Chichester WwTW
biological nutrient removal plant

by
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Southern Water's treatment works in Chichester, West Sussex, was built in the early 20th century and designed to treat wastewater from Chichester and the surrounding area. The original treatment involved a biological filtration process before releasing into Chichester Harbour. The works was designed to treat the incoming flow from a 45,000 population equivalent (pe). The River Lavant and Chichester Harbour are both in the catchment, so there were several environmental considerations with this project. Also, the storm facilities on site were unable to process increased wastewater flow because of the high ground water infiltration in the catchment area. This had been known to flood the site and surrounding areas.

Aerial photograph of Chichester WTW *Courtesy 4Delivery*

Improvement drivers
Recent environmental legislation changes and population growth triggered the need for the £14 million improvements to the works, enhancing final wastewater quality and overall treatment capacity. The Environment Agency (EA) designated Chichester Harbour as a sensitive area regarding eutrophication, which is a process whereby water bodies receive excess nutrients that stimulate excessive plant growth, often called algal bloom. This reduces dissolved oxygen in the water causing plants and other organisms to die and decompose.

New consents, or changes in the conditions, for the release of wastewater were issued by the EA, including total nitrogen consents, enforced for the first time in designated sensitive waters in the Southern Water region from the Urban Wastewater Treatment and Habitats Directive. In addition, ultraviolet disinfection of the final wastewater was introduced as a result of the EC Shellfish Waters Directive. This will protect the shellfish life in Chichester Harbour by reducing bacteria and pathogen levels in the wastewater released from Chichester WTW.

The Solution
In order to provide a value-for-money solution within challenging timescales, some existing works assets were assessed and retained:
- Inlet works;
- Two primary settlement tanks (PSTs) modified and reused, including auto-desludge;
- Two humus tanks converted to final settlement tanks (FSTs);
- Harbour outfall;
- Sludge holding tank.

New assets within the overall solution include:
- Combined lift pumping station to raise gravity flows from below ground;
- Activated sludge plant (ASP);
- Two new FSTs;
- Ultraviolet disinfection plant;
- Larger storm storage tank with additional screening and de-sludge facilities;
- Two drum thickeners;
- Polymer mixing plant;
- Two centrifuges;
- Five auto-feed cake skips;
- Additional sludge holding tank.

To minimise operational costs, the solution minimised the use of pumping stations and used gravity mains where possible. Full flow to treatment increased from 237 l/s to a maximum of 300 l/sec.

Activated Sludge Plant

To achieve the new 13.8mg/l Total N consent, a Modified Ludzak - Ettinger (MLE) activated sludge process was utilised at Chichester, which is a two-stage biological nitrification/de-nitrification process with internal recirculation, this process is shown in Figure 1.

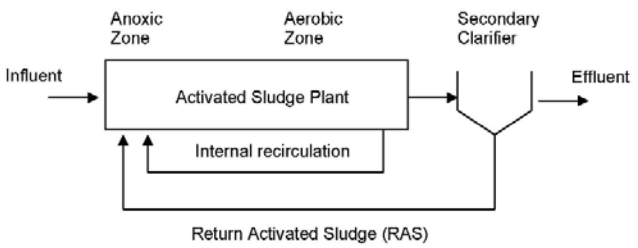

Figure 1 MLE process *Courtesy 4Delivery*

Suspended growth nitrogen removal processes consist of an aerobic zone (in which nitrification occurs) and an anoxic zone (in which de-nitrification occurs). Nitrified flow is fed back to the low oxygen anoxic zones, which is de-nitrified by the incoming flow from the PSTs.

Two types of bacteria are primarily responsible for nitrification, nitrosomonas and nitrobacter. Nitrosomonas oxidise ammonia to nitrite, and nitrobacter convert the nitrite to nitrate.

De-nitrification is the removal of nitrogen in the form of nitrate, by conversion to nitrogen gas, in the absence of oxygen. Conversion of nitrate is accomplished by several types of bacteria. These bacteria are heterotrophs and reduce nitrate to nitrogen gas.

The new activated sludge plant was divided into three separate lanes. During dry weather flows, the lanes can be isolated to reduce operational costs, then brought back into service as flows increase.

UV treatment

The purpose of disinfection in the treatment of wastewater is to substantially reduce the number of micro-organisms in the water to be discharged back into the environment. The aim of the EC Shellfish Waters Directive is to protect and improve shellfish waters to support shellfish life and growth. The directive is designed to protect the aquatic habitat of bivalve and gastropod molluscs, including oysters, mussels, cockles, scallops and clams.

Ultraviolet (UV) disinfection is used instead of chlorine, iodine, or other potentially harmful chemicals. Because chemicals are not used, the treated effluent has no adverse effect on organisms, as may be the case with other methods. UV radiation damages the genetic structure of bacteria, viruses and other pathogens, making them incapable of reproduction.

UV Plant *Courtesy 4Delivery*

Final concrete pour *Courtesy 4Delivery*

The disadvantages of UV disinfection are high energy demand, the need for frequent lamp maintenance and replacement and the need for highly treated wastewater to ensure the target micro-organisms are not shielded from the UV radiation. The converted existing humus tanks and two new final settlement tanks treat the wastewater to a very high quality. The new UV plant has a standby channel for use during maintenance and cleaning periods, so the treatment is never interrupted.

Sludge Treatment

The Chichester works has the ability to process 100 percent of sludge generated by the treatment process. A new auto-desludge system on the primary settlement tanks removes primary settled sludge to the sludge holding tanks. The by-product of the new sludge plant is surplus activated sludge (SAS), which is high in nutrients. This is dewatered by drum thickeners before entering the sludge holding tanks. The primary settled sludge and thickened SAS are blended together before being processed into a sludge "cake" by centrifuges. A powder polymer is mixed with the sludge to aid liquid removal from the sludge. The by-product of the dewatering process is a fluid called centrate, which is returned into the wastewater process.

Health, Safety and the Environment

Achievements during construction phase:

- Zero reportable accidents or environmental incidents;
- 250,000 man hours worked over 18 months, working within a congested, operational wastewater treatment works;
- Outperforming safety winner, runner-up in the Environmental Sustainability Awards 2007;
- Environmental Sustainability Award winner 2008;
- Zero non-compliance issues throughout construction and commissioning;
- Over 80 percent of waste reused on site or recycled;
- More than £10,000 raised for local charities through safety and environmental performance initiatives.

Working together, the Southern Water and 4D teams carefully applied their professional expertise, knowledge and skills to deliver this technically challenging scheme safely, within budget and four months ahead of consent compliance. A magnificent achievement by all parties involved.

On behalf of Southern Water, 4Delivery (4D) delivered improvement schemes in six wastewater treatment works in Hampshire and West Sussex, to meet new Total N consents which, in total, serve 670,000pe. The combined works provide treatment of up to 4,604 litres per second. 4Delivery is a consortium comprising United Utilities, Costain and MWH, and is carrying out a programme of environmental improvement and water quality schemes for Southern Water until 2015. The improvements are taking place across Kent, Sussex, Hampshire and the Isle of Wight.

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