

Blackburn Meadows WwTW Bio-Energy Digester

a new sludge treatment facility for Yorkshire Water

by Gareth Howell BEng, MSc, CEng, MChemE

The existing incinerator at Blackburn Meadows is at the end of its asset life so requires replacing. The incinerator has a high operating cost and would also require upgrading to meet new emission standards. In the past, heavy metal concentrations in the sewage entering Blackburn Meadows STW meant that incineration or landfill were the only options for disposal for the sludge. In recent years, the concentration of heavy metals has reduced to the STW, which has allowed other treatment options for the sludge. Following a strategy review, Yorkshire Water Services (YWS) decided to progress with digestion, sludge dewatering and composting, and the use of the bio-gas for energy generation in a CHP on the site. The total cost for the project is £18.4 million.



Aerial of Blackburn Meadows STW site - Courtesy of Yorkshire Water

Project scope

ETM have been selected by YWS to design, construct and commission the new Blackburn Meadows Bio-Energy Digestion facility. The digesters will treat all the indigenous sludge (primary & SAS) from Blackburn Meadows STW.

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.
- **Combined primary sludge and SAS thickening:** Sludge will

have polyelectrolyte added and will be thickened to around 6% using 3 (No.) drum thickeners (duty/assist/standby).

- **Digester feeding system:** The thickened sludge passes to two digester feed tanks where it is pumped into the 2 (No.) new digesters.
- **Digesters:** 2 (No.) 6,700m³ digesters.
- **Gas holder and handling system:** This comprises pipework from the digesters to the new gas holder and from the gas holder to the CHP/boilers. A flare stack will also be provided where excess gas cannot be used within the process.
- **1 (No.) CHP:** 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 2 (No.) 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.
- **Welfare and laboratory facilities:** ETM will also be providing new welfare and lab facilities for the whole site.

Interesting aspects/things that are different

ETM have 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. This phase of the works has been designed to allow future provision of the THP. ETM have 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 CHP and digesters will be the largest units installed within the YWS region.

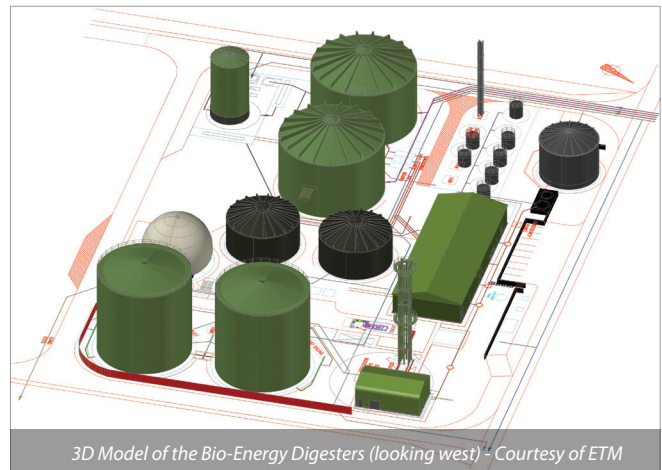
- The sludge load to the digesters is 21,000tds/annum including 5,073tds/annum of imported sludge.
- The CHP will generate 15GWh/year of electricity.
- The volume of each digester is 6,700m³.
- The total gas production from the digesters will be 18,000m³/d.
- Total heat input into the digesters will be 2,100kW.
- The CHP will generate around 65% of the site's power needs.

Technical excellence/innovation

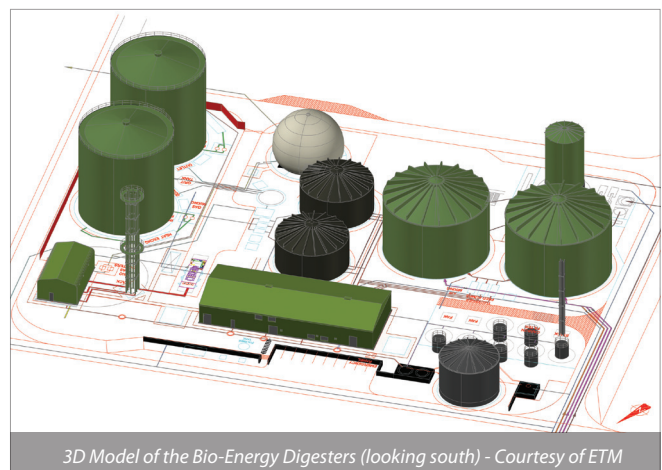
The space available for the new digestion plant is limited so the space available has to be used efficiently to ensure that sufficient space is available for the future THP. The efficient design also has to ensure that the operation and maintenance of the new equipment is not compromised.

As ETM are working on both the Blackburn Meadows WwTW FFD project and the bio-energy digester project, 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 have been able to rationalise the site layout to give:

- A single area for 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 a unimpeded traffic flow for sludge tankers and also chemical deliveries.



3D Model of the Bio-Energy Digesters (looking west) - Courtesy of ETM



3D Model of the Bio-Energy Digesters (looking south) - Courtesy of ETM



Site work underway for constructing new digester - Courtesy of ETM

With a £4.5 million/year operating cost saving, the bio-energy digester solution provides YWS with a 5 year payback period. The payback is achieved from the savings that YWS receive from the closure of the incinerator and also the income/savings from the energy generation from the CHPs.

Programme and current status

The start date for the project was March 2012, with a planned completion date for the works is October 2013.

At the time of writing (June 2012) the scheme is in the detailed design stage, and initial preparation works have started on site for the piling to the digester and other tanks.

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