

# Lyng Forge Nitrate Removal Scheme

## a £1.8m quality compliance project

by  
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**T**he level of nitrate is steadily rising in many of Anglian Water's groundwater sites in the East of England so, during Asset Management Plan Period 4, the Company will be reducing the nitrate levels at 22 sites using either treatment or blend solutions. The choice of nitrate removal technology was the topic of more than two years of study by Anglian Water Innovation and Technology Group. The study included a number of pilot trials and equipment valuation. In early 2005, a framework agreement was placed with ACWA Services Ltd for the design, procurement, installation, commissioning and staff training for their 'Nitreat' process.



Lyng Forge: Nitrate removal skid

Photo: courtesy Anglian Water Services

Anglian Water and Biwater Treatment Ltd (part of the Anglian Water @ One Alliance) have worked together with ACWA to produce a standard design for the process plant and treatment building. Where possible, instruments and equipment commonly used throughout Anglian Water have been selected and existing water company procurement agreements used for purchase of these items.

This article provides an outline of the process design, installation and performance of the first of the new generation of nitrate removal plant at Lyng Forge Water Treatment Works in Norfolk.

### Lyng Forge WTW

The existing works at Lyng Forge comprised of a local borehole source, a remote borehole source, an iron removal plant, chlorination and high lift pumping station. Raw water from the Lyng bore is high in nitrate ( $>70$  mg/l  $\text{NO}_3$ ), and this was blended with low nitrate/high iron water from Sparham Hills source before being treated in the existing iron removal plant.

The nitrates at Lyng are rising steadily and have seasonal peaks associated with periods of high aquifer recharge. The high nitrates at Lyng have effectively reduced the peak source works output from 6 MI/d to 3.1 MI/d, and the predicted maximum nitrate level in 2010 is 87 mg/l  $\text{NO}_3$ .

With the new nitrate removal plant in operation the works output

will be able to achieve its full licenced potential during peak demand periods.

### The ACWA 'Nitreat' process

This process is a multi-vessel ion exchange process utilising the principles of continuous counter-current ion exchange. At any one time, 14 of the 20 vessels will be in nitrate removal mode; one will be back flushing; three will be in regeneration and two will be in rinse mode before going back into treatment. The key component of the process is a rotating multi-port valve, which directs the raw water, brine and softened water to the relevant vessels. The valve, supplied by Puritech in Belgium, rotates at a speed calculated from the Kg/d of nitrate to be removed, and the volume of the nitrate selective resin. In normal operation the rotating valve moves in increments of 18 degrees every 90 minutes.

The process is very efficient, with a waste stream of approximately 0.5 per cent of the treated water flow; there is full utilisation of the resin and continuous flow of treated water and wastewater.

The treatment plant is designed to achieve a final blended nitrate level of 43 mg/l  $\text{NO}_3$ .

### Lyng Forge installation

The Anglian Water nitrate removal plants have two process streams, each capable of producing 100 per cent of the required

output of low nitrate water; any component failure stops the relevant stream and the other increases its output to compensate,

The plant has a small footprint and has been installed in a new treatment building designed to match other buildings on the site.

Work started on site at Lyng by the @One Alliance (with Biwater Treatment Ltd as main contractor) in August 2005, with the demolition of an old pump house building.

The civils work was completed by October 2005, and the treatment plant installed between November 2005 and February 2006. Commissioning started in mid February, with the plant going into supply in late March 2006.

**Performance of new plant**

During commissioning the raw water nitrate feed was between 72 to 77 mg/l NO<sub>3</sub>. The low nitrate water leaving the vessels was between 1.5 and 3 mg/l NO<sub>3</sub>. The plant is currently being monitored (May 06) and its performance optimised to ensure that it operates at peak efficiency.

A table of water sample results from the commissioning period is shown below.

Parameter	Units	Raw Water	Low nitrate	Blended
		Feed	water	final water
PH	-	7.37	7.3	7.27
Turbidity	FTU	0.04	0.03	0.04
Conductivity	µS/cm <sup>2</sup>	6.75	7.06	689
Nitrate	mg/l NO <sub>3</sub>	77	2.18	44.63
Hardness	mg/l CaCO <sub>3</sub>	360	360	360
Alkalinity	mg/l CaCO <sub>3</sub>	227	212	220

Sulphate	mg/l SO <sub>4</sub>	44.6	25	34.9
Chloride	mg/l Cl	39.7	114	72.5
Sodium	mg/l Na	18.8	20.7	19.9
Colour	mg/l Pt/Co	<0.34	<0.34	<0.34
TOC	mg/l C	0.94	0.41	0.74

**Summary**

Anglian Water has operated a number of conventional ion exchange nitrate removal plants for many years. The ACWA plant is a very different technology, which offers a small footprint with efficient performance and competitive costs. The Lyng Forge plant is the first of six new plants that will be completed during 2006.

The plant is performing well at the current low season demand. Full output and nitrate removal trials will be carried out in April/May 2006 to confirm the plant performance meets its design specification. Operating parameters such as power, salt usage and waste flows are being monitored over the first three months of operation, to compare the data with design figures. Anglian Water Innovation staff are monitoring performance and undertaking optimisation trials to ensure that the process is working at its peak efficiency.

The Lyng Forge nitrate removal plant is the first of its type in Anglian Water delivered by @One Alliance. The lessons learned at this site are being used to improve design, construction and commissioning of future plants. ■

*Note: This article was prepared by Guy Gregory, Programme Delivery Manager (Water), Anglian Water Services; Steve Jones, Team Leader; John Murrer, Technology Manager; David Pentecost, Sub Programme Delivery Manager; all with @One Alliance.*

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