

EU-backed MBR research highlights energy challenge for wider use

● The MBR-Network, formed of four projects extending research into membrane bioreactor technology, is due to complete its work at the end of this year. **BILL McCANN** reports on the advancements and future challenges discussed at the closing MBR-Network workshop.

At a workshop endorsed by AIWA and organised by the Berlin Centre of Competence for Water in Berlin earlier this year over 220 delegates met to discuss the results of more than three years of intensive research into membrane bioreactor (MBR) technology, a combined international effort involving personnel from around 50 institutions and companies from Europe, Australia, South Africa, Middle East and North Africa.

This was the final workshop of the MBR-Network, a coalition of the four EU-funded projects – Amedeus, Eurombra, MBR-Train and Puratreat – involved in the effort and due for completion at the end of this year.

Developments in MBR

In a detailed report on the two-day event Boris Lesjean (Berlin Centre of Competence for Water), co-ordinator of the Amedeus project and editor of the Network's website, makes particular mention of the closing lecture, given by special guest Professor Kazuo Yamamoto of Tokyo University. Professor Yamamoto is generally acknowledged as the inventor of submerged MBR technology, resulting from his pioneering research in the early 1990s.

The intervening 20 years have seen considerable further development, not least through this most recent research which, according to Boris Lesjean, has 'generated significant technological breakthroughs and key know-how to further improve the competitiveness and acceptance of the MBR process.' His report outlines those achievements, summarizing the wealth of findings put before workshop delegates in around 40 oral and numerous poster presentations during an intense two days.

Despite the advances and the

now proven abilities of the technology for specific applications Lesjean is quite candid and realistic about current limitations, particularly with regard to energy demand. Speaking recently to *Water21* he highlighted that as 'the battle to win' in urban water treatment applications.

The energy issue

Describing all membrane systems as by nature requiring more energy than equivalent conventional processes he said this was particularly true for MBR processes. 'They currently require two or three times more energy even in their most favourable capacity range, making them economically viable in specific situations only.'

In the light of the looming energy crisis and the focus on reduction of carbon emissions he saw this as a hindrance to the advance of MBR in the market place and said more work on energy optimisation was urgently required.

Some advances in that direction had been made within Amedeus; the first pilot results of an advanced control system developed by VITO of Belgium had, for example, shown 10% energy savings over more conventional approaches. An innovative backwash strategy like the one implemented by A3 Water Solutions (Germany) together with Veolia Water (France) also held promise.

Discussing the relevance of MBR to small water and wastewater systems (he is a member of the IWA Specialist Group) brought a return to the energy theme. 'The suggestion that MBR technology is the solution for decentralised systems is a (commonly accepted) myth! In reality, in the range 50 to 5000 population equivalent (PE) the energy balance is so unfavourable that MBR treatment is not viable either economically or

environmentally. There are however interesting and commercial low-energy MBR systems for households and very small populations, in the four to 50 PE range. And we should give attention to new developments in non-aerated, anaerobic MBR systems, such as the process tested in the Eurombra project by the University of Kwazulu-Natal, South-Africa for water reuse.'

Asked about advances in the areas of membrane fouling and cleaning he says those issues typically absorb about 30% of all the research effort on MBRs and membrane technologies in general.

'But, due to the complexity of the mechanisms, progress is very slow. Although the comprehension of the MBR fouling mechanisms has progressed through the European projects, the impact on operation optimisation is limited. Many partners however produced clear evidences that controlling the state of biomass flocculation is critical to prevent fouling, and that the addition of chemical additives (flocclulants, adsorbants etc) may therefore help in improving the filtration conditions. In the Amedeus project, the Berlin University of Technology demonstrated the feasibility of such strategies, opening opportunities for further development of this practical solution.

'In practice the optimisation of cleaning procedures in full scale plants has brought much more improvement than all the trials at laboratory scale. And that applies in general to the improved efficiency of MBR filtration systems. Much of that has come from incremental optimisations by the module and membrane suppliers, from improvements in module and aeration design and operation and from the engineering companies and system integrators of the whole treatment plants, from pre-treatment

through to the biological treatment stage and including overall process control.'

Drivers of the market

Regarding future market prospects and the historical dominance of industrial applications, he points to a significant change of trend.

'According to our last market survey, in the Amedeus project in 2008, there were about 800 full-scale MBR plants operating in Europe, of which 566 were in industrial applications and 229 in the municipal sector. But, in the year 07/08 the new plants built were 65 industrial and 45 municipal per year. The municipal market is now driving the overall market in terms of installed membrane surface because the municipal plants are on average one order of magnitude bigger than the industrial plants.

The MBR process has become more competitive with other technologies, especially for large plants in the 5000 to 100,000 PE range. But the process still remains economically viable only in specific situations, such as where advanced treatment quality or a compact system is needed, or in plant retrofitting.

In recent years the European market has been strongly driven by many water reuse schemes in the Mediterranean countries. Also, about a third of the municipal MBR applications are retrofits on existing plants and around half of those are 'dual' processes where the MBR operates in combination with conventional activated sludge treatment. In the Amedeus project Aquafin of Belgium demonstrated the economic advantages of such designs and has optimised their operation.' ●

Further information, workshop report and project deliverables can be found at: www.MBR-Network.eu