Membrane bioreactors in wastewater treatment

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More stringent purification standards, growing public awareness of water issues and shrinking prices have led to a boost in membrane activated sludge technology in recent years

The membrane activated sludge process requires far less space and provides more efficient cleaning than the classical activated sludge process. The engineering company VA TECH WABAG was one of the first to recognise the market potential of this technique for direct discharge and wastewater reuse applications and believes the current drop in membrane prices will further spur the use of this highly efficient process.

WABAG successfully applied membrane bioreactors (MBR) with pressure-driven external ultrafiltration (UF) systems already in the first half of the 1990s for landfill leachate treatment. When by the mid-1990s submerged MBR modules had finally reached their market maturity, WABAG -holding a licence from Japanese manufacturer Kubota- began to build several MBR facilities using submerged plate membrane modules. A perfect example showcasing this technology is the MBR in Glasgow (capacity 12,000 m³/d), where process water from the central sludge treatment plant servicing the Greater Glasgow area is purified for direct discharge. Based on BOD_5 the Glasgow facility even boasts a capacity of 300,000 population equivalents (PE), thus being the largest facility of its kind worldwide.

Since technical and cost factors tempted WABAG to convert to Zenon MBR systems in 2000, the company has become popular in the market for constructing facilities with submerged Zenon hollow-fibre membrane modules. Examples are the MBRs of Nordkanal (Germany), Schering (Germany) and Wädenswil (Switzerland).

The facility in Nordkanal services a population of 80,000 and is thus the largest MBR used in a municipal sewage treatment in Germany. It is also unique in the fact that the submerged UF modules are integrated in the nitrification stage. This option has various advantages, such as requiring little space. What plant operations deliberately put up with was the increased risk of “membrane fouling” but the first 18 months of operation revealed that there is no need for a more frequent bio-fouling plaque removal.

The MBR of Schering´s Bergkamen-based facility purifies effluents from chemical manufacturing for direct discharge into the Lippe river. The MBR has a hydraulic capacity of 4,800 m³/d and an organic load corresponding to 130,000 PE (BOD_5). It is thus the largest MBR used in German industry. The MBR in Wädenswil (Fig.1) is the largest in Switzerland, servicing 22,000 PE. In this facility the membrane aeration technique is used to assure that the stringent thresholds for suspended solids and phosphorus are safely met, and to protect the waters of Lake Zürich in the best possible way.

Figure 1: Membrane bioreactor plant Wädenswil, Switzerland

The choice of MBR systems has become greatly diversified in recent years, without any noticeable difference in efficiency between individual options. This is why since 2005 WABAG has adopted the strategy of choosing for each specific task the best and the cheapest technical solution available in the market. Projects where this has been achieved include Al Ansab in Muscat (Kubota system; Q=53,000 m³/d and Bei Xiao He in Beijing (Memcor system; Q= 60,000 m³/d). In both MBRs water for reuse is produced.

The membrane activated sludge process is a relatively novel technique which still requires some R&D input, especially in the fields of phosphorus removal, wastewater pre-treatment (fibre separation), chemical and mechanical membrane cleaning, fouling and scaling. WABAG is currently working on a project with a leading machine manufacturer, where the aim is to enhance a sieving machine in such a way that a high level of efficiency in pre-treatment at reasonable cost is accomplished. This is done by inserting a mesh screen and developing an innovative sieve cleaning concept.


Figure 2: WABAG MEGAMODUL™

Additional research goes into alternative membrane systems which offer advantages in terms of chemical cleaning, specific flow rate, space requirement, etc. In coping with this challenge, WABAG has meanwhile developed its MARAPUR™ process for market launch. This process relies on the use of compact membrane modules (MEGAMODUL™, Fig.2) by which the aforementioned advantages can be achieved. The MEGAMODUL™ may be operated in submerged mode or externally, as requested. Unlike most other MBR systems, the technique is based on an inside-out filtration flow. This requires an efficient fibre separation in the raw effluent yet also offers a defined filtration combining a higher specific flow rate with the option of a targeted purification. Current pilot tests conducted at the Vienna Main Wastewater Treatment Plant will be completed in 2006. The first large-scale customized unit shall then be installed in 2007.

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