Brighton & Hove WwT Scheme

£300 million environmental improvement scheme to bring cleaner seas to Sussex

by Frank Marron BSc

Work is well advanced on Southern Water's £300 million environmental improvement scheme to bring cleaner seas to Sussex. The scheme includes a new wastewater treatment works and sludge recycling centre at Peacehaven that, once complete, will treat the 95 million litres of wastewater generated each day by approximately 250,000 residents of Peacehaven, Telscombe Cliffs, Saltdean, Rottingdean, Ovingdean and Brighton and Hove. Various phases of the project have been featured in previous editions of UK Water Projects. The solution for the catchment was featured in 2010, while in the 2011 edition, the history of the project was covered along with a description of the construction of the green roof. In this article, we look at how the treatment process design was influenced by the constraints of the selected site, the associated planning conditions and some of the process issues that have had to be addressed during design and construction.

Peacehaven Wastewater Treatment Works - Courtesy of Southern Water
Designed to blend in with the surrounding downland landscape and includes the largest green roof of its kind in the UK spanning almost 18,000m²

Background

At present, wastewater from the area receives basic treatment at Portobello Wastewater Treatment Works in Telscombe before being released out to sea through a 1.8 kilometre outfall. As a result, this is now the only area in Sussex, and among the last in Europe, that does not meet European environmental standards on wastewater treatment.

This scheme includes the construction of 11km of new tunnelled sewers and 2 (No.) underground pumping stations – at Marine Drive, Brighton, and Portobello, Telscombe, to transfer wastewater to the new WTW as well as a new 2.5km long sea outfall pipe extending from Friars Bay, Peacehaven.

After the rejection of Southern Water's initial planning application in 2001 for development of a new treatment facility at the existing Portobello site, where currently only preliminary treatment is carried out, a protracted search was undertaken. This search identified 66 possible alternative locations which were considered. Following considerable evaluation, Lower Hodden Farm in Peacehaven was eventually selected as the most suitable site.

Further extensive studies were then conducted by Southern Water's consultants, Mott MacDonald, to select the most suitable compact treatment process that could fit in the constrained site and deliver the desired outputs. With the chosen location of a dry valley in the chalk downs just north of the coastal town of Peacehaven, both compactness and low profile were important selection criteria. Allowance also had to be made in the footprint for treatment expansion to meet possible future tightening of discharge consent conditions.

Few changes have been made to the original design concept which was put together at the planning stage. The long running planning

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Screened wastewater passes to aerated fat, oil, grit and grease FOGG channels, where air is injected to remove FOGG - Courtesy of Southern Water

process that culminated in a last minute judicial review before planning permission was finally granted in 2009, encouraged designers to ensure that there were no revisions to proposals in the planning application. The design team has worked tirelessly together to achieve this goal.

The treatment process

The wastewater treatment process involves preliminary treatment followed by a compact settlement stage and then a compact secondary treatment stage. Both indigenous and imported sludge are digested on-site and dried to produce a dry pellet product. Because of the proximity to housing and the stringent planning conditions, all treatment processes are within buildings or covered and are ventilated to a comprehensive odour treatment plant.

Preliminary treatment

Within the preliminary treatment building (PTB) an inlet pumping station raises the incoming wastewater 22m from the new tunnel to the first stage of treatment.

Flow enters the PTB where it passes through 6mm screens, to remove debris such as plastic materials and rags etc. The screens protect the downstream process and ensure the quality of final effluent and sludge product.

The resultant screenings are then washed and stored in enclosed skips within the PTB before disposal off site. Screened wastewater passes to aerated Veolia Water Solutions (VWS) designed FOGG (fat, oil, grit and grease) channels, where air is injected to remove FOGG. As a holiday area with lots of fast food outlets, high concentrations of FOGG are expected from the catchment.

The air injected at one side of the channel and the spiral motion that is induced in the wastewater as it passes along the channel encourages grit to settle and grease to float. The settled grit is pumped to grit washers and this gravitates into sealed skips which are contained in enclosed bays for disposal off site. The fat and grease is decanted from the water surface and passed to a grease concentrator where most of the entrained water is separated and returned to the head of the works. The concentrated grease is fed into the anaerobic digesters where it provides a rich source of organic matter for producing biogas. The grease concentrator importantly prevents excessive water passing to the digesters.

Ventilation of the PTB ensures a safe working environment while preventing the escape of odorous air to the environment.

Primary treatment

The screened, degritted and degreased wastewater then passes to primary settlement. Chemically enhanced primary settlement is carried out in VWS's Multiflo™ lamella settlers.

Chemical enhancement involves the addition of ferric salts and polymer chemicals. The ferric salts cause otherwise unsettleable materials, such as colloids, to coagulate and the polymer chemicals encourage flocculation into larger, more easily settleable particles.

A Multiflo™ lamella settler was chosen to provide primary treatment. The lamella plates in the settlers hugely increase the effective settlement area allowing for a very compact settlement process - Courtesy of Southern Water

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Inside one of the 10 (No.) BAFF cells, once complete this area of the cell will be filled with floating polystyrene beads - Courtesy of Southern Water

This process increases the percentage of solids that can be removed from the wastewater and reduces the size of secondary treatment required. The lamella plates in the settlers hugely increase the effective settlement area allowing for a very compact settlement process.

Innovations

Because the lamella plate settlers are covered, regular inspection and maintenance is more difficult. Therefore innovative facilities have been designed to help reduce the maintenance burden. One innovation is an automatic scum removal system. This incorporates spray bars and a scum channel with an actuated valve in each Multiflo™ unit. Any grease that escapes the FOGG channels will be skimmed off at regular intervals.

The 4 (No.) Multiflo™ units need to be regularly drained down to allow the lamella plates to be hosed down to maintain performance. This procedure is even more challenging when the tanks are covered. An innovative facility has been incorporated to help ensure the spaces between the lamella plates do not become clogged and reduce the need for hosing down. This facility consists of an aeration grid installed beneath the lamella plates. Aeration to the grids is cycled between each cell in turn. Air passing up between the plates helps release any accumulated solids.

Sludge is removed continuously from the Multiflo™ units and passed to the co-settled sludge tanks.

Secondary treatment

A cost-benefit analysis of compact secondary treatment processes led to selection of the biological aerated flooded filters (BAFF) process for this site.

The settled wastewater is distributed equally between 10 (No.) VWS Biostyr™ BAFF cells. Wastewater flows upwards together with air supplied by compressors though several metres of floating polystyrene beads. These beads are retained by a concrete slab perforated with nozzles that allow the water to pass but hold back the beads. Biological treatment is provided by the aerobic micro organisms that grow on the beads in the presence of nutrients and oxygen, provided by the wastewater and air.

The beads also act as a filter so that no final settlement stage is required. This system provides a compact biological treatment process, that is contained within the area available. The beads need to be backwashed regularly to remove excess biomass and prevent clumping. The backwash water is returned to the head of the works.

Final effluent gravitates 1.4km from the WTW to the start of the 2.5km long sea outfall extending from Friars Bay.

Futureproofing

Space has been set aside on the site for expansion of the plant should more stringent discharge standards be imposed in the future. The Biostyr BAFFs can be upgraded to simultaneous nitrification/denitrification configuration. Space has also been left

The upper level of the BAFF, the polystyrene beads are retained by a concrete slab perforated with nozzles that allow the water to pass but hold back the beads - Courtesy of Southern Water

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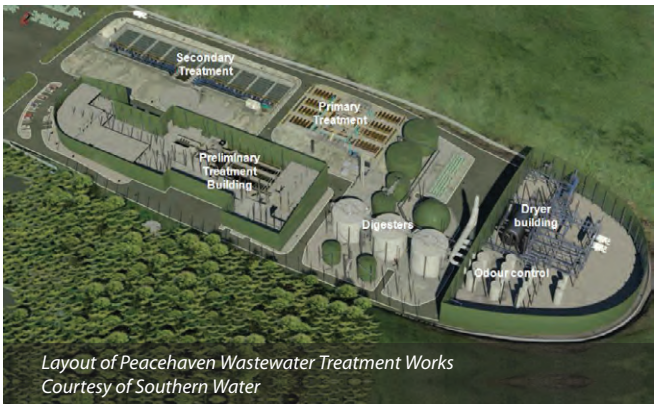

Layout of Peacehaven Wastewater Treatment Works
Courtesy of Southern Water

for the introduction of a tertiary treatment stage, should additional treatments be required.

Sludge treatment

Site space constraints as well as planning conditions limiting vehicular traffic to and from the site have led to the selection of a sludge drying process. Sludge imports will normally arrive as raw cake and treated sludge will be exported as dried pellets. The centre also has facilities to receive imports of cess, raw sludge as liquid or cake and digested sludge cake.

All raw sludge imports and indigenous sludge are screened and stored in the co-settled sludge tanks and then thickened. Raw cake imports are blended with a sludge stream from the co-settled tanks to 7% dry solids before screening and recombination with the thickened liquid sludge. Thickened sludge is then fed along with concentrated grease to three anaerobic digesters.

Sludge remains in the digesters for about 14 days while anaerobic organisms convert the organic matter into biogas, a mixture of methane and carbon dioxide. The biogas is normally used as a fuel to produce electricity in a combined heat and power plant (CHP). The waste heat from the CHP then heats the digesters.

Digested sludge is transferred to the drying building where it is dewatered in centrifuges to 23% dry solids. Cake is fed to Andritz's rotating drum dryer which is rather like a large tumble dryer which removes the remaining water by evaporation giving a product with less than 10% residual moisture. Numerous new safety features have been incorporated into the design of the facility. The dryer uses natural gas to dry the sludge or, if desired, can be fuelled by biogas. The dried sludge is pelletised and stored in bags. It will be used as soil conditioner in agriculture, though it is suitable for incineration.

Odour treatment

Odorous air is treated in a three-stage odour treatment plant. There are three separate ventilation lines: dryer air, odour hotspots and the buildings and BAFF. Air from the sludge dryer passes through a venturi scrubber to remove particulates, then an acid scrubber to remove ammonia. Air from the hotspots passes through an acid scrubber. Both air streams are then combined with the general building air and pass to a caustic/hypochlorite scrubber. The final stage is heating and carbon scrubbing using copper oxide impregnated carbon.

Conclusion

This work is being completed by 4Delivery, a consortium of Veolia Water, Costain and MWH and is due for completion by March 2013. Technical governance is provided by Mott MacDonald. When completed, the new works will meet the latest UWWTD, help improve the environment and provide cleaner seas to Sussex.

The Editor & Publishers thank Frank Marron, Process Engineer with Mott MacDonald, for preparing the above article for publication.

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