Basildon WwTW

increased efficiency aeration from improved design

by
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The Anglian Water Wastewater Treatment Works plant at Basildon is a 155,000 population equivalent works that serves a growing residential and industrial catchment area. DWF is 343 l/s and FFT is 640 l/s for the whole works. The works has grown to be a complex process with two main treatment streams and a sludge treatment centre.

Old works' disc diffusers in drained wide lane before replacement *Courtesy of the @one Alliance*

One main stream, the new aeration works, takes 40 per cent of the inlet flow, and is treated by a triple ditch aeration system installed in 1990s. The other main stream, the old aeration works, takes 60 per cent of the works flow, and is treated by a system of primary tanks, aeration ditches, and secondary tanks, and was constructed in three phases between the 1950s and 1980s. In early 2006 the sludge treatment digesters were shut down for a major refurbishment, which was due to be completed by Summer 2008.

Before the digesters were shut down, the old aeration works was approaching its consent ammonia target of 10 mg/l. A project was raised in 2006 to investigate the old aeration works and propose a refurbishment programme that would allow the works to maintain its ammonia compliance as the digester plant was brought back onto stream.

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 union of these companies brings together a wealth of experience, which is being used to enhance and increase Anglian Water's assets and infrastructure, providing innovative and sustainable solutions and the best value to customers. By doing so, the @one Alliance is helping Anglian Water fulfil its current supply and treatment obligations as well as make provisions for the increase in demand expected in the future.

Old aeration works plant detailed description.
The old works plant consists of:

- 4 primary settlement tanks.
- 14 aeration and RAS return lanes that are 55m long and vary in width between 1.5m and 4.5m. It had a complex series of return flow and mixing pipes for RAS return to the re-aeration lanes. Five blowers provided the air to disc aerators.
- 6 secondary settlement tanks.

	Inlet range		Outlet consent
	Mean (mg/l)	Peak (mg/l)	(mg/l)
BOD	275	500	45
Suspended solids	300	520	30
Ammonia	42	95	10

Identifying the key issues to address
A detailed analysis of existing and proposed plant loads raised some difficult questions about how the plant could be converted to being capable of treating the higher load once the digesters were brought back into service, and how this could be completed while maintaining compliance when the works was under full load.

The key issues were:

- The load onto the works had increased by over 20 per cent during the 2005 to 2007 period. This was much higher than expected, probably due to rapid industrial and population growth in the area.
- By early 2007, the old works was approaching its ammonia outlet consent level even without the digester load. It was believed that only one lane at a time could be refurbished, which would mean the 14 lanes would take more than a year to complete. Temporary works were needed.
- The RAS return method via re-aeration mixing lanes would cause installation difficulties.
- When the mass balance was completed for the plant, it became obvious that a simple refurbishment of the existing diffusers and aeration system would be insufficient to supply the quantity of air required to the aeration lanes to transfer the amount of oxygen that the microbes would need to treat the load. A way to get more oxygen transferred into the same volume was required.
- The blowers feeding air to the plant and air main were in need of refurbishment or replacement. The electrical supply to the site was already near to its operating limit. To supply more air, more efficient blowers would be required to maintain the power at or below the existing limit.
- Construction and commissioning had to run concurrently for several months.

Chosen options
The key choices on the project were:

- Use high efficiency aeration diffusers. These diffusers can achieve greater than 7 per cent oxygen transfer per metre of water depth, compared with 5.5 per cent for typical membrane diffusers. This reduces the air requirement by 22 per cent for the same oxygen transfer level.
- Use high efficiency blowers. These oil free blowers give high energy efficiency, requiring less than 2 kWh per 100Nm^3 of air compared with 2.6 kWh for the blowers being replaced. This reduces the power requirement by 24 per cent for the same volume of air supplied.
- Use an aeration control system design that combined the high efficiency aerators and blowers with a pipework system that gave accurate air dosing to each lane to maintain good dissolved oxygen target control. The control system was supplied by Max Wright Ltd. to match a control philosophy developed by the @one Alliance to combine the best efficiencies from the aerators and blowers.

High efficiency diffusers during installation *Courtesy of the @one Alliance*

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Pattern test on high efficiency diffusers during commissioning tests *Courtesy of the @one Alliance*

- Provide temporary works to allow a more rapid progress of the project's early stages so that beneficial use of the majority of the lanes could be achieved before the digesters were brought into full use.
- Of the temporary works, a very important element involved an overnight shutdown of the old works at a time of low rainfall. This process had to be very carefully planned, and approved through principle contractor Skanska-Aker Solutions' safety systems, then through Anglian Water's safety systems to obtain Operations' approval. Approval from the Environment Agency was also required because use of the storm tanks overnight was needed temporarily to divert some of the incoming flow. In a 12-hour shutdown on a very cold November night, portions of the old works were systematically drained, and metal plates over the underflow channels that previously could not be closed were sealed. As each section was completed, they were refilled and the next section drained. The @one Alliance site staff and M&E contractor Warboys Ltd. were instrumental in the success of this work. All overnight targets were achieved.

Results / status

Temporary works preparation started in October 2007. The major construction of this aeration refurbishment started in January 2008 and was completed in August 2008 with further minor works and handover completion by February 2009.

Throughout the construction period, and through all of the handover testing, the plant achieved its target treatment levels. The digesters were gradually brought on stream over several months from March 2008. This project could not have been achieved within the quality constraints without good teamwork between the @one Alliance design and site teams, Anglian Water Operations, technical team and asset planners, and our key suppliers, and sub-contractors.

The project was also a success in terms of energy reduction. The high efficiency blowers and the high efficiency aeration mean that the energy Opex requirement has actually reduced for an increased load. Despite a 20 per cent increase in load the daily average blower power now required is typically reduced by more than 20 per cent below its pre-refurbishment level.

This high efficiency aeration method is being applied on other Anglian Water sites.

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