Endocrine Disrupting Chemicals (EDC) scale pilot plants in Ilkeston, Derbyshire

by
Brian Morris BSc, CEng, MICE & Ricardo Almansi

In recent years there has been growing concern about chemicals in treated final effluent which may interfere with the hormone system of humans and animals. These are the so called endocrine disrupting chemicals (EDC's) that are known to cause feminising effects in the male fish population.The effects may block the development of male reproductive organs in the fish or lead to the formation of traits typical of females such as egg yolk proteins or egg cells in male fish. The main sources of these chemicals are the contraceptive pill and other pharmaceutical products.

Hallam Fields: GAC Pilot Plant *courtesy Norwest Holst Ltd & Severn Trent Water PLC*

In the current Asset Management Period (AMP4) Severn Trent Water Ltd have an obligation to assess the effectiveness, costs and benefits of existing and enhanced sewage treatment processes at reducing steroid concentration and oestrogenic activity in sewage treatment works effluent.

The purpose of this is to inform future decisions on appropriate regulatory strategy on this subject.

This has been implemented as part of a national demonstration programme with other water companies having similar and complimentary obligations. The scope of the national programme involves the construction of full scale demonstration plants and extended monitoring and analysis of final effluent from a large number of existing treatment works.

With the agreement of the Environment Agency, who are the co-ordinators of the national programme, Severn Trent Water selected *Hallam Fields Sewage Treatment Works* near Ilkeston, Derbyshire for the construction of three demonstration scale pilot plants. The pilot plants will be used to assess the effectiveness and economics of removing EDC's.s from the works final effluent.

Hallam Fields STW serves a population of 49,700 and has a flow to full treatment of 322 l/s.

The three demonstration scale pilot plants can each accept a maximum flow of 1 MLD. The flow is abstracted from the clear well of the tertiary sand filters by a dedicated pumping station. The technologies being tested in the three pilot plants are:

* **Granular Activated Carbon filtration;**
* **Chlorine dioxide dosing;**
* **Ozone dosing.**

The project has been procured under Severn Trent's AMP4 capital works programme with NORWEST HOLST Ltd., as the main contractor.

Hallam Fields: GAC Pilot Plant *courtesy Norwest Holst Ltd & Severn Trent Water PLC*

Hallam Fields: GAC Pilot Plant *courtesy Norwest Holst Ltd & Severn Trent Water PLC*

Granular Activated Carbon
The GAC plant consists of 2Nr. modified TETRA™ modular deep-bed sand filters as manufactured by Severn Trent Services Ltd.

Briefly, the system shall comprise the following features:

* 8 No. x 1.45m diameter stainless steel filter cells. Each cell containing 2.5m³ of GAC;
* access hatches are provided within the covers for the loading of GAC from flexible intermediate bulk carriers (FIBC's) which are lifted using an overhead gantry system;
* removal of the spent GAC will be achieved using a vacuum tanker connected to a valved port on the side of each cell;
* the eight cells can be configured to accept flow from the feed pumping station in parallel;

The testing regime will be managed by Severn Trent T & D staff and will involve using different types of GAC media and varying contact times to establish the effectiveness of the process in removing particular endocrine disruptors.

Chlorine Dioxide Dosing
Much of the equipment for the chlorine dioxide dosing plant was salvaged from an existing installation at Pinxton STW, Derbyshire. The existing plant had been installed by NALCO in 1997 as part of a requirement to remove colour from the final effluent.

The chlorine dioxide is generated on site from three pre-cursor chemicals. These chemicals are stored individually in bunded storage vessels on site.

The pre-cursor chemicals are:

* 25% solution sodium chlorite;
* 14% sodium hypochlorite;
* 15% solution hydrochloric acid.

The chemicals are mixed in the chlorine dioxide generator and the resulting clO_2 is stored in a small batch tank prior to dosing directly into a static mixer in the feed pipeline. The process will allow dose rates up to 5 mg/l and incorporates a 30m³ chlorine dioxide decay tank.

In addition, the plant has the facility to dose ferrous chloride into the decay tank to assist with the removal of cIO_2 residual.

Chlorine dioxide residual levels are continuously monitored in the decay tank and in the wet well of the intermediate pumping station. Detection of clO_2 levels above the low set point will inhibit the intermediate pump and prevent the treated effluent being returned to the outfall.

Ozone
The containerised ozone plant has been procured from *Wedeco Ozotech Ltd.* The generator itself has a variable output and can produce between 65 - 650 mg O_3 / lO_2 from the liquid oxygen bulk storage vessel on site. The plant is designed to treat up to 1 MLD. Ozone concentrations of between 3-15 mg/l will be possible but it is anticipated that treatment for EDC removal should be effective at the lower dose rate.

The process has been designed to introduce the ozone in two different ways. It can be dosed through fine bubble diffusers mounted in the base of 3No. x 4.1m high cylindrical contactor vessels adjacent to the container.

On the outlet of the ozone plant a UV unit has been provided to assist with the reduction of ozone residual in the treated water. Ozone monitoring is also present at the intermediate pump well and is designed to shut the process down in the event of high ozone residual.

Construction phase
The major challenges facing the project were:

* a very tight programme of works;
* co-ordination of the many different sub-contractors and suppliers that make up each plant;
* an important number of complex lifting operations were required;
* resolving the interfaces between the different automated controls in each plant and the main MCC panel;
* the safe delivery and handling of chemicals was of paramount importance;

Summary
All parties have worked hard to enable the project to overcome the many complexities inherent to a pilot scheme. At the time of writing, the works are being commissioned and it is envisaged that the works will be handed over by the original end date and on budget.■

Note:*The Editor & Publishers wish to thank the authors, Brian Morris, Project Manager with Severn Trent Water and Ricardo Almansi, Project Manager, with Norwest Holst Ltd for producing the above article.*