

Brighton & Hove WwT Scheme

Peacehaven WwTW - handover and completion of the *Cleaner Seas for Sussex* project

by Anthony Thomas MEng, Mike Walker & Iain McGregor BEng

Before the new treatment works at Peacehaven, wastewater from Peacehaven, Telscombe Cliffs, Saltdean, Rottingdean, Ovingdean and Brighton and Hove, passed through preliminary treatment before being released out to sea at Portobello. As one of the last remaining conurbation in the UK failing to meet the European Urban Waste Water Treatment Directive, Southern Water (SW) launched a major new environmental improvement scheme to bring the south coast into line with the directive. Twelve years later, planning was approved and work began on the *Cleaner Seas for Sussex* Project. In a dry valley to the north of Peacehaven, works began on the construction of the *Cleaner Seas for Sussex* Project in July 2009. After four and a half years, more than 1 million cubic metres of earth excavated, 39,000m³ of concrete poured and over 4.5 million man hours worked, this £300m project had to be handed over to Southern Water. After successful completion of commissioning the previous year, work began on achieving compliance and take over testing.



Introduction

Undertaken by 4Delivery Ltd (a joint venture between Costain, Veolia and MWH) this flagship project involved the construction of a new wastewater treatment works (WwTW), and sludge recycling centre (SRC) serving a population of 300,000, and capable of treating up to 218ML/d.

Three deep shaft pumping stations pass forward flow through 11km of new sewer tunnel which runs from Brighton Marina to the works at Peacehaven, varying from eight to 40m below ground level. At the works, flows pass through three stages of treatment before being released 2.5km out to sea. Preliminary treatment consists of 3 (No.) 6mm band screens followed by 3 (No.) aerated lanes to remove fat, oil, grit and grease (FOGG). Primary settlement takes the form of 4 (No.) chemically assisted Multiflo™ lamellas supplied and commissioned by Veolia Water Solutions & Technology.

A Biostyr™ biologically aerated flooded filter (also from Veolia) is the final treatment stage; 10 (No.) cells filled with polystyrene beads which promote the growth of bacteria, ensure that the quality consents for the final effluent are achieved.

Sludge from the lamellas is screened before co-settlement and thickening by gravity belt thickeners to 7% dry solids (DS). It is then fed into anaerobic digesters at 35°C. The resulting biogas is used by the combined heat and power (CHP) plant to produce 1MW of electricity, for use on site, and heating for maintaining digester temperature. The electricity generated from biogas allows Southern Water to receive Renewable Obligation Certificates (ROCs).

After 14 days the digested sludge passes into post digestion tanks before it is centrifuged to 25% DS and dried in a thermal dryer, supplied by Andritz UK, to 92% DS.

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The SRC has the facilities to accept deliveries of imported liquid sludge, raw cake and digested cake. This facility allows the site to help other SW assets in emergency situation.

All processes and building spaces have odour extraction (provided and commissioned by Plasticon (UK) which treats 250,000m³ per hour though three acid and three alkali scrubbers and three carbon absorbers before releasing it to atmosphere.

Commissioning

Before commissioning started, a detailed Commissioning Plan was produced explaining the test regimes and strategy of bring the plant online, ensuring client buy-in and establishing communication from the outset. By implementing a 100% testing regime the client signed off areas of commissioning on a daily basis, allowing for progress to continue without conflict.

As part of their strategy, 4Delivery broke down the project scope in to 18 areas with sub groups of between one and six sections. This allowed the site to be broken down into manageable process areas and achieve sign off on individual areas.

A phased approach was taken for commissioning. This allowed for construction completion of the later treatment stages whilst accepting flows for preliminary treatment. The works was brought into service in three defined Turn of Flows (TOF):

- TOF 1: Was the infrastructure pumping stations and preliminary WTW
- TOF 2: Focused on the lamella primary treatment and sludge treatment
- TOF 3: Looked at the secondary treatment BAFF plant and dryer package.



At TOF 1 flows were initially restricted to 600l/s to ensure a steady, continuous flow into the treatment works, with excess flows continuing to pass to the existing works at Portobello. After the FOGG process was optimised and working correctly, TOF 2 commissioning began. Over the course of a month the 4 (No.) Multiflo™ cells were brought online with their respective chemical dosing for flocculation and coagulation. The settled sludge was then screened and forwarded on to the sludge treatment process.

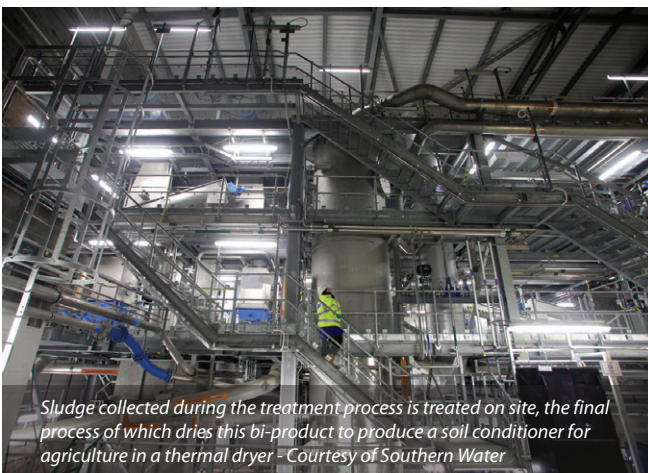
The digesters were seeded with stable sludge from another SW site promoting bacterial growth within the new indigenous sludge. Sludge from the co-settlement tanks was fed into the gravity belt thickeners before being pumped into the digester feed tanks. After a period of carefully introducing indigenous sludge to the digesters, they over spilled into the post digestion tanks, which enabled TOF 3 commissioning of the centrifuges and dryer, resulting in the production of granules for agricultural use.

In TOF 3 the Biostyr™ plant was brought online. Full flows were now being treated on site and all ten cells were brought online together. As the biological processes established themselves, the quality improved and once all phases of the plant had stabilised compliance testing could begin.

Compliance testing

Compliance testing for the *Cleaner Seas for Sussex Project* involved completing 13 tests to a strict set of criteria. The tests ensured that SW could meet discharge consents for final effluent and odour emissions. Biological oxygen demand (BOD), chemical oxygen demand (COD), metals and suspended solids were tested to ensure that the quality of the final effluent achieved the required consent.

Flow to site was also tested to ensure that the peak pass forward rate, as defined in the consent, is also achieved. Odour stack velocity and H₂S concentration were also measured for compliance with planning conditions.



The tests were conducted over a continuous period of 28 days for successful testing to be achieved. Prior to the commencement of testing, 4D entered into a phase of pre-testing. This ensured that the tests would achieve their criteria within the 28 days without having to restart the tests.

Compliance testing was completed on the March 10, 2013. Following the receipt of all accredited sampling two weeks later the compliance test report was handed to SW to review, signed off as complete one week later, achieving the consent deadline.

By holding daily meetings between 4D and Southern Water, 4D was able to react to any problems/risks we were faced with and reviewed progress towards completing any actions raised. These meetings allowed 4D to keep a running tally of completed days and tests without having to review them at the end. By involving SW prior to entering into compliance testing and conducting 100% pre-testing, 4D was able to provide SW with confidence that the tests would achieve the criteria within the period.

Take over testing

In a similar fashion to compliance testing, Take Over Testing (ToT) comprised of 44 tests running over a 28 day period, testing every part of the infrastructure and treatment works.

Some of these were repeats of the tests seen in compliance testing, however ToT looked into the operation and reliability of the plant as well as the quality for water and sludge processes. A pre-test period occurred before entering into test.

Incorporating lessons learnt from compliance testing; SW had a major role during the test period. Methodologies were presented to SW for approval before entering into the test. This ensured that they understood how the tests were being conducted and how the results would be presented. Daily meetings were held between

4D and SW during the test period where plant performance was reviewed, sampling, alarms, events and other tests results were discussed and approved at this meeting. Events of that day, previous and the next day were reviewed as well to ensure that all parties knew what was occurring and representatives could be arranged for witnessing.

On October 10, 2013, ToT began and was achieved on the December 19, 2013, except for a few areas where the plant still had to be tested, because sludge and cess imports were not at that stage being received on-site. This meant they couldn't be done within the original test period and were therefore tested when the programme of works was completed.

SW and 4D worked collaboratively for a successful resolution of these delayed areas and allowed the ToT to begin for the rest of the site while this work was on-going.

Examples of the take over tests

Test T23 was a repeat from compliance testing; 4D worked with Southern Water to define exactly how it would be carried out and what it entailed. With agreement 4D hired specialists from RPS to perform velocity measurements across the odour stack and report back their findings. The velocity achieved the criteria. From the results it was possible to determine a coefficient which can be applied to the flow meter of the fans for the stack, SW agreed that this method for ToT. This enabled 4D to save cost by not having to hire the contractor again and time by not having to wait for the results to be presented.

Test T30 tested the reliability of the plant. This test would fail should any process stream be unavailable for more than 1% of the test period. Since the whole works was included in this test, a permit regime was strictly enforced to manage planned maintenance. Daily alarms and events were used to measure the unavailability.



A biological aerated flooded filter (BAFF) provides the final stage of wastewater treatment at Peacehaven WwTW - Courtesy of Southern Water

| Test # | Specific Test | Performance criteria | Type of sample | Sampling point | Frequency of sampling | # of allowable failures |
|--------|--|---|---|--|---|-------------------------|
| T23 | Odour control stack velocity | A velocity not less than that assumed in the odour dispersion modelling (21m/s) and not less than 15m/s at average air flow rates | Spot reading | Ventilation system operating at average discharge rate | Until reliable readings obtained | 0 |
| T30 | Plant reliability | Not more than 1% unavailability of any process stream or operation during the 28 day test period. | Operational records | Operational records | Continuous | 0 |
| T35 | WTW hydraulic profile and performance verification | Water levels in process units, chambers and channels shall not exceed design levels. | Level sensors/SCADA and supplementary water level measurement as necessary to demonstrate compliance. | Throughout the water line of the WTW | Up to 4 times (at least once to coincide with maximum flow or simulated maximum flow conditions). | 0 |



More than 100 people attending the project's was formal opening on 14 October 2013 - Courtesy of Southern Water

The works has been designed with standby plant for nearly every item on site; as a result the test was passed with only 31 minutes of downtime out of the possible 403 minutes allowed within the 28 days' test period. This is a good example of how day to day management alongside the client and operation staff accommodated an effective and efficient test period.

Test T35 was a guarantee to SW that what has been design and built by 4D was hydraulically correct. The methodology for this test went through a series of revisions before an agreement was made. SW worked with 4D to define and perform the test which enable the results to be agreed as measurements were taken. The contract definitions of the take over tests noted above are in the table above.

Conclusion

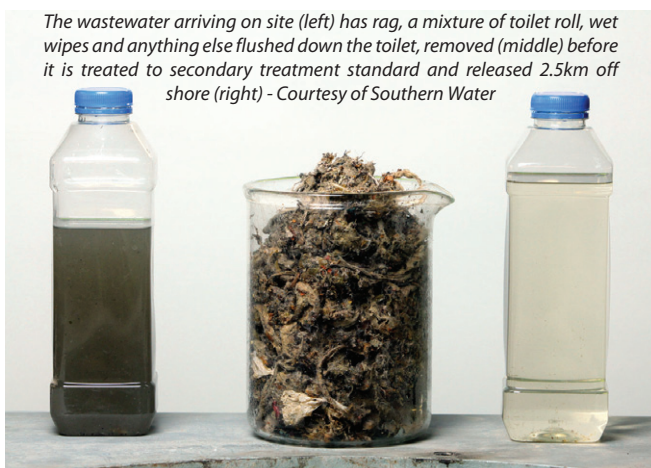
Bringing into service and testing of a new £300m wastewater treatment works and sludge treatment and recycling centre the size of the *Cleaner Seas for Sussex* project would normally result in considerable amount of time being spent in discussions with the client following the conclusion of the test period; generally these discussions taking longer than the tests themselves.



Media were shown the site as part of the formal opening of the project Courtesy of Southern Water

However, Southern Water provided a site team that was both involved and engaged with all aspects of the project and as a result gained a detailed working knowledge of the plant. More than this, they were determined and worked with the same drive and enthusiasm as 4D staff to have the tests professionally completed. Furthermore, issues arising from the test were worked through quickly to the satisfaction of both parties.

4Delivery implemented a regime of 100% pre-testing to prove to themselves and the client that the test criteria would be achieved before beginning the test. This ironed out any interference factors and demonstrated that the plant would operate as expected giving confidence to all parties.



The wastewater arriving on site (left) has rag, a mixture of toilet roll, wet wipes and anything else flushed down the toilet, removed (middle) before it is treated to secondary treatment standard and released 2.5km off shore (right) - Courtesy of Southern Water

Since achieving take over in December 2013, the final tests have been successfully completed and a series of performance tests commenced.

With client collaboration in every step of the commissioning phase and by committing to a 100% testing strategy, 4Delivery was able to achieve hand over of this flagship project, attaining the high quality standards required while demonstrating the stability of the process. The scale and engagement of this scheme makes it a truly remarkable project that has been extensively recognised by numerous national bodies.

The Editor & Publishers would like to thank Anthony Thomas, Engineer, Mike Walker, Commissioning Manager, and Iain McGregor, Project Installation and Commissioning Manager, all with 4Delivery, for providing the above article for publication.



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