

# Alwen WTW

## Dŵr Cymru Welsh Water's £14m investment to improve disinfection processes and aluminium removal performance

by Huw Roblin M.Sc, B.Sc (Hons)

**A**lwen Water Treatment Works is situated approximately 20km north-west of the town of Corwen, Denbighshire, North Wales. From this works, Dŵr Cymru Welsh Water supplies households and business customers in Denbighshire and Flintshire and combined with water from its Bretton WTW, also supplies customers in the lower Dee Valley. Following a bacteriological contamination in 2009 that resulted in a Boil Water Notice being issued, Welsh Water made commitments to the Drinking Water Inspectorate (DWI) to improve the performance of the Alwen WTW. Welsh Water allocated in excess of £14m to improve the disinfection processes and the aluminium removal performance. Black & Veatch, as a main AMP5 process partner to Welsh Water, undertook the design, construction and commissioning of the improvements over a period from May 2009 to March of 2012.



Alwen WTW - Pipe gallery installation - Courtesy of Dŵr Cymru Welsh Water

### Existing works

The current works was constructed in 1993 and consisted of coagulation, dissolved air floatation, primary and secondary filtration using Enelco style filters, chloramination and disinfection. Welsh Water gave the DWI an undertaking to provide an interim improvement to disinfection by July 2010 and final improvements to maximise disinfection performance by end of August 2011.

### Preferred option

The improvements to the disinfection process were agreed to be undertaken in two phases, allowing the new rapid gravity filtration (RGF) structure to be built between these phases. Once the new RGFs were built, the existing filtration processes could be modified and the newly redundant secondary filters could be converted to contact tanks, which would add the required volume to the existing disinfection process.

### Design

Once the initial process selections had been made, the main design issues were around hydraulics and integrating the construction of the new processes with the existing processes to minimise disruption during the construction and commissioning. The new RGF process had to fit between the existing DAF plant and filtration plant. The hydraulics between these existing processes meant that interstage pumping could not be avoided. This pumping stage was installed on the outlet of the new RGF process to pump filtered water up to the existing filtration building.

The new RGF process had to be built and commissioned before Welsh Water could give access to Black & Veatch to start the conversion works to the existing filtration processes. Many design hours were spent with Welsh Water operations to fully understand the limitations on existing processes so that the impact due to the

construction and commissioning of the new elements of the works were minimal to Welsh Water ongoing operation.

### Process improvements

The first stage of disinfection improvements was to move the ammonia dose for chloramination to a location on the outlet of the contact tank. Previously, ammonia was dosed on the outlet of the secondary filters prior to the contact tank. This was completed in line with the first part of an undertaking with the DWI in July 2010.

Work on the main RGF structures started in December 2009 and culminated in the new RGFs being online by the end of March 2011. Once the new RGFs were online, work started within the existing works to convert one pair of the existing primary filters to secondary filters for manganese removal. This then released the existing pair of secondary filters to be stripped out, cleaned and converted to a contact tank. This work was completed in advance of the DWI undertaking date of 31 August 2011.

The final stage of process enhancements at Alwen saw the construction and commissioning of a new Kalic dosing plant for intermediate and final pH control and a new poly plant to increase the robustness of the existing coagulation process. This work was completed in March 2012.

### Construction

The preparatory work for the construction of the new RGF structure began in late November 2009 with the diversion of buried HV cables that ran across the centre of the proposed excavation for the new structure.

The winter of 2009/10 turned out to be extremely cold with many disruptions caused by snow affecting access to the works. To meet the first major construction deadline of the project, the diversion of these HV cables, the site team had to sleep on site to ensure work could progress and get completed to programme. This was done, and allowed Black & Veatch to proceed with the main excavation for the new RGF structure in January 2010.

Alwen's location at an elevation of 350m, ensured that weather, extreme cold, snow and wind had major impact on working methods and progress throughout the programme of works.

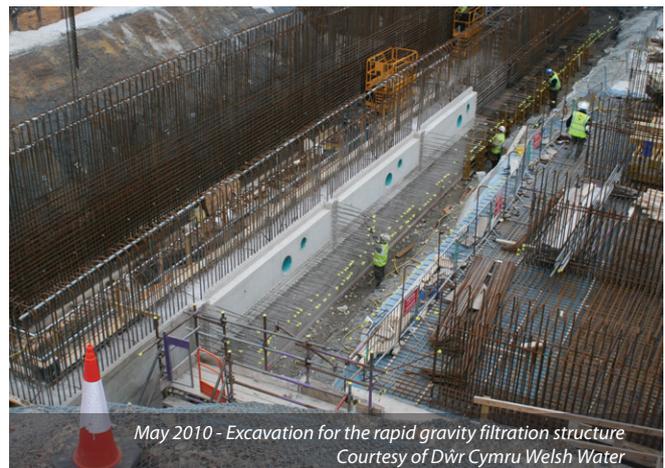
The excavation into the hillside took 3 months to complete and it was April 2010 before the blinding for the RGF structure was placed. Work then progressed to enable the mechanical installation to commence in August.

Running in parallel with the main concrete work for the RGF structure was the construction and infrastructure modifications to the existing contact tank. The modifications enabled the relocation of the ammonia dosing downstream of the existing contact tank, maximising free chlorine disinfection. To enable this work to proceed Welsh Water had to give Black & Veatch access to separate halves of the contact tank and onsite storage reservoirs for extended periods.

Close liaison with Welsh Water Operations and tight programme controls were required to minimise the time periods when DCWW were without these critical operational assets. DCWW had an undertaking with the DWI to have this work complete by 31 July 2010. Black & Veatch successfully met this first key project milestone.

Mechanical and electrical installation within the new RGFs continued alongside civil works on cross-site pipework and peripheral structures such as MCC room and storage tanks.

Like the winter of 2009/10 the winter of 2010/11 threw many challenges to the construction and installation teams with extended cold periods with heavy snow falls. Once again the site team met





August 2010 - Rapid gravity filtration structure under construction  
Courtesy of Dŵr Cymru Welsh Water



September 2010 - Rapid gravity filtration structure under construction  
Courtesy of Dŵr Cymru Welsh Water



October 2010 - Rapid gravity filtration structure under construction  
Courtesy of Dŵr Cymru Welsh Water



December 2010 - Bad weather caused disruptions  
Courtesy of Dŵr Cymru Welsh Water

the challenge and construction was completed enabling the new RGFs to be commissioned and put into supply by the end of March 2011. This was a critical date as it allowed the construction team to move into the existing filtration building to start conversion works.

A new set of challenges met the construction team as work moved to the existing filtration hall. The building had to be segregated by a tarpaulin scaffold dividing wall to minimise the risk of dust being transferred from the working areas to the areas still in production.

The first activity here was to re-sand a pair of the existing primary filters and re-commission them as secondary filters for manganese removal. This allowed the site team to then progress to the secondary filters that were decommissioned, had sand removed and all mechanical items stripped so that new dwarf walls could be cast to encourage a serpentine flow route through the new contact tank. A concrete roof was cast in situ and following disinfection and testing the new contact tank was brought online ahead of the DWI undertaking date of 31 August 2011.

Again, in parallel with the conversion work on the existing filters Black & Veatch was also constructing a new Kalic storage and dosing plant. The new plant provides pH control to intermediate and final lime dosing applications. This, together with a new polymer make-up and dosing plant to improve coagulation, were installed, commissioned and in service by the end of March 2012.

#### Commissioning

The commissioning activities followed the same phased construction activities outlined above. The Black & Veatch commissioning team met every key milestone date set them and this was key in enabling Welsh Water to meet its commitments to the DWI.

#### Challenges and team work

While the weather had significant impact on progress, the biggest challenge by far was to undertake all the construction and commissioning activities in and around the existing operational treatment works. From the very start Black & Veatch and Welsh Water operations teams worked closely in firstly approving the process selection and then onto planning and scheduling of construction and commissioning activities with ongoing production constraints.

Weekly site meetings were held with the operator to ensure clear line of communications were maintained so that the construction team were aware of operational constraints they had to mitigate. The operator was able to manage the works and network to accommodate shut downs and periods of reduced production output. This continued for the full 17 months of the construction and commissioning.

Through the whole period designers regularly attended site to support swift decision making to enable construction to continue with minimal disruption. More than 30 full works shutdown and significant interruptions to daily operations were managed successfully in this way.

#### Undertakings

Black & Veatch designed, procured, managed the construction and commissioned the works with the use of Welsh Water's supply chain. Mulcair were the main civil partner, mechanical installation was by IPS, MCCs supplied by MCS, electrical installation by LME and control and SCADA systems by Oasis Software Services.

All parties contributed to the successful delivery of these significant process improvements for Welsh Water, all of which were completed ahead of the the Drinking Water Inspectorate's undertaking dates.

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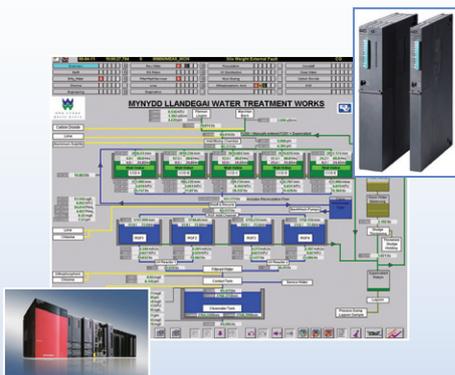
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