Huyton WwTW

modifications as part of the drive to improve the efficiency of the sludge treatment process systems in the Lancashire/Merseyside area

by Paul Lee & John Clark

Huyton WwTW is located on the outskirts of Liverpool, Merseyside. The Huyton WwTW AMP5 Sludge Scheme driver is a Pollution Prevention and Control (PPC) requirement and the output of the scheme is linked to the overall AMP5 Sludge Programme. The existing sludge digestion process was to be decommissioned and replaced with a sludge thickening process with the sludge disposed of at the new Leigh WwTW Advanced Digestion Plant. New safety measures were required to be installed on the site to protect the nearby Sherwood Sandstone Aquifer from any potential spills of sludge at the Huyton site. This scheme highlights the approach taken to supply innovative, cost effective designs to tight timescales.

New sludge storage tanks - Courtesy of KMI+

Undertakings

KMI+ was tasked by United Utilities with the design and construction of the new works. The new works were required to treat imported and indigenous sludge whilst treating sludge liquors and maintaining the flows in accordance with the proposed AMP5 Discharge Consent as follows:

Quality Drivers	BOD mg/l	SS mg/l	Ammonia mg/l
95%ile	20	35	5
UTL	56	-	20

The approach

The KMI team was issued with the United Utilities Scope Book, which contained the outline design upon which the detailed design was to be based. This outline design was reviewed on site and suggested modifications to the design discussed with the construction team, design team and the client team. These discussions promoted the optimisation of design of the new equipment on the site with respect to constructibility and the resulting construction costs.

Design elements

The main design elements optimised were as follows:

Existing GBT Building, liquors transfer pumping station and odour control unit, all to be modified - Courtesy of KMI+

Existing Gravity Belt Thickener to be replaced - Courtesy of KMI+

Construction of new sludge storage tank bases - Courtesy of KMI+

Construction of new sludge storage tank bases - Courtesy of KMI+

New unscreened sludge storage tank area: The sludge screen and associated building, plus the screened sludge storage tank, were relocated from the primary digester area to the new unscreened sludge storage tank area. This ensured that the unthickened sludge storage facility was concentrated in a single area and thereby reduced the length of odour control ducting required from the sludge storage tanks to the odour control unit.

This action also ensured that the primary digester units were able to remain in service throughout the scheme, a requirement that became apparent as the scheme progressed due to the fact that the Leigh Sludge scheme was not progressing as quickly as anticipated and therefore the sludge was required to be digested on the Huyton site for significantly longer than originally anticipated.

The third benefit emanated from the fact that the length of main to be used to pump unscreened sludge was massively reduced, thereby reducing the risk of rising main blockage from rags and debris within the main which would potentially lead to additional operational cost to United Utilities.

Sludge pipework: The double contained sludge pipework was originally designed to be built underground. Review of the requirement to register the fact that a rising main has failed and that the sludge had then filled the associated catchpot indicated that maintenance of these catchpots would prove to be difficult for the client's maintenance teams due to the underground locations.

Removal of any blockages within these sludge pipelines would also prove to be challenging as the washout points would be located below ground and so the design was modified to an above ground system that proved to be less difficult to maintain and also less expensive to construct.

Odour control: The odour control system was relocated to the existing decommissioned storm water tank as opposed to being built on the decommissioned digester site. This again allowed the existing digester unit and associated boiler unit to remain in operation for longer than originally anticipated at the commencement of the scheme.

The lengths of odour ducting required to extract odorous air from the unthickened sludge tanks was reduced and less complicated to build due to all of the unthickened sludge storage tanks being located in the same location next to the MCC associated with the sludge pumping.

Transformers: The original requirement for 2 (No.) new transformers on the site to power the new sludge treatment plant was analysed and the transformer requirement reduced to 1 (No.) with this single unit being located next to the unthickened sludge storage tank and sludge MCC area. This eliminated the requirement for a 600KVA transformer and the associated concrete structure and HV cabling.

HV switchgear building: The initial outline design indicated that a revised HV switchgear installation was to be installed within a modified existing building. Review of this building identified that fact that the degree of modification required to allow the installation of the proposed switchgear made the modification work potentially more expensive and more hazardous than building a new HV switchgear building.

A new HV switchgear building was designed and built based on a standard design developed initially by the Network Operating Company and modified by Mouchel to meet the full requirements of power distribution on the site.

Kiosk relocation: The MCC kiosk housing the new MCC to power and control the new gravity belt thickener (GBT) units within the GBT building and the associated thickened sludge pumps was

reviewed and relocated such that the installation was located on unused ground and not positioned on the current location of the existing gas boiler house. This again allowed the existing sludge digestion system to operate whilst the new build was ongoing.

Description of the completed works

The unscreened and screened sludge storage tanks were constructed in glass coated steel with GRP sectional roofs. Each tank sits on a significant concrete base with an in-built leakage trough such that any tank leakage would promote the flow of sludge to the adjacent sludge pump bunded area to guarantee that any sludge leakage is retained.

As part of the Pollution Prevention and Control requirement, pipework within bunded areas is not double contained whereas pipework mounted over open ground is required to be double contained.

All sludge transfer pipework was constructed as a PE 100 SDR17 polyethylene sludge transfer pipe located within a ductile iron/ fabricated steel outer pipework system to ensure that any sludge leakage from the PE pipeline is retained within the double containment. The leakage of any sludge within the ductile iron pipework is monitored by level probes within catchpots.

The design of the sludge pipework has been optimised to utilise the odour control support steelwork when it traverses the site. Electrical cabling also utilises this support steelwork to keep steelwork design and build costs to a minimum whilst ensuring that the installation is as compact as possible on an already congested site.

The odour control system takes air flow from the primary sludge tanks, the screen building, the gravity belt thickener building, the return liquors pumping station and the thickened sludge storage tanks and has been designed to guarantee 5,500m^3/hr at 1,000 OUE/m^3. The system uses a carbon filter, biological filter and duty standby fans to discharge the treated air through the 15m tall stack.

The location of the new system on the revised storm tank location ensures suitable access for maintenance whilst allowing the existing digester system to remain operational. The combination of carbon filter and biological treatment systems ensure a cost effective odour treatment system that is simple to maintain and operate.

Conclusion

The scheme has allowed United Utilities to improve the efficiency of its regional sludge digestion system by rationalising the main digestion plant at Leigh WwTW and also by uprating the Huyton site sludge storage and mixing facility whilst also improving the sludge screening capacity.

The installation of 2 (No.) new gravity belt sludge thickeners has improved the reliability of the sludge thickening system and the refurbishment of the sludge holding tanks including the addition of roofs and air mixing systems has improved the transportability of the thickened sludge when tankered to Leigh WwTW, making the Leigh digestion system more robust.

The team

The Huyton WwTW AMP5 Sludge Scheme was delivered for United Utilities by the KMI plus team, which comprised of the KMI plus construction team in addition to the Mouchel civil and MEICA designer teams.

The Mouchel civil design team is located in the Mouchel Liverpool office whilst the Mouchel MEICA team is based in the Wyke office.

The Editor & Publishers would like to thank Paul Lee, Principal Mechanical Engineer, and John Clark, Senior Civil Engineer, both with Mouchel, for providing the above article for publication.

Huyton WWTW AMP5 Sludge Scheme

The existing sludge treatment works comprised:

- 1 (No.) imported sludge tank.
- 1 (No.) sludge screen within steel portal frame building.
- 2 (No.) primary sludge digester units.
- 1 (No.) secondary sludge digester unit.
- 2 (No.) Gravity belt thickener (GBT) units.
- 1 (No.) thickened sludge storage tank c/w odour control system.
- 1 (No.) sludge liquors transfer pumping station c/w submersible pumps.
- 1 (No.) sludge liquor collection tank and associated submersible pumps.
- 3 (No.) Secondary digestion tanks (sludge holding tanks).
- 1 (No.). tanker loading station.

The new sludge treatment works comprised:

- 2 (No.) New pre-screened sludge tanks c/w air mixing system.
- New sludge screen feed pumping station.
- New sludge screen building incorporating relocated sludge screen.
- New screened sludge tank c/w air mixing system.
- New GBT feed pumping station complete with 2 (No.) progressive cavity pumps.
- Modifications to existing GBT building.
- Modifications to existing thickened sludge storage tank.
- Modifications to existing liquor transfer wet well.
- Modifications to existing liquor collection tank pumps and pipework.
- New thickened sludge holding tank feed pumping station complete with 2 (No.) progressive cavity pumps.
- Modifications to secondary digestion tanks(sludge holding tanks) c/w new roofs and air mixing system.
- New tanker loading pumping station.
- New odour control unit incorporating fans carbon filter and biological filter c/w 13m high discharge stack.
- New access road and hard-standing area in vicinity of sludge holding tanks.
- New access roads and hard-standing in vicinity of new sludge area.
- New interconnecting pipework.
- 3 (No.) new MCC Kiosks.
- Demolition of existing structures.
- Abandonment of existing structures and pipework.
- 1(No.) Transformer compound c/w transformer.
- 1 (No.) HV switch building.

New mechanical & electrical equipment:

- 2 (No.) Sludge screen feed pumps.
- 1 (No.) Additional sludge screen.
- 2 (No.) GBT feed pumps.
- 2 (No.) GBTs.
- 2 (No.) GBT outlet pumps.
- Modifications to existing polymer dosing equipment.
- 2 (No.) Thickened sludge transfer pumps.
- 2 (No.) Tanker loading pumps.
- 2 (No.) Liquor transfer pumps.
- 2 (No.) Liquor return pumps.
- Odour control unit complete with duty standby fans, carbon filter and biological filter.
- 3 (No.) new steel MCC kiosks.
- Radio link to Woolton WwTW