Stoke-on-Tern WTW

installation of new nitrate treatment plant

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Stoke-on-Tern Borehole Pumping Station (BPS) is situated in a rural area of Shropshire, to the north-east of the village of Stoke on Tern. The BPS has a single borehole which provides a peak daily flow of 2.3Ml. Nitrate levels in the raw water at Stoke-on Tern have been rising steadily for several years. Historically, the nitrate level of water passing into supply has been controlled by blending in the local service reservoir with low nitrate water from another source. This option is becoming unsustainable and the problem had to be resolved by providing nitrate treatment to the output of the Stoke-on-Tern BPS.

Stoke-on-Tern: New nitrate plant building with salt saturator *courtesy Severn Trent Water*

Project need & choice of treatment process

The Drinking Water Inspectorate (DWI) imposes a limit on the level of nitrates in potable water supplies of no more than 50mg/l. The average level of nitrates in the raw water abstracted from Stoke-on-Tern exceeds this. Some form of treatment or blending of this water was required to comply with regulatory requirements. The need to always blend placed restrictions on the water supply network in terms of available abstraction volumes and flexibility of sources.

Severn Trent Water (STW) has several borehole abstraction sites with high nitrate water which require treatment and has elected to use ion exchange as the process for nitrate treatment at the majority of these sites, including Stoke-on-Tern. The main reasons for this relates to limited water resources and restrictions in the waste discharges.

Scope of works

In the existing works, raw water from the borehole is pumped through an iron and manganese treatment process to a balancing tank, it is then pumped directly to the local service reservoir. The nitrate treatment plant has been introduced immediately downstream of the existing Fe/Mn treatment plant to reduce predicted 2020 nitrate levels from an incoming feed level of 102mg/l (average) and 110mg/l (peak), to a blended water outlet level of 42 mg/l. The nitrate treatment plant is controlled by measuring the nitrate levels in the water feeding the plant and diverting a percentage of the flow to have the nitrate removed. This treated water is then blended back to a target level of 42mg/l of nitrate leaving site. The quantity of water diverted to the ion exchange plant is controlled by variable speed pumps.

The nitrate treatment plant is protected by an automatic pre-strainer to remove any sand or particulate matter in the raw water. It is not intended that these filters will actually see a solids loading and as such are not designed with this in mind. They are installed as protection to the ion exchange plant should the borehole water contain sand.

The ion exchange plant consists of three Advanced Amberpack vessels which operate at different stages in the cycle of removing nitrate and being regenerated. This ensures that treatment capacity is always available. Nitrate is removed by the reversible exchange of nitrate ions for chloride ions. Nitrate ions are attracted to the resin in the vessels and retained there until all the available nitrate reception points have been filled. At this point a regeneration is required. A salt solution is used as a source of chloride ions to remove the nitrate ions from the resin.

Stoke-on-Tern: New nitrate plant building with salt saturator *courtesy Severn Trent Water*

The salt is stored as saturated brine in a salt saturator outside the main process building. The saturator is bunded so that in the unlikely event of brine escaping it will not contaminate the aquifer.

Waste water from the regeneration process is minimised by the very accurate control of flow through the resin vessels and the accurate cut off when regeneration is needed so that both leakage of nitrate and use of chloride is minimised.

The use of chloride as a regenerant means that corrosion is an issue for the waste stream from the ion exchange plant. In its undiluted form the waste would attack concrete and corrode steel. Therefore, plastic is used wherever possible for pipelines and specialist titanium pumps have been selected to dispose of the waste. The waste stream from the nitrate plant is discharged by gravity via a new dedicated pipeline to the River Tern, approximately 2km away.

The new process has been housed in a new brick and profiled steel building designed to blend in and match other buildings on site. This and the decision to make the salt saturator and waste tank the same colour give the site a co-ordinated look.

Challenges of interfacing with existing works

Many of the challenges the team had to overcome at Stoke-on-Tern related not to the installation of the ion exchange process itself, but to interfacing with existing plant on site.

The site is congested and the options for siting the new plant were limited to one unless additional land was purchased - which would have been difficult to achieve in the timescales required,

The project has been complicated by the presence of an iron and manganese removal plant on the site. Soluble iron and manganese in the raw water is removed by oxidation with chlorine so that the iron and manganese becomes particulate and can be removed on a pressurised sand filter. The new ion exchange nitrate treatment plant had to be installed after the pressure filters because the iron and manganese could block the ion exchange resin. However, the presence of chlorine in the water feeding the ion exchange plant would have materially reduced the life of the ion exchange resin so the chlorine residual post iron and manganese filtration had to be minimised.

The original proposal was to modify the existing chlorination system to ensure that the level of chlorine passing onto the ion exchange plant was below 0.1mg/l. However, it became apparent that this was not possible, as the existing system was not suitable for refined dosing at very low levels. This meant that alternative chlorination equipment had to be installed in order to operate the ion exchange plant.

Implementation

The scheme has been delivered using the STW AMP4 procurement process. The main contractor was Black & Veatch, a framework contractor for STW. The nitrate treatment process was supplied as a package by Chris Kennicot Water Technology Ltd, who are framework suppliers to STW for nitrate treatment plants on a number of sites across the STW region. The consultant was Grontmij, who operate under a framework to provide consultancy services to STW during AMP4. Various other items of plant such as MCCs, valves, pipework etc, have been procured through framework agreements between STW and a number of suppliers.

The scheme has been steered through the feasibility, design and construction process by an integrated team of client, consultant and contractor. This integrated team system has worked well as it allows, allocations of tasks, during the various phases, to those parties best able to perform the required task. The integrated team approach also ensures that all parties share the responsibility to provide the scheme within required constraints of time and budget and all have a voice in the best way of achieving this. In addition to Stoke on Tern, the same integrated team has been involved in the provision of the other 8 plants in STW's AMP4 programme of nitrate treatment plant installations.

Conclusion

The plant went into service in March 2007 with water passing through the plant into supply on a 24 hour basis. Final plant optimisation was then carried out to refine settings within the nitrate treatment process.

There are two main lessons to be learnt from this scheme, which will be applied to other sites. Firstly, there are many benefits from the integrated team approach to working. Secondly, the challenges of interfacing a new nitrate treatment plant with existing site processes should not be underestimated.

The scheme has proven to be a successful start to Severn Trent Water's programme of nitrate treatment projects and the team intend to build on this success as they move forward on to the subsequent projects. ■

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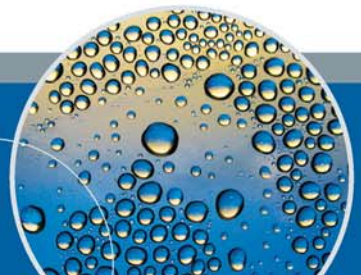

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