Eccup WTW
ozone system upgrade

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The Yorkshire Water Service (YWS) Eccup WTW complex lies to the north of Leeds and supplies part of the city and the YWS grid. There are two plants on site, Eccup No.1 WTW, which treats impounded upland water, and Eccup No.2 WTW, which treats water from the River Ouse. Eccup No.2 WTW has a treatment capacity of 30 to 90 Ml/d with a treatment process consisting of clarification, filtration, ozonation, GAC filtration and disinfection. CostainMouchel was tasked with upgrading the ozonation plant.

Existing ozone generators *Courtesy of CostainMouchel*

The existing arrangement comprised two ozone generators arranged as duty/standby. Ozone gas leaving the duty generator is directed to two stages:

- Stage 1 (Pre-Ozone): Into the lamella separator return water, known as the side-stream.
- Stage 2 (Post-Ozone): Into the post-ozonation contact tank prior to GAC filtration for pesticide removal. Distribution is via a diffuser system.

After the ozone gas has passed through the contact tanks, two thermal destructors destroy any residual ozone in the off-gas, before the gas is vented into the atmosphere.

The Challenge

Introduction of the European Bromate standards in 2003 necessitated a significant reduction in post-ozone dose. The ozone control system was modified accordingly in February 2003 under an AMP3 scheme; a supplementary air injection system was introduced to mix atmospheric air with the ozone in order to meet the gas flow requirements and to satisfy the required diffusion/injection conditions.

A number of operational problems subsequently developed from the introduction of the dilution system, namely:

- Delivery pipework, fittings and instrumentation on the post-ozone distribution system suffered from contamination.
- Nitric oxide residue coated the inner parts of the distribution system.
- The catalytic reaction between the ozone and the residue caused the components to heat up to excessive temperatures leading to joint failures and ozone leaks in the system.

Emergency schemes and capital works were carried out to remove this contamination but they proved to be only short-term solutions, as contamination quickly returned to the system.

The Solution

The first step was to fully understand all operational issues. This included feasibility work, supported by process and plant audits, to investigate options and provision of a solution for bringing the ozone plant back online and under full automatic residual control.

The main challenges were:

- Limited space available for new equipment within the existing ozone generation building.
- The need to both re-use and extend the ozone plant to accommodate the new arrangement with minimal interference to the control and operation of the existing works.

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New CODs and ozone generator (left) and Wedeco SMO 600S unit (right) *Courtesy of CostainMouchel*

- Short site shutdowns due to the strategic importance of the site.
- The WTW had to remain operational throughout.

Owing to the specialist nature of the work, the project team worked closely with key supplier ITT Water & Wastewater - Wedeco throughout to ensure its expertise was included in all areas of the project.

Possible options were identified together with the associated CAPEX and Whole Life Costs, and following various risk and value challenges, a preferred solution was selected based on the segregation of the ozone dosing streams and replacement of the ozone destructors. This option significantly reduced the footprint, simplified the layout and avoided the need to extend the ozone generator building, providing an innovative, cost-effective solution.

It comprised the removal of several key components:

- Air dilution system.
- Thermal ozone destructors.
- Post-ozone distribution system.

The solution also included the installation of:

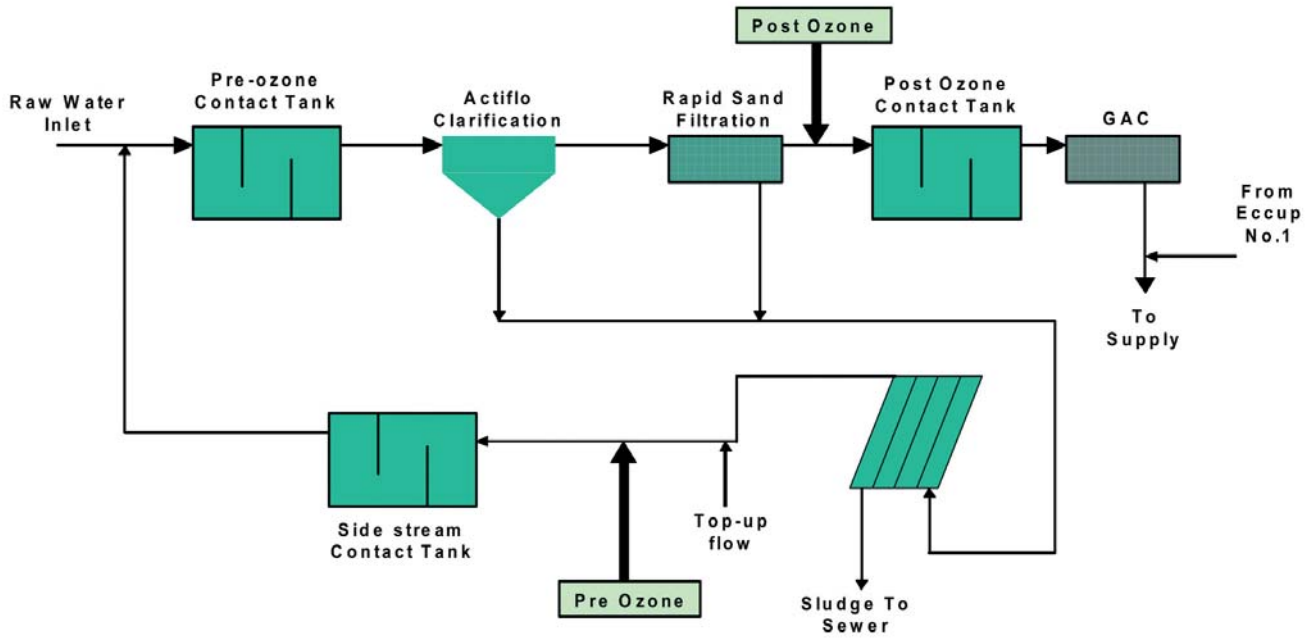
- A third ozone generator.
- Two catalytic ozone destructors.
- Modifications to the existing cooling water system.
- A post-ozone gas flow control assembly.
- A complete electrical installation.
- System integration into the existing PLC/SCADA architecture.

The solution was based on dedicating both the existing ozone generators to pre- and post-ozone treatment, with a new third ozone generator to act as a standby. The new generator was sized and selected by ITT Water & Wastewater - Wedeco. It was designed, built and certified to German standards, with various additions and modifications then made to ensure compliance with the YWS Engineering Specification.

The existing thermal destructors were replaced with low temperature Catalytic-type Ozone Destructors (COD), which have a smaller overall footprint and reduced energy consumption when compared to the existing destructors.

Optimisation of the existing generator control also improved the reliability and efficiency of gas production.

A new residual ozone monitor was installed to facilitate the removal of a problematic sample pump system and a reduction in the length



Process Flow Diagram *Courtesy of CostainMouchel*

of sample pipework resulted in a significant improvement in sampling and control system response.

Installation
The specialist nature of ozonation plants and the hazardous nature of ozone gas required exacting standards for Health and Safety. The project team developed specific installation, testing and commissioning procedures to ensure that these standards were met.

The upgrades had to be undertaken sequentially to one process stream at a time to avoid long plant shutdowns. The pre-ozone stage was identified as the critical process stream and, following a short shutdown to allow installation of temporary equipment and modifications to the existing arrangement, one of the existing generators was dedicated to supply ozone for the pre-ozone stage only under manual control. This permitted decommissioning of the post-ozone treatment stream, and also, critically, allowed disconnection from the existing PLC and the subsequent integration of a replacement control system.

Delivery
The project was delivered in 12 months, from financial approval to project operation and the system is now in full automatic operation. Final performance testing was carried out in May 2009. The project out-turn cost will be in the order of £1m.

Conclusion
The completed improvements now ensure consistent ozone dosing and control of the ozone generation across the pre- and post-ozone stages. Improvements to the operation and reliability are very visible with operational intervention being minimised.

The success of the project has been attributed to a number of factors including:

- Early involvement of the specialist sub-contractor, installation and commissioning staff.
- Comprehensive feasibility work to identify solution.
- Close liaison with YWS operational staff.
- The preparation of a detailed installation and commissioning sequence which was followed precisely.
- Co-location of the Joint Delivery Team.

The Team
The project was delivered for YWS by the AMP4 Clean Water (East) Joint Delivery Team, comprising YWS, Costain and Mouchel. All staff involved, working together as CostainMouchel, are co-located at offices in Castleford, West Yorkshire.

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