF coated membranes with a capacity of 850 kg/d COD. This design was selected due to plant effluent characteristics, small footprint (space limitation) and minimal sludge production. The choice for a submerged MBR reduced energy consumption compared with the alternative external cross-flow membranes. The tubular type membranes allow reversed flow at regular time intervals while coarse bubble aeration creates enough turbulence to avoid biomass built-up at the surface of the membranes. The effluent quality should allow reusage as a make-up water-source to provide cooling water in the near future.

In Amsterdam Cargill is investigating the option of using MBR technology for aerobic side stream treatment of plant effluent containing sulphates in the range of 20,000-40,000 ppm. The objective is to discharge the sulphates directly into the dock and consequently to eliminate the constraints to discharge via the municipal sewer. Sulphates may contribute to corrosion as sulphates are biologically reduced to sulphides under anaerobic conditions. Also H_2S-formation raises concerns regarding occupational health and safety conditions at wastewater treatment plant Westpoort. In this application MBR looks promising as the biomass is retained in the reactor as in the classical design, sludge-settling characteristics are poor due to dispersed growth. A pilot plant trial has been successfully completed and now that the salts containing water can be discharged into the receiving brackish water, the approval by the authorities is to be expected.

Diosynth Oss

Diosynth is an Akzo Nobel company and produces active pharmaceutical ingredients. The manufacturing facility in Oss produces wastewater (20,000 p.e.) that contains priority substances. Anticipating on expected limitations on effluent components under the Water Framework Directive, Diosynth aimed to improve knowledge on stabilising effluent quality. Diosynth therefore installed an MBR-

Tabel 1: MBR *in waste treatment.*

company	location	sector	year	capacity (m^3/h)
Essent	Landgraaf	landfill	1995	13
Essent	Montfort	landfill	1996	10
Afvalzorg	Middenmeer	landfill	1996	5
Recept	Rotterdam	composting	1996	2
Nijhoff Wassink	Rijssen	tank cleaning	1997	1
Smink	Hoogland	landfill	1996	20
Den Ouden OTT	Alblasserdam	tank cleaning	1999	1
Royal Dutch Navy	Den Helder	bilgewater	1999	5
Dekker Transport	Oudekerk a/d IJssel	tank cleaning	1999	1,5
Dekker Transport	Dendermonde	tank cleaning	2000	2
Vos Logistics	Zuidbroek	tank cleaning	2000	2,5
Vos Logistics	Rotterdam	tank cleaning	2000	12
Gentenaar	Moerdijk	tank cleaning	2000	4
Biocel	Lelystad	compost	2001	2
Pieter Bon	Zaandam	tank cleaning	2002	8
Van Gansewinkel	Weert	liquid waste treatment	2002	16
TCL	Maastricht	tank cleaning	2003	3
Ecopark De Wierde	Oudehaske	landfill	2003	30
Essent	Haps	landfill	2004	5
Hoyer	Rotterdam	tank cleaning	2004	8
ATM	Botlek	tank cleaning	2004	7,5
Vos Logistics	Hoogerheide	tank cleaning	2004	1,5
3e Merwedehaven	Dordrecht	landfill	2004	36
Stubbe	Gouda	tankcleaning	2005	2

Sources: DHV, Triqua, Logisticon, Zenon, Solis, RWB Afvalwater, TNO-MEP

Tabel 2: MBR *in industry.*

company	location	sector	year	capacity (m^3/h)
Noviant	Nijmegen	coatings	1996	20
SCA	Suameer	paper	1998	0,7
Driessen	Dongen	leather	1998	10
Rendac	Bergum	rendering	1999	40
VWS	Broek op Langedijk	flowerbulb cleaning	1999	3
VHP	Ugchelen	paper	2000	12
Platvis	Volendam	food	2000	2
Cerestar	Bergen op Zoom	wheat refinery	2001	35
Rentex Floron	Bolsward	textile cleaning	2002	35
Astra Faam	Harlingen	food	2002	2,5
Rendac	Son	rendering	2003	100
Akzo Nobel	Oss	pharmaceutical	2003	1,2
Du Pont / Invista	Dordrecht	chemical	2003	60
Fuji	Tilburg	photo/film	2004	35
Bavaria	Eemsmond	malt	2005	55
Noviant	Nijmegen	coatings	2005	3
Cargill	Amsterdam	soja bean crushing	2005	3

Sources: DHV, Triqua, Logisticon, Zenon, Solis, RWB Afvalwater, TNO-MEP, VEMW

Diosynth.

pilot with a capacity (membrane flow) of 1,200 litres per hour.

The pilot aimed to investigate the biodegradability of substances in the wastewater streams in the production process using MBR-technology. The research programme was specifically aimed at the biodegradability of COD, nitrogen and priority substances (volatile organic solvents, chlorinated carbon-hydrogen and toluene). The pilot also gave information about operational costs, the necessary maintenance and operation tasks and the capacity of the installation. During the pilot also technical questions had to be answered which led to modifications of the design. This was the case for e.g. the composition of the membranes, the aeration and adaptations to improve the operations (e.g. cleaning of the membranes, tuning of the process parameters and maintenance schemes). Diosynth paid much attention to stabilise operations and to the training of operators.

The pilot was evaluated at the end of 2003. The MBR led to a reduction of contamination to 3,500 p.e. The pilot was run without subsidy. The Water Board was very interested in the results of the pilot, especially in its contribution to improving the effluent quality. New environmental standards were expected according to the Water Framework Directive, and the wastewater of Diosynth complied entirely with the discharge permit submitted by the Water Board, also on the aspects of thin water. A possible replacement of the pilot with a definitive plant might have consequences for the wastewater profile.

Changes in the water sector

As the Dutch representative for non-domestic water users, VEMW has concerns about exclusive rights of dominant suppliers of water services covering industrial water users in the Netherlands. These rights lead to efficiency loss in the water market and therefore to unnecessary high prices. Prices that are not set by the market are as such not a clear indicator for investment for industry. This lack of both transparency and efficiency implies a strong need for an independent authority with sufficient and effective instruments to enhance efficiency and lower prices in water services. To counter this inefficiency in the water market, VEMW calls for an independent supervisor to stimulate the investment climate.

As illustrated in the cases, a possible conflict of interest in the wastewater sector emerges as the water boards combine both economic dominant positions in wastewater treatment and granting wastewater discharge licences. In combination with the legal monopoly on treatment of domestic sewage, this competence for granting permits is a serious threat to industrial initiatives for the treatment and reuse of processwater. Due to the ability of water boards to place restrictions to industrial initiatives, in order to protect their own sewage treatment plants (i.e.: of the water boards), they can prevent or discourage initiatives for water reuse which are as such beneficial both for economic and environmental reasons. This combination of functions of the water boards leads to the undesirable situation in which the referee is also a player in the match. Therefore, the current combination in the Netherlands of responsibilities in the field of operations, permits and inspections of the treatment of wastewater, should be separated. Clear options on permit-conditions are necessary to improve the investment climate.

Due to geographic circumstances, water availability should be an incentive for companies to settle in the Netherlands. Specialised and applicable knowledge about water technology is widely available. Changing the water sector in order to reach transparent and structural low tariffs, and eliminating conflicts of interest will boost innovation. Industry is ready for MBR -The government must now set the right conditions. ¶

Henk Boenink (AKZO Nobel), Chris Velzeboer (Cargill), Ernst Covers (Cerestar), Johan Raap (CSM) and Joan Brouwer (Diosynth) made this article possible by adding information.

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Samenvatting

Vanaf 1995 zijn circa 20 industriële toepassingen van de membraanbioreactor gerealiseerd. Met name voor wat betreft het sluiten van de waterkringloop is de MBR kansrijk in de industrie. Cerestar te Bergen op Zoom realiseert sinds 2001 door gebruik van een MBR hergebruik van proceswater voor koeling. Diosynth te Oss heeft in een pilotinstallatie een aanzienlijke reductie van prioritaire stoffen bereikt. Toepassing van MBR binnen de industrie wordt echter beperkt doordat vanuit het beleid onvoldoende oog is voor de rol van industriële waterbehandeling in de waterketen. Het waterschap kan in de lozingsvergunning de mogelijkheden van voorzuivering door bedrijven beperken, bijvoorbeeld door een eis voor 'dun water'. Bovendien is de financieringsstructuur in de waterketen star en ondoorzichtig, wat investeringsbeslissingen bemoeilijkt. Doordat economische machtsposities in de watersector bestaande inefficiënties in stand houden of zelfs bevorderen, zijn watertarieven te hoog. Onafhankelijk toezicht op de watersector draagt bij aan het terugbrengen van deze inefficiënties, geeft meer kostentransparantie en levert door beter voorspelbare watertarieven een bijdrage aan het investeringsklimaat. Een beter investeringsklimaat draagt bij aan de toepassing van MBR in de industrie.