Workington WwTW

AMP4 modifications to the sludge treatment and disposal process

by
Paul Redford CEng MIMechE

Workington WwTW is a relatively modern wastewater treatment works, built in 1996, extended in 1999 and 2002 and is located just north of the town of Workington in West Cumbria. The treatment process comprises screens, "bendy channel" grit removal, primary settlement, activated sludge plant (surface aerators), final settlement, raw sludge storage and centrifuges. Workington is also a sludge reception centre with approximately 50% of sludge's being imported. The facility is owned and operated by United Utilities Water (UUW) and has a Population Equivalent (PE) of 71000 with approximately 40% of the PE being due to the local industry. The site is located directly on the coast and the final effluent is discharged to the Irish Sea via a sea outfall.

New limed sludge storage tanks *Courtesy of MWH with kind permission of UUW*

Prior to this project; sludge from 4 sites in Cumbria (of which Workington was one) was taken to the central sludge processing centre at Shell Green in Widnes. To create some headroom in the capacity at Shell Green and to enable a more beneficial disposal of sludge to land, temporary sludge process modifications were implemented at Workington. The temporary measures involved the installation of a basic sludge powdered liming system which was sufficient to operate the site until the permanent process modifications could be made.

This article describes the recent permanent modifications to the sludge treatment and disposal process.

The Existing Sludge Process

The existing sludge process stream consists of the following;

- Co-settled sludge consolidated in primary settlement tanks (PSTs);
- Sludge holding tanks – (accepts sludge from PSTs and sludge imports);

Existing sludge building with new cake silo and loading bay. 1 of 2 new limed sludge tanks in foreground *Courtesy of MWH with kind permission of UUW*

- Sludge storage tanks – (feed stock tanks to strain presses);
- Strain presses;
- Centrifuges;
- Temporary Cake liming;
- Conveyor system;
- Skip / vehicle loading facility for disposal to land.

The driver for the project was to secure a long term agricultural recycling route for wastewater sludge from Workington and other satellite sites. The solution to this driver was to provide a liquid liming process upstream of the existing strain presses and centrifuges. The liquid liming plant would achieve the regulatory "log kill" requirements to achieve "treated" sludge status. Thus enabling United Utilities to continue with their strategy of recycling sludge's to agricultural land.

The Team

The UUW Competitive Tender Capital Delivery Department have been responsible for the successful delivery and project management of the project throughout its lifecycle.

The conceptual design was completed by MWH and Imtech Process Ltd were the successful bidder, providing detailed design, construction and commissioning expertise. MWH continued to support the detailed design and construction phase including the provision of CDM Coordinator services.

Construction Management and Asset Integration activities were closely managed by UU specialists (including Project Management, Construction and Commissioning Engineers). UU Asset Management and Process Operations were also directly involved throughout the project lifecycle.

When

The conceptual design phase commenced in October 2007 with Contract award in October 2008, the project has recently achieved Permission to Process (P2P) and is now in readiness for completion testing such that "treated" quality sludge cake can be exported from the site in summer 2010.

Overview of the Liquid Liming Process

The modified limed sludge process stream consists of the following process elements/equipment:

- Lime import and storage silo;
- Lime slurry batching facility;
- Lime slurry dosing pumps and associated pipework;
- Limed sludge blending tanks including mixing;
- Limed sludge transfer pumps;
- Strain presses (existing);
- Centrifuges (existing);
- Modifications to cake conveyors;
- Cake storage silo;
- Enclosed cake loading bay.

An extension to the existing odour control system was also provided for the limed sludge blending tanks, sludge cake silo and the loading bay. Improvements to the site roadways for both operational and maintenance access completed the scope of work.

Specific Process Details

The lime is delivered as Hydrated Bulk lime powder ($CaOH_2$) by road tanker. The lime reception area is protected by a suitably sized bund sufficient to contain the delivery tanker. Lime is then transferred to the storage silo; the silo capacity is $95m^3$.

Lime batching and dosing system *Courtesy of MWH with kind permission of UUW*

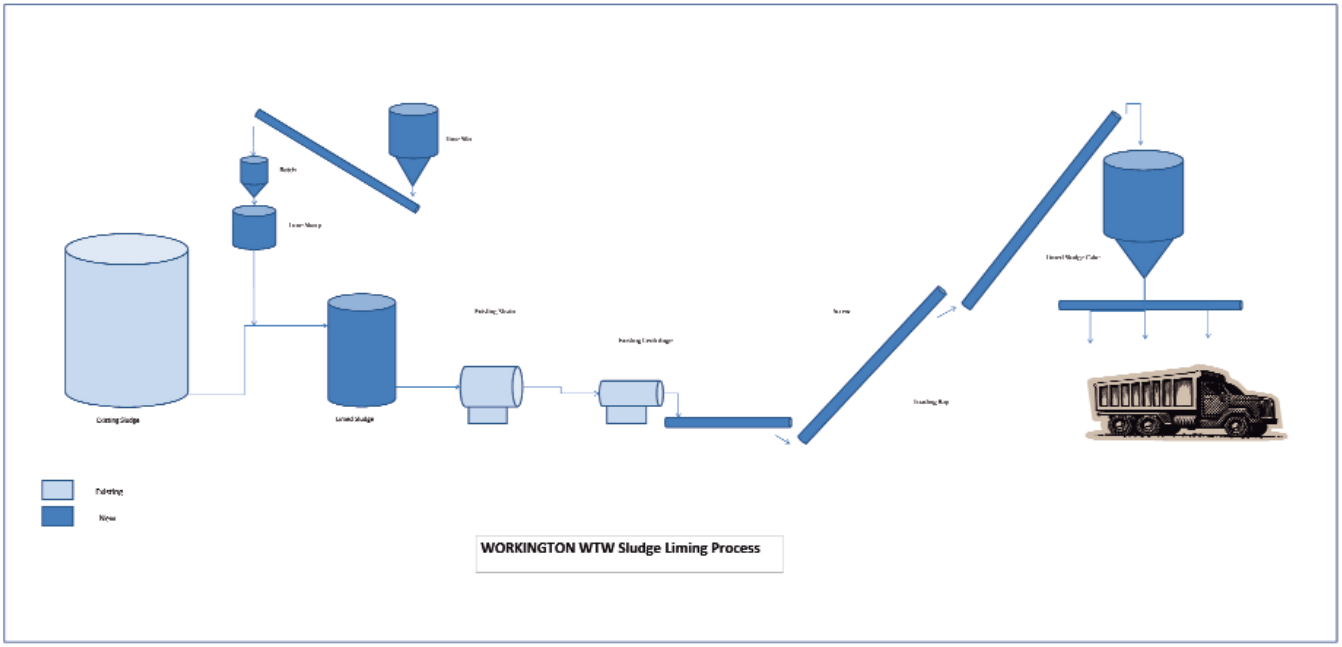
Lime is then batched in 2 No. lime mixing tanks, each 25m³ capacity to a strength of 5% (wt/wt) where once aged it is used to dose the 2 No. sludge liming tanks, each 400m³ capacity. Sludge within the liming tanks is typically 2-4% dry solids (ds).

Lime dosing of the sludge is controlled against a pH set point. This pH set point is in the range 11-12. Effective liming of the sludge is aided by the incorporation of low and high level mixing pumps. These pumps are controlled on tank level. In addition to the high pH, effective pathogen kill also relies on the retention time of the limed sludge within the limed sludge tanks, typically sludge's are held for 2 hours within the tanks.

New sludge transfer pumps then feed limed sludge onwards to the existing strain presses and centrifuges for dewatering, typically to 25-30% ds. Centrate (the wet centrifuge waste effluent) now with high lime content and hence high pH continues to be returned to the primary tanks with added benefit of assisting in reduction of primary tank odours.

Limed dewatered cake is then transferred via a series of inclined centreless screw conveyors to the limed sludge storage, a single silo of 100m³ capacity, located directly over the loading bay.

The loading bay is designed to take a broad range of vehicle types, the bay permits the total enclosure of the vehicle during loading such



Workington WTW Sludge Liming Process *Courtesy of MWH with kind permission of UUW*

that any odour can be extracted and processed via the odour control plant. The loading process is completed automatically with the vehicle stationary within the loading bay. To ensure even distribution of sludge within the vehicles load area, loading is completed via several equally spaced discharge chutes fed from a conveyor located directly above the loading bay. The load is controlled by monitoring the loss in weight of the silo contents while checking vehicle loads via the weighbridge that is integrated into the floor of the loading bay.

Key Success Criteria

Although at the time of writing completion tests have yet to be carried out, it is expected that the new facility will achieve the following:

- Ability to treat up to 3800m^3 of sludge per week within the range 2-4% ds;
- Able to export up to 250 Tonnes of sludge cake per week at 25-30% ds;
- Retain the sludge for a minimum of 1 hour at pH12 to achieve pathogen kill;
- No increase above 5 odour units/m^3 above background levels at site boundary;
- The project also achieved the milestones of 10,000hrs and 25,000hrs without a reportable accident and as a consequence charitable donations were made to the local Air Ambulance and Macmillan Nurses. This excellent health and safety record continued throughout the project lifecycle.

Conclusion

At the time of writing the project was in the final stages of commissioning. Imtech Process Ltd construction and commissioning engineers working closely with UU Project Management and UU Operators expect to complete and achieve handover in early July 2010.

The project is on target to be delivered within the original budget of £3.7M.

Key project success criteria are expected to be achieved including reliable plant operation, the ability to process the expected quantities of sludge, maintaining odours emissions within acceptable limits and thus enable UUW to continue with its disposal strategy of "treated" sludge to land.

Note: ***The Editor & publishers thank Paul Redford, Design Manager - Water Projects - with MWH for providing the above article.***■

Cake transfer and storage silo ***Courtesy of MWH with kind permission of UUW***