

Berry Hill STC & Taunton STW

£16m of improvements to sludge digestion facilities

by Stuart Lewis BEng Hons, Trevor Farrow BSc (Hons) C Eng MIMechE & David Shepherd

A key objective of Wessex Water's AMP5 Sludge Strategy was to provide the capability to digest over 90% of all sewage sludge by March 2015, in order to minimise greenhouse gas emissions and increase renewable electricity generation in conformity with UK Government climate change commitments. By the end of AMP5, sludge digestion has been concentrated at five sites, with major investment in additional capacity carried out at three sites in particular. This paper details the sludge digestion facilities at Taunton Sewage Treatment Works (STW) and the Berry Hill Sludge Treatment Centre (STC).



New digester and gas storage at Berry Hill STC - Courtesy of Nomenca

Project need

Customer research carried out in preparation for Wessex Water's AMP5 proposals showed that they place a high priority on a reduction in greenhouse gas emissions and increase in sustainability of the company's operations. This contributed to Wessex's commitment to substantially increase its self-generating capacity by the end of AMP5 by 55% to just over 50GWh/yr, focusing treatment on five main sludge treatment centres and digesting all sludge.

Following detailed examination and cost-benefit analysis, one of the key objectives of the strategy adopted was "...to consolidate sludge digestion at fewer sites with round-the-clock treatment capability, to benefit from operational and generation efficiencies"; which also reduces the sludge transport requirements, as well as the number and location of sludge digestion sites.

During AMP4 it was demonstrated that the most cost-effective, flexible and least risk treatment option to provide sustainable benefits of reduced greenhouse gas emissions and renewable power generation was sludge digestion. Following on from this, during AMP5 the plan was to consolidate sludge treatment at fewer, larger facilities with 24/7 digestion capacity to realise further operational benefits from economies of scale and maximise process efficiencies.

These were based on existing digestion sites serving the major population centres, by expanding and enhancing existing capacity. By the end of AMP5, sludge digestion has been concentrated at five sites: Avonmouth, Poole, Berry Hill, Taunton and Trowbridge. Major investment in additional sludge treatment capacity was committed to the latter three sites.

The strategy of developing three existing sites had been appraised against an alternative option, where a new geographically central site would be developed to minimise sludge transport movements. The three-site strategy was shown to have significantly lower capital cost as it avoided the development of a completely new digestion centre and liquor treatment plant. The three-site strategy also had a lower NPV despite incurring increased tankering costs which were significantly outweighed by the savings in CAPEX.

The graph (see next page) shows the anticipated changes in sludge production in the Wessex region; and the potential of adopting a 100% digestion strategy to reduce sludge solids to be recycled or disposed, increase CHP generation and reduce greenhouse gas emissions. The graph shows a net saving in CO₂; derived by taking into account current embedded carbon from using lime, which will be avoided in future, and accounts for the energy generated from the biogas.

Providing liquid and biogas storage solutions with all ancillary equipment as a specialist design & build contractor for Water, Wastewater & Bioenergy Infrastructure.



Specialist Design & Build Contractor

KIRK UK is the leading liquid storage tank specialist in the country and our success, product portfolio and infrastructure is unrivalled in the industry.

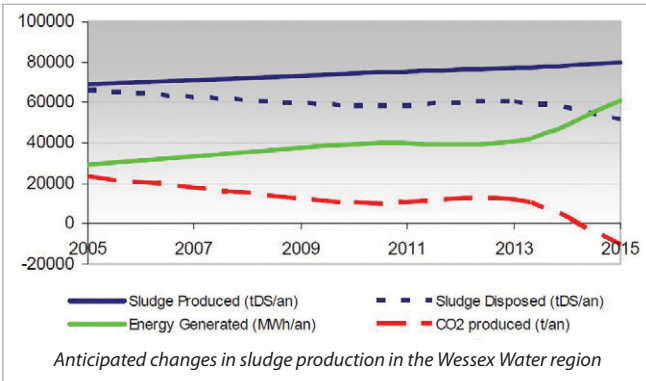
Our unrivalled reputation has been attained through years of successful project completions by our dedicated team of professionals who offer the highest levels of support from early involvement in proposals and continuing through engineering, manufacturing and site installations.

All manufacturing, project management, design and installation are carried out in-house to provide a complete service whatever your requirements.

- Glass-Fused-To-Steel Tanks
- Epoxy Coated Steel Tanks
- Stainless Steel Tanks & Digester Roofs
- BIODOME® Double Membrane Gas Holders
- Access Steelwork & All Ancillary Items
- In-house Engineering, Project Management & Construction

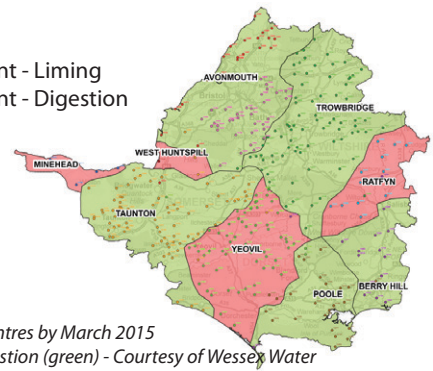


www.kirk-uk.com



KEY - STCs named

- STC Catchment - Liming
- STC Catchment - Digestion



Sludge Treatment Centres by March 2015
Liming (red) and digestion (green) - Courtesy of Wessex Water

Increased digestion capacity has been provided under AMP5 at Taunton, Berry Hill and Trowbridge; under three separate schemes.

The first two have been delivered by the Treatment 1 Workstream for Wessex to extremely tight timescales - the original scope for both sites required the provision of a new acid phase digestion (APD) plant upstream of the existing digesters, but this was changed to the provision of new digestion capacity late on, though still to be available by the original target date of March 2015.

Vehicular access to both sites has historically been a significant issue and the provision of alternative access to both was to be delivered under separate schemes; land and planning issues have delayed these to an extent that they are now due to be completed in AMP6. For instance one is currently the subject of a CPO, while the other involved an appeal to the Planning Inspectorate.

Digestion at Taunton STW

The existing digestion facilities at Taunton include two RC mesophilic anaerobic digesters (MAD) of 4,500m³ total volume that were reliable, but in need of refurbishment.

The gas from these digesters is processed through two CHP units that had been installed in 2010 in advance of this scheme, sized to process the future increased gas production. The electricity produced is used to power the site, with the facility being in place to export to the Grid.

The original brief for Taunton asked for the following to be provided:

- Improvements to sludge reception and screening.
- Improvements to thickening and dewatering plant.
- New acid phase digestion plant upstream of the existing digesters.
- Additional biogas storage.
- Improvements to mixing in the existing digesters.

However, in October 2013 it was agreed that the APD plant and biogas storage would be deferred and a new digester constructed instead. This placed a significant challenge on the delivery team as only outline design of the digester had been completed at this stage; the challenge was therefore to design and construct the new digester within 15 months.



ABC (Stainless) Limited

Craftsmen in stainless steel

Pipework • Tanks • Weir Plates • Baffles • Pressure Vessels •
Storage and Process Tanks • Process Equipment • Launderers •
Aeration Pipework and Lift Out Grids • Biogas Pipework •

“Approved for use in public water systems”






Empson Road, Eastern Industry, Peterborough PE1 5UP
T: +44 (0) 1733 314515 • F: +44 (0) 1733 315273
www.abcstainless.co.uk • martin.smith@abcstainless.co.uk



Work at Taunton STW started on site in May 2014 and has proceeded without too many significant issues; an incident with the existing STW facilities on site did cause a 6-week delay while Operations looked to reinstate the process capacity.

In order to undertake the construction work it was necessary to relocate a number of existing services including propane storage tanks and below ground gas pipelines and electrical services.

Also of significance is the modification works required to the existing hot water primary and secondary circuits in order to provide for integration of the 3rd digester.

The new digester (of 2,400m³) capacity is manufactured from epoxy coated sectional steel panels with conventional thermal insulation and cladding to the external shell and roof. Both tank and access staircase have been designed and built by Kirk Environmental.

Refurbishment of the existing digesters will be carried out sequentially. One digester (the smaller one with a capacity of 2,100m³) will be taken out of service, while still maintaining sludge compliance. Once it had been commissioned the larger digester would be refurbished.

The treatment capacity following completion will be 21.8tDS/day, though the addition of an APD stage in the future (the detail design for which has been completed under this scheme) will allow this to rise to 30tDS/day.

Digestion at Berry Hill STC

Berry Hill is the largest sludge treatment centre in the south of the Wessex region and currently has three RC MADs, totalling just over 7,000m³.

The outline design for the scheme was reviewed in March 2012. Initially this included an acid phase digestion plant, but the estimated outturn cost at this time exceeded the available budget by a significant margin.

As a result it was agreed that a 'high-level' review of alternative solutions and scope reduction should be carried out to see whether significant cost savings could be identified.

An alternative proposal of installing a fourth mesophilic anaerobic digester (2,360m³) with secondary sludge storage (3,300m³) was assessed at high level. This confirmed that the construction of this 4th digester would bring cost savings to the scheme.

Agreement was subsequently given in October 2012 to proceed with the alternative solution.

The scheme started on site in May 2014 and now includes:

- Improvements to sludge import facilities, storage and screening.
- Improvements to sludge thickening and polymer plant.
- New 4th MAD.
- Improvements to the existing MADs.
- New biogas storage to serve all digesters.

The additional biogas generated will be used by the existing 1MWe CHP plant. The scheme also includes for strategic capital maintenance work to the imported sludge reception area, sludge holding tanks, sludge thickening, inclusive of new polymer dosing plant and the existing 3 (No.) mesophilic anaerobic digesters.

Berry Hill STC receives imported sludge delivered by road from a number of sites, together with Surplus Activated Sludge (SAS) and primary sludge pumped separately from the nearby Holdenhurst STW. Treatment capacity will be 29 TDS/day on completion.



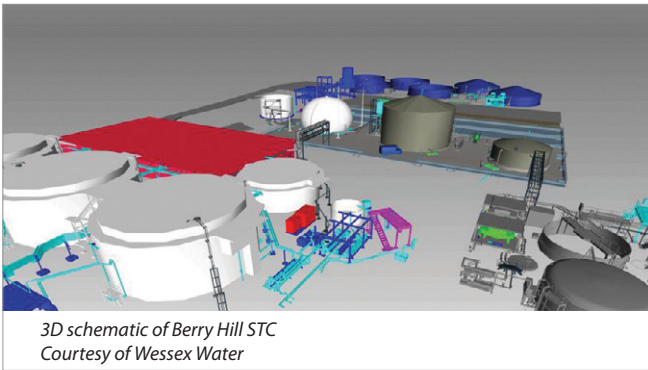
New Digester at Taunton STW - Courtesy of Nomenca



New GBT at Taunton - Courtesy of Nomenca



Digester #4: Berry Hill STC - Courtesy of Nomenca



Ongoing improvements

The improvements at Taunton STW are costing approximately £7m, while those at Berry Hill STC are £9m. Both schemes provide for a planning horizon of 2025. Both digesters were available by March 2015. Interfacing with existing operational assets and the constrained nature of the sites has presented challenges to the construction teams and influenced the construction programme.

Work at both sites will continue on through AMP6. At Taunton the 2 (No.) existing digesters will be refurbished through 2016 and sludge cake processing facilities installed by the end of the AMP. Refurbishment of the existing digesters at Berry Hill commences in June 2015 and will run through until December 2016.

As a result of the complexity of both schemes 3D modelling was employed in order to assist with the design and to enable both the design teams and operational staff to visualise the final designs so everyone knew what was to be provided once the schemes had been completed. Other benefits include reducing wastage & re-working, minimising clashes etc, which helped ensure the programme was achieved.

Implementation

Wessex Water adopted a 'workstream' approach for the delivery of schemes in AMP5, and the overall roles of the Partners for these schemes are as follows:

- CH2M HILL (who acquired Halcrow Group): Responsible for the outline and detailed design at Taunton, and the outline design at Berry Hill.
- Balfour Beatty Regional Civil Engineering (formerly Dean & Dyball Construction): Responsible for civil engineering construction services.
- Nomenca: Responsible for M&E procurement, installation, and joint commissioning with WECS (and employed Eastwood & Partners to complete the detail design for Berry Hill).
- Wessex Engineering and Construction Services: Responsible for Automation, Commissioning and Environmental Services.

Conclusion

The schemes presented a number of challenges. Access to both sites is constrained by consideration given to local residents on traffic movements and working hours, and this ultimately had an effect on the programme. The Taunton site itself lies within the flood plain of the adjacent River Tone, which is the main river for the discharge from the works.

These schemes have proved to be complex and all parties involved have worked well together in order to deliver the schemes by the deadline of March 2015.

The editor and publishers would like to thank Stuart Lewis, Programme Manager with Wessex Water, and Trevor Farrow and David Shepherd, both Project Managers with Nomenca, for providing the above article for publication.



Mixing pump - Courtesy of Nomenca



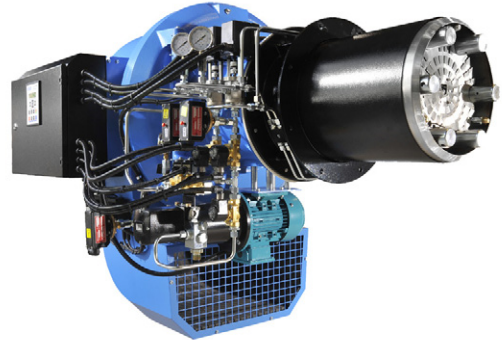
Sludge blending tank - Courtesy of Nomenca

DUNPHY**Reliable, high efficiency, low NOx combustion**

Dunphy burners are designed with axial air flows, internal flue gas recirculation and special combustion heads to deliver high operating efficiency, low fuel costs and ultra low NOx emissions.

Our multi fuel burners will simultaneously fire sewerage biogas and natural gas and have the capability to burn gas and gasoil.

Our RatioTronic™ control systems manage the safe cofiring and switching of fuels as well as modulation and sequencing.



Dunphy design, manufacture, install and maintain fully equipped, containerised boiler houses which are ideal for wastewater treatment sites where space is tight or where professional build control is required.

Assembled and fully tested in our purpose built plant, the containers are then transported to site and quickly and efficiently linked up and commissioned by our specialist engineers.

We prepare all FDS reports, DSEAR analyses, SIL and risk assessments.

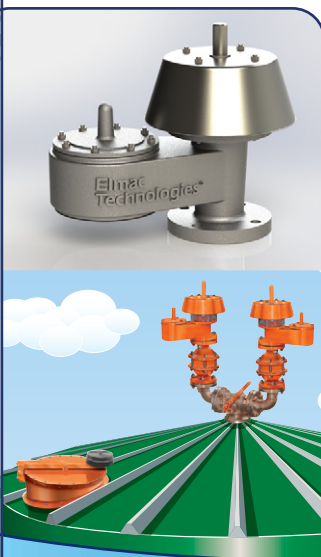
For further information, contact sharon.kuligowski@dunphy.co.uk



Elmac Technologies®

Protecting People, Property and Our Planet

BIOGAS - VENTING & EXPLOSION PROTECTION EQUIPMENT



ATEX approved valves & flame arresters

Digester over-pressure protection

Foaming relief vents

Flare - gas line & pilot flame arresters

Expert sizing & specification services

In-house test & performance enhancement capabilities

T: +44 (0) 1352 717600

sales@elmactechnologies.com

www.elmactechnologies.com

Elmac Technologies Ltd., Coast Road, Greenfield, Flintshire, UK, CH8 9DP