Trowbridge STW

acid phase digestion generating green energy with advanced digestion

by Jonathon Gillard

Wessex Water's Trowbridge STW is a regional sludge processing centre currently treating approximately 2,000 tonnes of dry solid (TDS) per annum of indigenous sludge and around 4,500 TDS per annum of imported sludge. Historically only a portion of this sludge has been digested at the Trowbridge site so an advanced digestion project was identified as a regulatory output with a delivery date of March 2014. Based around acid phase digestion (APD) technology, a competitive tender was issued in May 2012.

The APD tanks being erected - Courtesy of MWH Treatment

Achieving renewable energy goals

Wessex Water has implemented a 25-year plan for becoming a truly sustainable water and sewerage business where reducing its carbon footprint and generating more renewable energy are priority issues. For many years Wessex Water has utilised methane gas for renewable energy; by 2013 this met approximately 20% of the business energy needs.

Trowbridge advanced digestion scheme was included in the Wessex Water AMP5 business plan as the first of three further APD projects that will achieve the regulatory target of 51GWh of renewable energy generation by 2015. The aim is to progressively use more energy from renewable sources with a goal of generating 30% of its own energy by 2020.

Prior to the APD project there were 3 (No.) existing digesters at Trowbridge STW with an associated combined heat and power plant (CHP). This digestion plant had capacity for treatment of only circa 30% of the sludge and required significant capital maintenance work to remain operable and safe. The digestion plant was therefore shutdown and decommissioned, while compliance was achieved by dosing all of the imported and indigenous sludge with liquid lime. The new APD plant will digest all of the indigenous and imported sludge to the site.

Undertakings

In August 2012 Wessex Water engaged MWH Treatment (MWHT) for the £10m turnkey project that includes detailed design, construction, supply, installation, testing and commissioning of a complete new digestion facility under NEC Option A contract terms.

The scope of the contract with MWHT comprises the complete mechanical, electrical and civil works for the APD plant as well as:

- Sludge storage tank.
- Sludge thickening plant and associated polymer dosing plant.
- Thickened sludge storage tank.
- Acid phased digestion plant with the provision for future upgrade to enhanced enzymic hydrolysis.
- 2 (No.) mesophilic anaerobic digestion tanks .
- Conversion of 2 (No.) existing lime blending tanks to digested sludge storage tanks.
- Biogas holder.
- Gas chilling and siloxane removal.
- Combined heat and power (CHP) plant.
- Sludge heating system and standby boilers.
- Fully enclosed biogas flare stack.
- Demolition of existing tanks.

Water Excellence

Our scale, track record and skill diversity in water and wastewater bring assured delivery and a solution for every challenge.

MWH is one of the world's largest providers of water, environmental, infrastructure and energy services.

For further information please email:
mwhuk.info@mwhglobal.com

www.**mwhglobal**.com

MWH®

BUILDING A BETTER WORLD

BUSINESS CONSULTANCY • PROGRAMME & PROJECT SERVICES • ENVIRONMENTAL ENGINEERING • CONSTRUCTION

Demolition of the existing digestion tanks - Courtesy of MWH Treatment

Recycling of materials on site - Courtesy of MWH Treatment

- Associated siteworks, on-site access roads, surface treatments.
- New MCCs.
- Power distribution and site-wide HV electrical infrastructure upgrade.

Design basis

The plant was designed at a 2025 design horizon of sludge load inputs to the works and incorporates some spare headroom to give a digester feed of 30,000 kg dry solids (DS) per day at an average feed concentration to APD of 6% DS, with the thickening plant and ancillaries designed to achieve up to 8% DS. Together with a modest growth in indigenous sludge load the design basis represents a 50% increase in Imports to the site.

	Design basis (digester feed)	
	kg DS/d	TDS/yr
Indigenous sludge	6,999	2,555
Imported sludge	23,001	8,395
Totals	30,000	10,950

The plant will achieve a guaranteed pathogen reduction of *escherichia coli* by not less than 2 log across the enzymic hydrolysis plant and produce 1.15MWe.

Process description

Imported sludge is received via the existing imported sludge storage tank and passed to either the new 940m^3 or the existing sludge storage tank via the existing sludge screens where it is blended with indigenous sludge prior to thickening. These tanks provide a total of two days of storage in combination. Thickening is achieved by duty and standby gravity belt thickeners (GBTs) to an average of 6% DS utilising powder polymer. The thickened sludge

is stored in a 640m³ thickened sludge storage tank with one day retention from where it is pumped to the APD plant.

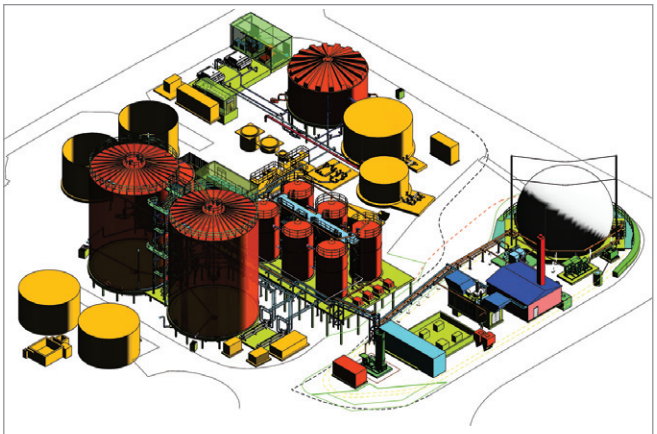
The APD plant is an enzymic hydrolysis process having 500m³ per day throughput and using 6 (No.) tanks in series to pre-treat the sludge prior to digestion in 2 (No.) mesophilic anaerobic digesters (MAD) with gas mixing. The APD plant provides both pathogen kill and hydrolysis of the sludge which is the first stage of the digestion process. The hydrolysis process ruptures the cells and makes more organic material from the sludge available to the methanogenic bacteria in the digesters leading to an increase in biogas production in the MAD digesters. The system is designed with an eye to the future and can be readily upgraded to enhanced enzymic hydrolysis providing an 'advance treated' standard in accordance with the ADAS Safe Sludge Matrix.

2 (No.) 15.4m dia by 20.2m high glass coated steel anaerobic digestion tanks each provide 3,500m³ capacity with a combined 14 days retention time. Gas is compressed and recirculated through the tanks to mix the sludge. Biogas is also passed to a double membrane type gasholder of 2,100m³, providing four hours retention.

Biogas from the gasholder is chilled and boosted to the new CHP engine via a regenerative siloxane filter. The CHP engine uses the biogas to produce up to 1.15MW of green energy and also provides heat for both the APD and digestion systems. Standby boilers with a combined heat capacity of 1,500kW are also incorporated into the hot water system. A new enclosed waste gas burner of 600Nm³/hr capacity, complying with the EA LFTGN05 emissions standards is provided to burn excess biogas.

Digested sludge gravitates to the 2 (No.) existing lime blending tanks now operating as digested sludge storage tanks from where it is pumped into the existing dewatering belt presses. The resulting cake is transported off site for beneficial reuse.

Pouring the slab for the APD area - Courtesy of MWH Treatment



3D model of the new APD and digestion plant
Courtesy of MWH Treatment

Programme efficiency delivering early benefits

MWHT worked very closely with the APD technology provider, Monsal, to determine the optimal programme for project; with particular focus on the installation phase and commissioning period. There was close attention to the sections of the plant that were on the critical path and programme efficiencies enabled Wessex Water the opportunity for an earlier income stream from power generation. The regulatory completion date for the works was March 2014, but MWHT have been able to offer a completion target of December 2013, providing Wessex Water with the potential for up to 2,000MW of additional power generation together with cost saving from an earlier shutdown of the liming operation.

Achieving a tight programme with constraints on the space available, while maintaining existing sludge imports, exports and lime processing operations adjacent to and around the working area has proven a challenge to which the MWHT team has risen. Despite the worst that the British weather could throw at the team, the project is progressing to plan.

Collaborative construction

Wessex Water is a new client to MWHT and the project utilises NEC Option A terms; a design and build form of contract that Wessex Water has not used during AMP5. In order to ensure the individuals in each organisation understand the others priorities, a facilitated workshop was arranged. The workshop brought the team closer together and enabled a better understanding of the key success and pitfall criteria for each individual.

In line with the Government Construction Strategy, MWHT has placed 3D modelling and building information management (BIM) design tools at the heart of the detailed design, collaboratively using engineering staff in both Heywood and Pune offices with additional input from the supply chain. This 3D model was particularly useful to provide a visualisation for submission to the local planning authority and for the access, lifting and maintenance study. Its use during construction has represented challenges to both the client and the construction team, but adaptation to this method of working are enabling the long term benefits to be realised.

Future directions

The plant has been designed to enable future upgrade of:

- APD to enhanced enzymic hydrolysis, which would achieve an 'advance treated' status in accordance with the ADAS Safe Sludge Matrix.
- Biogas processing to 'gas to grid' enabling injection of a cleaned biogas to the network.

While these are not part of the current contract scope, they are technologies that can readily be retro-fitted into the works at any time in the future when considered appropriate by Wessex Water.

Conclusions

Wessex Water has a strategic objective of increasing self-generated renewable electricity. This is being achieved in AMP5 through a programme of enhanced digestion projects built on the success of the previous project enhancing digestion at Bristol STW.

MWHT was contracted to provide a complete design and build service of M&E and civil engineering services using the Monsal enzymic hydrolysis process for the first of the three new enhanced digestion schemes. The programmed completion date for the Trowbridge APD plant is December 2013 providing the potential for up to 2,000MW of additional green energy generation.

The Editor & Publishers would like to thank Jonathon Gillard, Proposals Manager with MWH Treatment (for Wessex Water) for providing the above article for publication.

The snow piles up over the winter - Courtesy of MWH Treatment