

Chelmsford WwTW

new aeration lane to increase overall capacity

by
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Chelmsford WwTW in Essex serves a population equivalent of 137,900, which is projected to increase to 149,200 by 2016. The works comprises three treatment streams - North, South and East Works. The North and South Works are biological trickling filter plants, which in 2007 took 56% of the total load between them. The East Works is an activated sludge plant (ASP) and treated the remaining 44% of the load. The liquors from the sludge digestion plant were divided across all three streams. Compliance was dependent on the high quality performance of the East Works. In late 2008, a refurbishment of the aeration system in the original two aeration lanes went a long way to improve performance. This meant that the old centrifugal blowers were now able to maintain dissolved oxygen (DO) set points over the full range of flows. But despite the increase in aeration capacity, the ASP was still overloaded.



Aeration lane and anoxic zone view

Courtesy of the @one Alliance

Scheme overview

A scheme was commissioned to increase the overall capacity of the works. It quickly became clear that the most cost effective option was to increase the capacity of the East Works ASP stream by adding a new aeration lane. The existing primary and final settlement tanks had scope to deal with a small increase in the proportion of crude sewage and take all of the digester loads, but only if the aeration volume was increased. The new aeration lane added 50% more

process volume thus enabling the ASP to treat 50% of the crude sewage and 100% of the site return flows to a high standard. The budget was exceptionally tight and the design team was tasked with reducing CAPEX as far as practicable, but still deliver the required performance and an acceptable whole life cost.

To achieve this, the key areas where more imaginative approaches were taken were as follows.

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SHEET PILING (UK) LTD *takes to the 'AER'!*

Sheet Piling (UK) Ltd has completed the design, supply and installation of sheet piles for the 55m x 15m x 3.6m underground Aeration Tank at Anglian Water's Chelmsford STW for Skanska Aker Solutions.

Sheet Piling (UK) Ltd proposed an innovative and alternative permanent sheet pile wall scheme including welded interlocks to give an equivalent of a Grade 2 to 4 structure to BS8102:1990. The tank was made 100% watertight by using a horizontal steel 'puddle flange' water bar and hydrophilic strip at the mid slab height in conjunction with plated and welded pile interlocks from the base soffit level to the pile head level within the RC capping beam.

Specific and stringent welding procedures, which are Lloyd's accredited, were undertaken in order to carry out the works.

As at Chelmsford STW, cost and programme savings can be gained by utilising steel sheet piles for permanent underground tanks such as Storm Water Overflows, Aeration Tanks etc. Sheet Piling UK can provide a full design and installation service, and can liaise closely with the client's technical consultant to provide the most cost effective, innovative and value engineered solutions.



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Construction of the tank

Construction of a traditional in situ 4.5m deep concrete tank required sheet piling support on at least three sides of the excavation at substantial cost. The project team proposed the use of a permanent sheet pile structure instead of in situ concrete. After investigation it was deemed that a sheet pile system could provide the required asset life, based on expected corrosion rates in activated sludge.

Sheet Pile UK was chosen as the piling contractor with piles installed to a depth of 11m, thus forming the perimeter of the tank. A concrete capping beam was cast around the top of the sheet pile wall before excavation of the tank. This meant the capping beam shuttering could be placed safely at ground level and the ground itself was used as the floor shutter to the beam. The tank was excavated and then the pile clutches sealed by welding a steel plate across the clutch.

The tank floor slab was cast using in situ concrete. A “water bar” arrangement was adopted where a 200mm wide plate was welded continuously around the perimeter of the sheet piling at mid depth of the slab. A sealant strip was then fixed onto the top of the plate and the floor slab cast around the plate.

Aeration system

An extensive review of available fine bubble diffusers by the Alliance concluded that Hydrok/Aquaconsult’s diffuser strip system provided the best whole life cost. Standard oxygen transfer efficiency was in the region of 7%/m – a substantial improvement on typical EPDM membrane diffusers.

Approximately 200 diffuser strips were installed in the lane by Hydrok, split into two independently controlled zones. The strips were fixed directly to the floor slab of the tank with 40mm long self tapping anchors. The anchor penetration was shorter than the nominal rebar cover, so there was no interference with the slab reinforcement during diffuser installation.

An online ammonia meter was installed in the lane which was linked to the DO control system. If ammonia is low then the DO set point is reduced, if ammonia is high then the DO is increased to increase the nitrification rate. So long as the choice of DO set points is not too aggressive, aeration power savings can be achieved without compromising final effluent quality.

Flow split chambers

In order to divert the required proportion of flow to the new lane, a flow split needed to be formed. The original intention was to construct a sizeable concrete chamber with fixed weirs that would serve the flow split function. The electrical engineer suggested a



Flow split diversion chamber and modulating valve Courtesy of the @one Alliance

control solution using the existing flume flow meters and a new pipeline with a modulating control valve and dedicated flow meter to achieve the flow split. This eliminated construction of the large chamber, saved £50k and had the added benefit that overall head loss was reduced. Moreover the flow proportion to the new lane could be altered at the touch of a button – very useful during commissioning and for any future optimisation. This solution was adopted and proved to be very stable in operation, accurately delivering the flow split as intended.

Undertakings

The work was undertaken by the @one Alliance, a collaborative organisation comprising Anglian Water Engineering, Balfour Beatty Utility Solutions, Barhale, Biwater Treatment Ltd, Black & Veatch, Grontmij and Skanska-Aker Solutions, which was set up in 2005 to deliver a large part of Anglian Water’s AMP4 capital investment programme. The success of the AMP4 programme led to the @one Alliance engaged again to deliver a substantial element of the AMP5 capital investment programme.

Conclusion

Overall the project has been a success, it has delivered the required additional process capacity, was completed on time, within budget and there were no adverse impacts on compliance during construction and commissioning.

Note: The Editor & Publishers wish to thank Stuart Cameron, Senior Process Engineer in the @one Alliance, for providing the above article for publication. ■



Aeration system pattern test

Courtesy of the @one Alliance



Aeration lane air pipework

Courtesy of the @one Alliance

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