

Brancote Sludge Treatment Centre

construction of a new sludge treatment facility to allow the dewatering and transport of raw cake as part of Severn Trent's sludge strategy programme

by Benjamin Staniland CEng MIET BEng (Hons)

Located to the east of Stafford, the Brancote Sewage Treatment Works (STW) catchment will see an increase in population from 78,075 current population equivalent (PE) to 85,532 by 2028. The site is split into two distinct areas with the STW processing the sewage flows from within its own catchment and the sludge treatment centre (STC) processing indigenous sludge from the works as well as imported sludge from some nine other smaller rural STWs. Brancote STC has been designated as having rural works status; based on the sludge strategy alignment process carried out in AMP5, the site's single digester will be shutting down and the works will convert to a strategic raw sludge dewatering site. Brancote STC will be required to dewater raw sludge to 25% dry solids (DS) which will be transported to the thermal hydrolysis plant at Strongford STW for advanced digestion.



Brancote STC - picket fence thickener corner - Courtesy of nmcn PLC

AMP6 growth scheme

The Brancote STW catchment is forecast to see an increase of 7457 PE by 2028. The nine satellites sites that currently feed Brancote STC will see an increase in their populations from a total of 75,094 PE to 79,274 PE by 2028; with the vast majority of the imports coming from Rugeley and Penkrigde (64,414 PE by 2028). Cannock STW currently transfers its sludge via an 8km rising main to the Tour Ashes Sludge STC. Additional work is being undertaken to now thicken Cannock STW indigenous sludge to 6% and for this to be tankered to Brancote STC for dewatering. This will add an additional sludge population of 65,494 PE by 2028 to Brancote STC.

Therefore, the sludge makeup at Brancote will be made up of 33% indigenous sludge, 66% imported sludge of which Cannock STW will supply 50% of the imports.

Existing works

The Brancote STW is split into two streams; the old works treating 65% of the sewage flows and the new works treating the remaining 35%. The settled primary sludge from the old works gravitates

through the existing Huber Rotamat indigenous sludge screens and is then pumped into the existing 37m² picket fence thickener (PFT). The settled primary sludge from the new works is valved to gravitate through the Huber Rotamat import screens and is then pumped into a 390m³ blending tank. Imported sludge is pumped through the Huber Rotamat import screens and is then further pumped to the blending tank combining with the sludge from the new works. The existing PFT is undersized against design manual criteria, 9.1 m²/TDS (tonnes dry solids) versus 15 m²/TDS hence why the indigenous settled sludge is split for processing.

The PFT flows are then combined prior to the digestion plant in a blending tank with the imported sludges. The single digestion plant has an effective volume of 2544m³ (assuming 80% working capacity). Digested sludge is buffered in 3 (No.) holding tanks with the effective volume of 3000m³ which provide buffering for the 2 (No.) centrifuges. The centrifuges do not have capacity to treat sludge up to 2028 design horizon. Once dewatered the digested sludge cake is transferred to 4 (No.) cake storage bays for a period prior to being tankered off site.



MCS Control Systems



system integrators to industry



MCS Control Systems is an ISO 9001 and 14001 accredited control systems and systems integration company with 40 plus years' experience in the water industry supplying to the majority of the utility companies and their first-tier suppliers. The Woolston story is a good example of a typical MCS project. MCS is also involved in the majority of vertical markets including food and FMCG, automotive, aerospace, defence, distribution, energy from waste and nuclear.

MCS can provide full turnkey solutions including CDM/ site management, civils, mechanical, electrical, MCCs, instrumentation, telemetry, distribution boards, along with services such as installation, including cabling, PLC and SCADA programming and support, PLC upgrades, motor upgrades, energy saving services and surveys, network support, support contracts and training. Systems to ATEX standards can be supplied.

MCS is an approved Systems Integrator for Mitsubishi, Rockwell, Siemens and Wonderware
MCS is happy to consider projects however big or small.

Please contact MCS as below with any project enquiries, or for further information:

T: 02476 360211 E: sales@mcscontrolsystems.co.uk W: www.mcscontrolsystems.co.uk

HUBER
TECHNOLOGY
WASTE WATER Solutions

INDUSTRY-LEADING expertise in high
quality **SLUDGE TREATMENT** solutions

Solutions for sludge
treatment:

- Screening
- Thickening
- Dewatering
- Drying

T. +44 1249 765000
E. rotamat@huber.co.uk
www.huber.co.uk



Dublin Bay

Technical solution

The proposed technical solution was to build a new facility that is capable of receiving the indigenous sludge and processing this through a new correctly sized PFT before being transferred to a liquid thickened sludge balance tank (TSBT). A new template sludge import facility was to be constructed which could accept 2 (No.) sludge tanker discharges simultaneously prior to being transferred to TSBT.

All sludges prior to entering the TSBT are to be screened using Strainpress equipment to 2mm in 2 dimensions. The TSBT had to be designed for 3-days storage, require a mixing arrangement to ensure a homogenous mix between the indigenous and imported sludges and required additional standard decant valve tree for removing the top waters (if required).

A duty/duty centrifuge system along with a polymer chemical dosing system will process the liquid sludge from the TSBT to 25% DS and transfer these to a 5-day capacity cake storage silo complete with a cake dispensing system for the cake transport vehicles. An auxiliary centrate balance tank and pump transfer system will handle the picket fence thickener and centrifuge centrate liquors as they are required to be transferred back to the head of the sewage treatment works over a 24-hour period.

Design phase

Ultimately the single largest difficulty to overcome on this project was space. The whole of the new STC works required to fit into an area 60m x 40m. To ensure this succeeded additional discussions and solutioning work were undertaken between the client and nmcn PLC and is discussed later in the article. Adding to the complexity, the build area was centred between the existing STC plant and the cake storage bays, meaning that the construction works had to ensure continued normal operation of the existing sludge digestion process.

All sites are scanned using a Faro3D laser scanner to generate a point cloud of the existing site from which a 3D model was created in 3D building information modelling (BIM) software, Autodesk Revit. Other surveys were imported such as topographical and underground surveys to provide pertinent and complete information to develop the site arrangements.

Each subcontractor submitted their designs in compatible 3D models which were then imported to the master model. These models included the largest tanks down to simple pumps and lifting equipment. The design team extensively use Autodesk360 cloud-based viewing platform for review and comments by the client and other parties. By converting the model to virtual reality (VR) we were able to use the VR headset to undertake design reviews and hazard and operability (HazOp) studies with the client prior to construction at key stages throughout the project.

Processing plant

Sludge imports: The new sludge import facility required a 60mm³ below-ground wet well; however due to the close proximity of the existing water sealed gas holder and the high water table mixed with running sand, this made normal excavation activities non-viable. nmcn PLC engaged with HB Tunnelling Ltd to install a shaft tank with concrete plug running to a depth of approximately 8m.

The pumping station was then capped off with a prefabricated concrete biscuit lid delivered and installed in 2 sections. The sludge pumping is facilitated by duty/standby Hidrostral Ltd open impeller type pump arrangement to deliver 60m³/hr at a pressure of 1.2bar. During solutioning works the team reviewed construction options for all process tanks from below ground to above ground vessels.

Materials such as glass fused to steel (GFST) and prefabricated concrete were reviewed; the solution finally settled on above-ground GFSTs.



1018m³ thickened sludge storage tank - Courtesy of nmcn PLC

Picket fence thickener (PFT): There were 2 original solutions for the PFT, the first retained the existing undersized existing PFT, however upon inspection of its poor condition the risk to the process was deemed too great, additional a TSBT of 1490m³ @ 19mØ would have been required and would severely impact on our available space. The second option included using the existing PFT and providing a further PFT asset of 59mm³ to increase the thickening capacity to comply with the client's design manual criteria.

This option allowed for a more manageable 1018mm³ @ 13mØ TSBT, however the risk of the existing asset still remained and provided additional complexity with now having to unevenly split the flow between two different sized assets.

Having discussed options with the client the design was changed to provide a new 94mm³ PFT which has a throughput of 6.4 TDS/d, 641 mm³/d @ 1%DS, thus allowing the retention of the smaller TSBT option. The PFT constructed rise up 4.8m @ 11.5mØ. The concrete base had a slope of 1.5° to the centre. The PFT along with all the GFSTs on the project and PFT mechanical fittings and access steelwork was undertaken as a design and build package by Stortec Engineering Ltd.

Strainpress screening: Both imported and indigenous sludges required screening to 2mm in two dimensions dictated by the downstream THP projects and had a client specified Strainpress process. To ensure that the solution allowed both sludge streams to have a duty/standby screening facility, an automated valved feed system was designed to allow the 3 (No.) Strainpresses to work as a duty/duty/common standby for all process stream.

As the screens work on a pressurised pumped system with a gravity discharge, the screens are required to be mounted on a raised platform 4.7m high to allow discharge of the screenings to the single skip below; the system is capable of processing 60m³/hr of sludge at a thickness of 6%. A complete Strainpress solution including steelwork access platform was designed, manufactured and installed by Huber Technologies.

Centrifuge system: As previously stated, a 1018m³ (8.4m @ 13mØ) GFST has been installed to provide a 3-day storage capacity for the liquid sludge, and therefore allows the normal running of the centrifuges 5-days per week. An 18.5kw Hidrostal mixer was provided to ensure that the sludges have a homogenous mix.

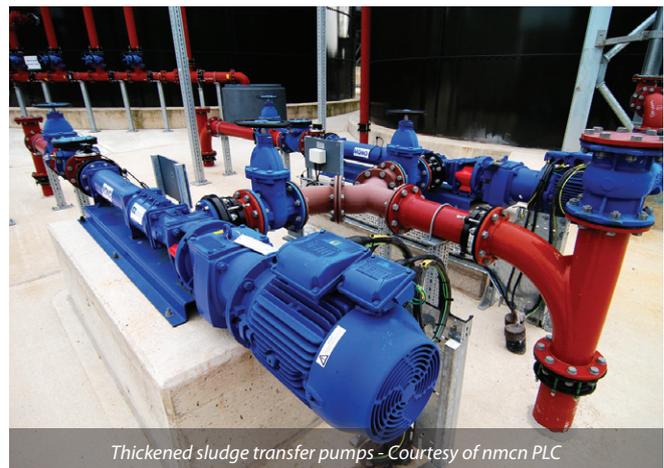
Additional functionality has also been embedded by providing a standard valve decant pipework tree allowing top liquors to be taken off prior to mixing; the decanting tree also allows the ability during commissioning to adjust the thickness of the sludge so that the performance criteria can be tested and verified.

A duty/duty centrifuge system (G3-95) installation provided by Alpha Laval gives a process capacity of 18.3m³/h @ 4% sludge per unit running for 80hr/week; but is also capable of meeting the process volume of 26.3m³/h as a duty only centrifuge running for 168hr/week and requiring an output in both scenarios of 23% ±2% DS. Both centrifuges are installed on a combined raised platform designed and manufactured in house by nmcn Fabrications and are housed in full acoustic enclosures provided by Alpha Laval.

Polyelectrolyte dosing system: A full design and build package was let to Northern Pump Supplies to provide a big bag polyelectrolyte dosing system. The solution includes 2 (No.) GRP buildings, the first being for the dry storage of 2-weeks requirement of granular polyelectrolyte and contains the powder dispensing hoist and metering equipment. The second GRP building is a fully self-contained bundled structure which houses the batching and running equipment for the chemical along with the duty/standby dosing pumps. The system is designed to deliver a maximum dose of 15kg/TDS at strength of 0.3% and a volume of 7m³/h.



3D model of the installed assets - Courtesy of nmcn PLC



Thickened sludge transfer pumps - Courtesy of nmcn PLC



Automated Strainpress feed installation - Courtesy of nmcn PLC



Huber Technologies Strainpress installation - Courtesy of nmcn PLC

Brancote STW Supply Chain Key Participants

Client	Severn Trent
Principal contractor	nmcn PLC
MCC & ICA	MCS Control Systems Ltd
Electrical installation	Mealey Electrical Contractors Ltd
Mechanical installation	De Havilland Group Ltd
GRP enclosures	Pro-tech GRP Enclosures Ltd
Ram pumps	EMS Industries Ltd
Cake silo system	CTM Systems Ltd
Submersible pumps	Grundfos Pumps Ltd
Mono cake pumps	NOV Process & Flow Technologies
Lifting equipment	T Allen Engineering Services Ltd
Glass fused to steel tanks	Stortec Engineering Ltd
Trace heating and lagging	Jade Insulation Ltd
Screening equipment	Huber Technologies Ltd
Shaft tank	HB Tunnelling Ltd
Chemical dosing equipment	Northern Pump supplies Ltd
Demolition & ground works	Collins Earthworks Ltd
Odour control systems	Odour services International Ltd
Prefabricated plastic tanks	Moor Fabrications Plastics Ltd
Centrifuge plant	Alfa Laval Corporate AB
Pumps and mixers	Hidrostral Ltd
Telemetry services	JR Pridham Sevices Ltd
HV power systems	Central Power Ltd

Cake handling: The original solution for the cake handling included a conveyancing system from underneath the centrifuges to the top of the cake silo, but due to the available space and size of silo, it was evident that this would not be feasible. Then during the design stage several contractors were approached to discuss available options which led to placing the contract with CTM Systems, who were able to show through significant experience that a cake progressive cavity pump system would provide the required solution within the confines of the limited space available.

Below each centrifuge sits a dedicated Mono cake pump from NOV Process & Flow Technologies; each capable of pumping 5.4m³/hr @ 17-30% DS to the cake silo. CTM Systems were able to provide a full cake silo, support and access steelwork, cake pump, and cake dispensing design and build package.

The 326m³ silo (9m high @ 6.8mØ) was raised by 6m to allow the cake transport vehicles to manoeuvre underneath the structure for the cake to be dispensed. The silo GFST was assembled at ground level and the raised in one crane lift onto the structure, removing the difficulty of assembly above ground level.

Liquors: The two sources of liquors (PFT and centrifuges) return back to the STW process. The design assumes that liquors generated from the PFT occur consistently over a 24-hour period and therefore do not require further intermediate balancing. Due to the large volumes of imports and the potential resultant septicity and strength, the liquors are pumped to a 400m³ GFST for balancing over a 24-hour period with an outlet rate of 14.7m³/h.

Odour control: One key critical success factor for the project was to have no additional odour production at the site boundary. Therefore, Severn Trent procured a baseline odour survey. A full site-wide odour abstraction system provided by Odour Services International Ltd has been installed to all key assets for the removal and treatment of fouled air. It has a capability of treating 2,048m³/h of air volume utilising both a Lavarok® biofilter (20m³) and a carbon filter for secondary polishing (2.28m³) connected in series, all providing a performance requirement < 1,000 ouE/m³.

Success criteria/commissioning

At the time of writing (June 2020) the project has undergone dry and water commissioning. The programmed sludge commissioning is due to commence mid-August 2020.

- All sludge has been screened to 2mm in two dimensions with Strainpress.
- A homogeneous sludge fed into the centrifuges with a variance of ±0.2%DS/hr (as measured with the online %DS monitor). The feed %DS will vary depending on the volume and source of imports.
- Combined maximum centrifuge throughput of 30m³/h (1394 kg/h) measured pre-poly dose or 37m³/h (1415 kg/h) measured post-poly dose.
- Cake dry solids 23 ± 2%.
- Poly dose < 10 kg/TDS on average.
- Poly dose < 15 kg/TDS when dewatering difficult sludge.
- Centrifuge solids capture rate of 97%.
- No increase in odour at the site boundary due to the scheme.

Conclusion

The contract started in March 2018 with the design phase running for 9 months, construction started February 2019 and was due to complete in March 2020 however due to unforeseen difficulties from external factors the completion is planned for August 2020. The project value was £4.25m.

The editor and publishers would like to thank Benjamin Staniland, Project Manager with nmcn PLC for providing the above article for publication.



Cake silo north view - Courtesy of nmcn PLC



Manufacturers of Screens, Biofilters & Rotary Distributors for Wastewater Treatment

Sewaco package screening unit 200-50-0.75 can receive solids from any source

The process takes raw screenings and separates solids, rag and non-organic wastes, allowing effluent to pass downstream. Separated matter is compressed and delivered to collection skip ready for off-site disposal.



- Greatly reduces operating costs and transportation.
- No backwash water required.
- BOD load to downstream process reduced by lowering organic content.
- System can incorporate flow balancing tank to complete the package.
- Standalone package units designed to suit treatment plants up to 2000 PE.
- Operating capacity 0.2-15 t/hr.
- Low capital outlay combined with low power consumption provide TOTEX advantages.
- Compaction of solids achieves up to 30% dry matter cake and 75% volume reduction.
- Simple low maintenance requirements with extended service intervals.



Other range of products available from Sewaco include:

- HYCOVER static & rotary distributor systems (from 5 l/s up to 980 l/s flow range) with optional auto cleanse and electro-pneumatic belt drive mechanism.
- HYRATE Polytower biofilter systems using modular plastic media for:
 - High rate (BOD/COD reduction), upstream of existing treatment plant.
 - Secondary (BOD removal only or combined BOD removal/nitrification).
 - Tertiary nitrification applications, downstream of existing secondary treatment processes.
- HYRATE Polytowers that can easily incorporate natural ventilation or air extraction systems for odour control purposes.
- Factory built timber support matrix for modular plastic media support.
- Steel structures to ISO 1090 include access stairs, platforms and bridges.



In 2019 Sewaco celebrated 40 years successful trading.

Contact
T: 01778 342202
E: info@sewaco.co.uk
W: www.sewaco.co.uk

Sewaco Limited
Eastgate House, 87 Eastgate
Deeping St James
Peterborough PE6 8HH

CTM

SYSTEMS

Design, manufacture, install, aftercare:

- Sludge cake reception bunkers
- Sludge cake storage silos
- Shaftless and shafted screw conveyors
- Fixed and Radial conveyors
- Live bottom bins
- Dried sludge cooling screws
- Screenings handling conveyors
- Troughed belt conveyors
- Continuous mixers/blenders

CTM Systems Ltd
 Units 7-8
 Arkwright Road Industrial Estate
 Cambridge Road
 Bedford
 United Kingdom
 MK42 0LQ

Tel: 01234 355700
Email: sales@ctm-systems.co.uk
Web: www.ctm-systems.co.uk

