Kendal WwTW

Amp 4Q Phosphate Removal Project

by
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Kendal WwTW in Cumbria, owned and operated by United Utilities has a catchment population of 31,000, but because of industry the population equivalent (PE) is 83,000. Final effluent is discharged to the River Kent in a designated Special Area of Conservation (SAC). This article describes the design and construction of a phosphate removal project at Kendal WwTW. Phosphate is removed by both biological and chemical processes and this £10.6m project added a new chemical phosphate removal process to the existing processes at Kendal.

New ferric sulphate bulk storage tanks *Courtesy of UUIA*

The main elements of this project are:

- Ferric sulphate storage and dosing
- An interstage pumping station to lift flows of 500l/s to tertiary filtration
- New 10mm disc filters for tertiary filtration
- A new power supply to the works, with new main switchboard and site cabling
- Modifications to the storm tank inlet and outfall pipework

Cost and schedule savings have been achieved by using a fully integrated delivery team, the Integrated Alliance North, comprising United Utilities, MWH, and KMI+ (Keir, Murphy, Interserve) to deliver this project. UU and MWH led the Concept and Definition phases, KMI+ led the implementation and handover phases. In addition United Utilities Process Operations and Asset Management were involved throughout the project.

The concept and definition phases commenced in June 2007 and a definition phase design was issued in February 2008. The project started on site in August 2008 and will be in use in September 2009.

Background and Description of Kendal WwTW

Flows arrive at Kendal WwTW in a 1500mm diameter combined sewer, there is a Formula A inlet overflow and flows up to 786 l/s are then raised by Archimedean screw pumps to elevated 6mm screens, and detritors.

There is a storm overflow where storm flows are diverted to storm tanks, flow to full treatment (FTFT) of 486l/s then pass into the Covered Oxygenated Activated Sludge Plant. (COAST) The COAST plant is supplied with pure oxygen rather than air which allows a smaller footprint than a standard ASP plant. Following the COAST flows are then settled in 4 settlement tanks. From these settlement tanks flows pass a bifurcating weir, flows up to 180 l/s are passed to

nitrifying filters and humus tanks, and then to the outfall, flows above 180l/s are discharged directly to the outfall.

Sampling and analysis has shown the COAST plant removes 66% of the phosphate by biological removal, however the average P load after biological treatment was 1.66mg/l, in excess of the new consent of 1.0mg/l.

The purpose of this project is to reduce the phosphate discharged from Kendal WwTW to the River Kent to 1.0 mg/l on an 80 percentile basis. The client United Utilities also requested an upgrade of the power supply to Kendal WwTW so that a mobile generator which has been supporting part of the works could be removed.

Chemical removal of Phosphate - Ferric Sulphate Storage and dosing

Tanker unloading facilities were provided together with two bunded bulk ferric sulphate storage tanks, each with a capacity of .46m3 . Two sets of dosing rigs and the MCC are housed in a new kiosk. Dosing lines convey the ferric sulphate to two dosing points. The primary ferric dose is applied upstream of the COAST plant and the secondary dose is applied, when required upstream of the humus tanks.

The primary ferric dose is controlled on a diurnal pattern and also increases proportional to sewage flow. The secondary ferric dose is only applied if the measured phosphate level downstream of the COAST plant is too high following the primary ferric dose and biological removal in the COAST plant.

Most of the phosphate precipitated out settles out in the settlement tanks with the sludge, but tertiary filtration is required to ensure all the flocs are captured.

Interstage Pumping Station

An interstage pumping station is required to lift flows from the existing final effluent outfall pipe to the new disc filters for tertiary filtration. This pumping station has three axial flow pumps to lift the flow to a reinforced concrete channel, which feeds the disc filters. The pumping station is 10m deep and is founded in wet gravels hydraulically connected to the River Kent. It was decided to sink the shaft as a 10.3m dia caisson, with well point dewatering to temporarily reduce the ground water level. As shown in the photo, advantage was taken to use the areas (segments) within the caisson not required for the interstage pumping station to site both clean and dirty washwater pumping stations. This saved the cost of separate excavations for these pumping stations.

Tertiary Filtration

Tertiary filtration is required to remove phosphate flocs not captured in settlement tanks, and also to ensure the effluent complies with a 4mg/l iron consent.

During the project definition phase UU's standard process of rapid gravity filters was replaced by disc filters. Disc filters have the advantage of a smaller footprint, together with lower capital and operating costs.

Three Veolia disc filters are arranged duty, duty, duty; any two filters are able to treat FTFT at average solids loading. During detailed design Veolia launched a modified disc filter with an internal overflow. This internal overflow will operate if the 10mm filter ever became blinded. Interserve produced a modified layout incorporating this modified disc filter which produced cost savings and a better layout compared to the Definition stage design. One of the benefits of this new layout was an increased space for planting between the new disc filters and the site boundary, which gave an opportunity to screen the disc filters with planting.

The disc filters backwash is initiated automatically at a preset head loss or by a timer if they have not washed by a preset time. Dirty backwash water drains to a sump; a segment of the interstage pumping station caisson was used for this, from where it is pumped to the inlet of the COAST.

Filtrate is discharged to another interstage pumping station caisson housing new clean washwater pumps that feed the works washwater main. This wet well then overflows to the outfall.

Power Supply Upgrade

The power supply to Kendal WwTW was already inadequate, the existing odour control units had been supplied by a mobile generator for some years. The new interstage pumping station would require further additional power.

From left, New REC Incomer kiosk, Ring Main unit and new switchboard kiosk *Courtesy of UUIA*

Disc filters during construction, outlet end *Courtesy of UUIA*

The existing Kendal WwTW main switch board was located in an undercroft below the pumping station and had flooded a number of times when extreme storms had beaten the capacity of the inlet works.

It was decided to locate the new electrical equipment on higher ground. The electrical equipment comprised a new incoming switch board owned by the REC, a new transformer and new main switchboard, all housed in new GRP Kiosks.

Contaminated Soil

Part of the site was contaminated by invasive non native plants Himalayan balsam and giant hogweed. The initial proposal was to remove this to tip, however this would have caused many wagon movements through the neighbouring housing estate. KMI+ employed a specialist Tower Forestry who proposed treating, wrapping and burying the contaminated soil within Kendal WwTW. This had the additional benefit of producing a landscape bund that would help screen the wastewater treatment works from the riverside footpath.

The Environment Agency accepted this proposal and as a result disturbance to nearby residents was greatly reduced.

Storm Tank Modifications

The storm tanks at Kendal had inadequate feed and overflow pipework and channels. The existing feed channels were duplicated and part of the outfall pipe duplicated thereby reducing head losses in the system. This will reduce the risk of overtopping of the storm tanks in extreme storms.

Conclusion

This original budget was £10.6m. The project will be delivered well below this budget. Savings have been identified by all parties in the Integrated Alliance working together at all stage of the project. The reduction in phosphate will reduce the nutrient levels in the River Kent.

Note: ***The Editor & Publishers thank Peter Ratcliffe of MWH UK Ltd who is working as a Design Manager in the Integrated Alliance, for providing the above article.***■

From Top, Interstage Pumping station MCC Kiosk, Interstage Pumping Station awaiting pumps, Feed channel and Disc Filters *Courtesy of UUIA*