Llanbedr, Barmouth, Fairbourne & Nefyn WwTWs

programme to improve MBR performance in North Wales

by
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In 2005 Dwr Cymru Welsh Water (Welsh Water) identified a need to improve the wastewater treatment at four of its sites situated along the northwest Wales coast line. The four sites – at Llanbedr, Barmouth, Fairbourne and Nefyn – are located in some of Wales' most attractive high amenity coastal regions and were therefore known to be situated in environmentally important areas. One site in particular, is located within Snowdonia National Park. Due to the sensitivity of these proposed wastewater treatment works (WwTW), Welsh Water decided to look towards new cutting-edge technology that would meet the two key objectives of high quality wastewater treatment and a plant with a small footprint. The leading technology of Membrane Bio Reactor (MBR) plants was identified as being able to meet both these needs.

Nefyn WwTW *Courtesy of Dwr Cymru Welsh Water*

The problem

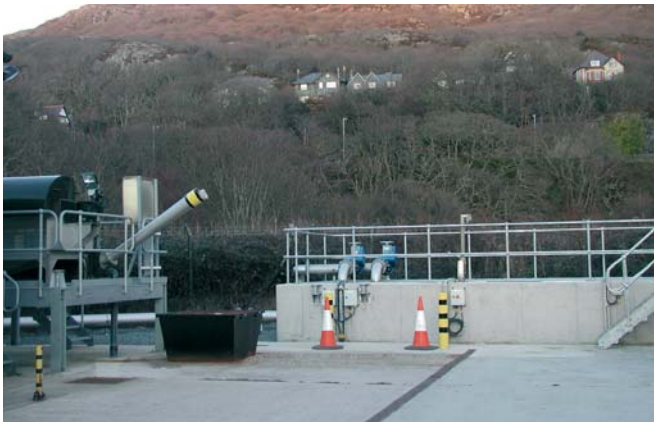
Following their completion in 2005, all the plants developed unexpected operational issues, which in turn began to compromise the performance of the works. The resulting problems led to a two year intensive programme of investigation into the cause of these issues. During this investigation it was discovered that other MBR plants across the UK could also be experiencing similar issues.

Ultimately after several months of investigations a thorough understanding of the plant's performance criteria and maintenance requirements was developed. Solutions, including frequency of cleaning the membranes, the techniques used and fixed maintenance plans were also developed and implemented. This improvement programme has proven to be highly successful and to date all four plants are performing extremely well and providing OPEX savings for Welsh Water.

Further description of the plant, its issues, and the resulting investigations

The MBR technology was developed in the mid 90's with the first full scale plant constructed in 1998. Since then it is understood the technology has been installed at over 50 sites across the UK.

Barmouth WwTW *Courtesy of Dwr Cymru Welsh Water*



Barmouth WwTW *Courtesy of Dwr Cymru Welsh Water*

However, it is believed that operational problems arose with some of these plants, including excessive fouling of the membranes, issues with diffuser arrangements, and process instability. As a result it is possible that several of the plants could not have achieved the consented flow, particularly under storm conditions, despite utilising the advised annual cleaning regime.

The interpretation of the plant data and the undertaking of a thorough literature review demonstrated that the Welsh Water plant results were fairly typical of experience elsewhere in the UK. When verified graphically, flow deterioration rates were high and not what was expected from the initial design.

A number of remedial measures were introduced to try and remedy the situation, such as the installation of high pressure water washes for the diffusers at one site and dosing of alkalinity as sodium bicarbonate at all the others – however, these measures had limited success.

Additional third party analysis was also carried out to confirm that the flows and loads into the inlet of each works were not exceptional. Once this was confirmed an extensive research, sampling and investigation programme of other users in the UK and overseas was introduced. Welsh Water sanctioned a study team to go out to investigate similar plants in the United States and identify the best practises used over there, where more than 100 plants have been installed.

During this research it was discovered that a number of sites across the UK were experiencing similar failures. From the findings gathered and a review of the best practises overseas an improvement programme was developed and implemented, which lead to significant improvements in operation. Part of these improvements include the continuous monitoring of key process parameters including permeability, which allows automatic performance monitoring and planning of optimum chemical cleaning intervals.

Technical description and benefits of the improvement programme

The programme of improvements that have been introduced now provide Welsh Water with reliable, sustainable, high quality treatment plants, which are protecting the environment in some of Wales' most attractive coastal regions. The improvement programme has provided a three-fold improvement in performance and significant operational savings.

Benefits of the improvement programme include:

- Achievement of full flow to treatment reliably throughout the year, even during storm conditions;
- Highest quality effluent discharged to the environment;
- Continuous monitoring to ensure reliable operation with optimum membrane cleaning procedures;
- Significant operational and maintenance savings.

The MBR plants now produce high quality effluent within the following criteria:

BOD5	<5 mg/l
TSS	<1 mg/l
Ammonia	<1 mg/l
Turbidity	<0.2 NTU

The plants are also able to act as an alternative to the more traditional methods of disinfecting final effluent for reducing harmful bacteria and viruses to acceptable levels, ie. complete removal of *Coliform* bacteria and *Cryptosporidium*. The equivalent disinfection capability has replaced ultra violet (UV) dosing, with its associated regulatory reporting requirements and high energy use.

All of the MBR sites are subject to tourist population inputs and discharge into Blue Flag coastal waters and Shellfish waters. This new technology provides treatment that comfortable meets the required consents consistently.

There have been further benefits in using this technology intelligently, for example specific energy consumption reductions, sludge volume reductions and associated operating cost for treatment. Future plans include minimising power use and water reuse for irrigation of local amenity planting.

Who carried out the work?

A collaborative approach led by Imtech Process for Welsh Water has led to a fundamental understanding of the issues that initially compromised operation. Fine screening has been installed with the use of anoxic zones at all four sites for recovering alkalinity to improve plant performance. Further improvements include improved diffuser operation, optimum filtration cycles and fully automatic monitoring of membrane performance to identify when chemical cleaning is required.

The local operations team has played an important role in improving the performance of these plants through collection of site based data, timely maintenance and attending to alarm events to help maintain reliable performance.

Conclusion

All plants are now operating reliably and in a sustainable manner, and significant operational savings have been achieved when compared to early performance. A programme of further optimisation is now underway with targeted further OPEX savings. This improvement programme will enable the MBR technology to have a much longer life and greater opportunity to deliver sustainable solutions for many challenging projects.

Note: ***The Editor & Publishers thank Jon Allen, Process Engineer with Imtech Process, for preparing the above article for publication.***■