

Europe's oldest municipal MBR celebrates ten years

● Porlock wastewater treatment works, with its membrane bioreactor based on Kubota membranes, is not only the jewel in Wessex Water's crown – it is Europe's oldest municipal MBR plant and provides a ten-year perspective on the use of this technology.

The municipal wastewater treatment plant at Porlock in the south west of the UK is the oldest continuously operating full-scale municipal submerged MBR plant in Europe, serving 3800 people, the Wessex Water plant is now celebrating its tenth anniversary. As a coastal site in a National Park, the plant had to blend with its surroundings and have a small footprint. Also, its proximity to a bathing beach meant disinfection was required.

After ten years' operation Wessex Water's technical team feels that 'overall the plant has performed well with membranes proving exceptionally robust'. Effluent quality data remain good (see table), with the average reduction in faecal coliforms exceeding 5.8 log. Moreover, Silt Density Index (SDI) tests carried out in February 2007 on permeate from the plant showed an average value of 1.50, well within the guidelines for reverse osmosis feed. In Wessex Water chairman Colin Skellett's words, 'we see membranes providing a physical barrier and a physical warranty of high quality effluent'.

The works has no primary treatment or grit removal, and screening is to 3mm prior to entering the four MBR tanks with a total surface area of 2880m² flat sheet membrane. It has a treatment capacity of 1907m³/d and filtration by gravity at a maximum head of 0.1 bar. The plant is unmanned and monitored via telemetry.

Membrane chemical cleaning is performed on average every eight months, with six hours off-line per tank, always using sodium hypochlorite

at 0.5–0.7% w/v as free chlorine. Mixed liquor suspended solid (MLSS) ranges from 8000 to 27,000 mg/l, sometimes exceeding 30,000 mg/l. Long sludge ages (30 to 90 days) and low food to microorganism (F:M) ratios (0.02–0.07 kgBOD/kg mixed liquor volatile suspended solids) keep sludge production low (0.35 to 0.50 kgds/kgBOD).

The decline in average permeability since 1998 represents a mere 1% increase in trans-membrane pressure over a nine and a half year period. Full membrane overhaul has only been carried out once, in year nine.

Seawater ingress during high tides created problems with foaming and fouling until the sewerage network was improved. Following the first removal and overhaul of the membrane units in year nine, all membrane panels were checked and damaged ones replaced. Despite the long-term exposure to sand and grit, macroscopic abrasion on membranes was remarkably slight, and no microscopic effect was detected. GRP membrane unit housings were reinforced with steel brackets to compensate for the abrasion.

To date, a total of 230 panels have been replaced out of the 3600 installed, giving a failure rate of less than 6.4% after 10 years of operation. The majority of the failures were from potentially preventable causes: 127 had holes from debris and grit, 55 had internal sludge or contamination inside (probably smaller holes), 25 were damaged in handling, 14 had seals torn or split and nine were removed in error (cleanable staining). Given the remarkably low failure rates, it is not anticipated that the plant will need any



The Porlock MBR treatment plant.

further overhaul until year 12 or later.

Very probably, the keys to the longevity and reliability of the Porlock plant are good, competent, well-trained operational staff, maintaining uniform aeration, and low maximum trans-membrane pressure due to hydraulically-limited gravity flow. According to Mr Skellett, 'one of the big dangers is that contractors install plants with a new technology and soon after that they hand it over and disappear. A longer commissioning and training period is required, especially when users are not familiar with this technology. Once staff are trained, Kubota MBR plants are relatively straightforward to operate. They need to have the right maintenance systems in place, plus the influent and the sludge conditions shall ensure the membranes are not prematurely fouled.'

As Mr Skellett states, 'tighter standards imposed by both the [EU] Water Framework Directive and the Bathing Water Directive will drive the requirements for future plants'. If Porlock were to be designed today it would probably have to meet a nutrients consent. Kubota units would adapt but retain their simplicity: they would be configured in double decks with membrane diffusers optimised, saving energy on air scouring. Membrane casings would be built in corrosion and abrasion-resistant steel. Also, maintenance of dissolved oxygen would become more critical, so careful control of MLSS range would be implemented. ●

Reference:

Churchouse, S, Warren, S, Floyd, M. Feedback from the Porlock MBR plant in its 10th year of operation: An analysis of the flux, effluent quality and membrane lifetime data to date.

Article provided by Kubota Membrane Europe, <http://env.kubota.co.jp/ksnu>. Kubota Membrane Europe would like to thank Wessex Water's chairman Colin Skellett for his kind contribution to this article.

Porlock effluent quality data, 1998 to July 2007.

Parameter	No. of samples	Feed average	Permeate average	Typical detection limit
BOD - mgO ₂ /l	360	226	< 5	6
COD - mgO ₂ /l	200	424	22	10
Faecal coliforms - counts/100 ml	200	12,800,000	< 21	10
F+ Coliphage virus - pfu/litre	80	1,540,000	< 26	10