

Blackburn Meadows WwTW Bio-Energy Digester

a new sludge treatment facility with a 5-year payback saves Yorkshire Water £4.5m/year in operating costs

by Gareth Howell BEng MSc CEng MIChemE

As a business, Yorkshire Water Services (YWS) is striving to increase its self generation and minimise power consumption. As such, a regional strategy has been developed. Part of this strategy includes the provision of a regional sludge treatment centre which will enable the sewage sludge incinerators at Blackburn Meadows WwTW and Esholt WwTW to be put into standby. The aims of the new bio-energy digester (BED) at Blackburn Meadows WwTW are to optimise energy generation and contribute significantly towards Yorkshire Water's energy and carbon strategy.



Blackburn Meadows Bio-energy plant under construction - Courtesy of ETM

Identifying solutions

In the past, heavy metal concentrations in the sewage entering Blackburn Meadows WwTW meant that incineration or landfill were the only options for disposal for the sludge. In recent years, the concentration of heavy metals to the WwTW has reduced. This has allowed other treatment options for the sludge.

Following a sludge strategy review, the YWS preferred option was to progress with a regional sludge treatment centre. The works covers digestion, sludge dewatering and composting; and the use of the bio-gas for energy generation in a combined heat and power (CHP) unit on the site. The total cost for the project is £23 million.

With a £4.5 million/year operating cost saving, this solution provides YWS with a five-year payback period. This is predominantly achieved by putting the two incinerators into standby, therefore reducing the intensive running costs, but also by installing new CHPs which will enable YWS to generate renewable energy which will be used to run the site.

ETM, a joint venture between AECOM Design Build and Galliford Try, has been selected by YWS to design, construct and commission the new digestion facility.

The digesters will treat all the indigenous sludge (primary and SAS) from Blackburn Meadows WwTW. In addition, as the site will be a regional sludge treatment facility, the site will receive imported sludge. The digested sludge will then be dewatered and composted on site before being recycled as a soil conditioner.

The scope of the project is to provide:

- **Imported sludge tanker points for thickened and thin sludge.** The imported thin sludge passes to a storage tank where it mixes with the primary sludge before screening.
- **Primary and imported sludge screening.** Sludge gravitates from the imported/primary sludge tank through the screens and it is then pumped to the storage tanks upstream of the sludge thickening facility.



TORISHIMA

(Europe) Projects Ltd
A Torishima Group Company



A UNIQUE TURNKEY OFFERING FROM THE STEAM ENGINEERING EXPERTS

WITH UNRIVALLED KNOWLEDGE AND OVER 20 YEARS OF EXPERIENCE IN THE INDUSTRY, TORISHIMA (EUROPE) PROJECTS LTD (TEP) IS ABLE TO DELIVER 'BEST IN CLASS' ENERGY CENTRES FROM START TO FINISH. OUR ACQUISITION OF THE UK DIVISION OF LEADING BOILER MANUFACTURER, ICI SPA ITALY, GUARANTEES THE SUPPLY OF HIGH QUALITY EQUIPMENT WITH ENERGY EFFICIENCIES OVER AND ABOVE ANYTHING ELSE IN THE MARKETPLACE.

Project Feasibility // Design // Equipment supply // Installation
Training // Commissioning // Aftersales



TEP: YOUR IDEAL STEAM AND HOTWATER SYSTEM PARTNERS

- Ⓞ PROVEN TRACK RECORD
- Ⓞ EXCELLENCE IN ALL AREAS OF PROJECT DELIVERY
- Ⓞ NO TIME WASTED ON MULTIPLE CONTRACTORS/SUPPLIERS
- Ⓞ SECTOR-LEADING BOILERS AND WASTE HEAT RECOVERY TECHNOLOGIES
- Ⓞ FINANCIAL SECURITY - PART OF A \$630 MILLION GLOBAL CORPORATION

CONTACT

SALES@TORISHIMAPROJECTS.CO.UK // TEL:+44 (0) 1373 858143

WWW.TORISHIMAPROJECTS.CO.UK

- **Combined primary sludge and SAS thickening.** Polyelectrolyte is added to the sludge and it is thickened to $\approx 6\%$ using 3 (No.) drum thickeners (duty/assist/standby). The thickened sludge then passes to digester feed tanks from where it is pumped into the two new digesters.
- **Two 6,700m³ digesters.** These are fitted with duty/standby pressure & vacuum relief valve arrangements to protect against overpressure and vacuum situations. This unique arrangement consists of 2(No.) interlocked twin isolation ball valves as an alternative to the standard 3-way ball valve, specifically designed to reduce cost & weight from the system.
- **Gas holder and handling system.** This comprises pipework from the digesters to the new gas holder and pipework from the gas holder to the CHP/boilers. A flare stack will also be provided to burn excess gas that cannot be used within the process.
- **1 (No.) CHP unit.** This will be the primary user of the bio-gas from the process. The CHP will generate electricity to reduce the site reliance on imported power and the waste heat from the CHP will be used to heat the digesters. This will include provision of HV equipment to pass the energy generated from the CHP forward to the incomer at the Don Valley pumping station.
- **3 (No.) dual fuel boilers.** One new boiler will be provided and two refurbished boilers will be transferred from an existing YWS site. These will operate either on failure of the CHP or to provide supplementary heat when the CHP is operating but cannot provide the full heat requirement. The boilers will run on bio-gas as their primary fuel with natural gas as the secondary fuel.
- **Sludge heat exchangers:** The heat exchangers will take the heat from the CHP/boilers and transfer it into the sludge contained within the digesters. This will ensure that the digesters are operated in the temperature range 36-39°C.
- **2 (No.) dewatering centrifuges.** The centrifuges will dewater the sludge to around 25% so that it can be conditioned on the conditioning area. ETM will also be providing additional conditioning storage areas on site.
- **Odour control.** The odour control is for all tanks that are covered in the digestion area and also for the sludge thickening plant.

Delivering efficiencies

ETM has also been awarded the Freshwater Fisheries Directive (FFD) scheme on Blackburn Meadows. This allows ETM to deliver the works on site as one project allowing us to ensure that the key areas of commissioning and the interfaces between both schemes are managed correctly.

It is likely that the works will be upgraded in the future to provide a thermal hydrolysis plant (THP). This phase of the works has been designed to allow future provision of the THP. ETM has also made provision for a third digester that will be added in the future.

As part of the commissioning of the new digesters, ETM will be required to build the feed up to the digesters at the same time as reducing the sludge feed to the incinerator. This will require a detailed review of the incinerator operation / sludge movements around the site to optimise the operation of the incinerator on sludge and minimise the incinerator fuel oil use.

The digestion site in numbers

- The sludge load to the digesters is 21,000tds/annum including 5,073tds/annum of imported sludge.
- The CHP will generate 15GWh/year of electricity.
- Each digester volume is 6,700m³.
- Total gas production from the digesters 18,000m³/d.
- Total heat input into the digesters 2,270kW.



**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

- The CHP will generate $\approx 65\%$ of the site's power demand.
- The CHP and digesters will be the largest units installed within the YWS region.

Technical excellence/innovation

The space available for the new digestion plant is limited so the space available has to be used efficiently to ensure that sufficient space is available for the potential for a thermal hydrolysis plant (THP) in the future to enable the generation of further renewable energy. The efficient design also has to ensure that the operation and maintenance of the new equipment is not compromised.

As ETM is working across the FFD and the BED schemes, the excavated material from the FFD scheme will be used on the BED scheme as fill material to raise the levels locally. This means that no excavated material will leave the site and no imported fill will enter the site. ETM has been able to rationalise the site layout to give:

- A single area for tanker unloading of thickened and thin imported sludges.
- A common area for unloading of liquid chemical deliveries of polyelectrolyte, anti foaming chemicals and ferric.
- A one way system around the digester area. This provides an unimpeded traffic flow for sludge tankers and also chemical deliveries.

Status and delivery

Main contractors ETM are scheduled to complete the project in October 2013. Key suppliers and sub-contractors include: Galglass (digesters and tanks), Edina (CHP), Torishima (boilers) Kirk Environmental (gas holder), Alfa Laval (drum thickeners and centrifuges) and Elmac Technologies (relief valves).

The Editor & Publishers would like to thank Gareth Howell, Batch Manager with ETM, for providing the above article for publication.



Plant under construction - Courtesy of ETM



Main process units in place for the digestion area. The structures (clockwise from right) are the thickener feed tanks, thickener building, boiler house, digesters and digester feed tanks - Courtesy of ETM

Fusion Bonded Epoxy Coating of Pipework Lining of Pipework & Tanks Using Resicoat® R4 & Scotchkote™ Materials

- Large fluidised bed 4m x 3m x 4m deep, which facilitates the treatment of pipes up to 7.5 metres long.
- A full range of coating systems applied by hot airless spray, fluidised bed, electrostatic spray & standard application methods.
- Fully equipped works with numerous cranes and a heavy lifting bay with 2 x 40 Tonne capacity cranes.
- ISO 9001 registered firm.

ORRMAC COATINGS LTD

Newton Chambers Road
Thornccliffe Park Estate
Chapelton
Sheffield S35 2PH

Tel: 0114 246 1237 Fax: 0114 257 0151
orrmac@aol.com www.ormmac.co.uk



SHOTBLASTING - METAL SPRAYING - PAINTING - POWDER COATING