Asset Optimisation Programme

optimising United Utilities' wastewater asset base with joint operational and engineering teams

by Mark Hughes CEng MICE

In 2010 United Utilities initiated the Asset Optimisation Programme (AOP). The objective was to optimise plant performance by reducing chemical usage, optimising power consumption, improving performance of combined heat & power (CHP) facilities and reducing reactive working time. A high level analysis comparing United Utilities wastewater treatment works against company averages for power, chemical use and CHP production was undertaken. A benchmarking exercise was also carried out against other water companies by means of relative efficiency measures to identify outlier sites and these were then prioritised in terms of potential for optimisation. This benchmarking and prioritisation process identified 30 wastewater treatment works for further investigation.

Macclesfield WwTW - Analysis team site walk-around - Courtesy of United Utilities

The developed programme of work consisted of four stages for each of the sites: analysis, implementation, benefits tracking and embedment.

Delivery of the optimisation benefits was realised by the formation of joint operational and engineering teams on a site-by-site basis, thereby combining engineering expertise with operational experience and pragmatism. A systematic approach, reliant on data rather than subjective opinions, was used.

Analysis phase

The analysis phase was initiated by the formation of a team of engineers with knowledge of operational procedures and specifically skilled in mechanical, process and EICA disciplines. The team was led by a design manager and split into two groups, which allowed the analysis of two wastewater treatment sites simultaneously.

The approach was to start the analysis of each site by undertaking a kick off meeting with the operational staff familiar with the site. This meeting would allow the AOP team to introduce themselves and their process, and to start engaging with the site-based personnel.

The site controllers would then talk through their site, process stage by process stage. This talk through was an opportunity for the analysis engineers to start quizzing the operators on potential optimisation opportunities. There would then be a site tour, allowing the engineers to become familiar with the site and also encouraging the two elements of the newly formed team to start working collaboratively.


Davyhulme WwTW part of the Asset Optimisation Programme
Courtesy of United Utilities


Dye testing of Bury WwTW Detritors by Implementation team to demonstrate improved flow pattern - Courtesy of United Utilities

The analysis team would then undertake a data collection exercise to assist in identifying areas for further investigation. This part of the analysis phase would rely upon corporate data systems and would focus heavily on the previous twelve months data for patterns and indicators of under-performance. Typical indicators would be; volumes of screenings removed from site, frequency of operation of de-sludging systems, dissolved oxygen probe readings from aeration processes, etcetera. The full list of data points reviewed typically ran to over one hundred.

In parallel with data collection, the engineers would also undertake site-wide mass and energy balances. The mass balance would flag up potential optimisations for a given process stage by comparing actual performance with asset standard and industry best practice. The energy balance would focus on energy used within the process stages, and also link to energy generation at sites with CHP installations.

It was also necessary to engage with other areas of the company to ascertain what other programmes of work were applicable to any given site at any given time. The most obvious being the AMP5 Capital Programme. But other smaller programmes of work (such as minor capital works, or other business initiatives) also had to be included in the findings of the ongoing analysis.

Once all the on-site investigations, data capture, data analysis, discussions, progress meetings, etcetera had been completed, then the results would be presented in the form of an end of phase review.

This would consist of a presentation to all stakeholders on the fundamental findings including recommended courses of action, accompanied by a document summarising all data used and ownership of activities going forward. These two key documents would be handed over to the Implementation team.


Warrington North WwTW part of the Asset Optimisation Programme - Courtesy of United Utilities

Implementation phase

The implementation team itself consisted of professionals working alongside operational staff of various backgrounds and talents. The core element of the team was again based on engineers; process, mechanical, electrical amongst others. But the team also had a representation of project engineers with comprehensive experience of delivering projects across multiple sites. All of these were supported by a backbone of project controllers with responsibility for tracking all the tasks and elements attributed to each of the thirty sites in the programme. This team was led by a project manager with a strong operational background.

Upon receiving the outputs from the analysis team, the implementation team would initially prioritise and programme all the work that had been identified. Each and every line on the programme would then be assigned an owner. This owner would either be a member of the direct implementation staff, or otherwise a member of the operational team who would still be very much part of the process at this stage. The programme itself would then be owned by one of the project engineers. Ownership was the key element to ensuring activities progressed as expected.

The type of actions that were progressed related to any part of the process and included not just quick fixes and low value work, but also detailed engineering investigations and even the initiation of large capital schemes to meet an identified need. From the installation of self-adjusting brushes to inlet screens and the replacement of sensors on dissolved oxygen probes, to recommissioning of failed grit removal systems and rationalisation of aeration control systems, all the way up to installation of new CHP engines and piloting of new polymer injection systems. There was no task too big or too small for this dynamic team.

After the first few sites had passed through this process, it became apparent that patterns were appearing in the types of opportunities identified. This became the starting point for a number of regional programmes of work. This rationalisation of the process itself allowed improvements to be made at a number of sites before the analysis team had even arrived. Data reliability, chemical dosing, inlet screen improvements and others all had their own dedicated resources across multiple sites.

Another key aspect of the work undertaken by this team was the justification of the work being proposed. As with all other water companies, United Utilities has a well-managed albeit over-subscribed funding programme. Out of this, an element was ring-fenced for use in the Asset Optimisation Programme. However, it was still necessary for the implementation team to justify all project proposals with a business case inclusive of a benefit analysis.

This benefit analysis was reliant upon the data sources identified during the analysis phase, and also (as the programme progressed) evidence of improvements at similar installations.

Benefits tracking, embedment & sustainability

Benefits tracking is a simple way of monitoring if the expected results of any project have delivered the objectives it set out to in the original business case. It requires a pre-project analysis of the data identified in the business case. This is done in conjunction with the analysis team and includes a base-lining exercise to ensure that a reference point exists for future claimed benefits. The benefits team are also responsible for checking the reliability of any data points to be used. They must also certify that any benefits being stated in the business case are achievable and auditable.

Corporate data systems are used to obtain initial data sets. They are also used consistently throughout the implementation of any given improvement. This allows all stakeholders to rely on one data source as a baseline for demonstration of improvements. It also improves accuracy and engagement with the corporate system by all staff involved. This fundamental concept is key to the optimisation process.

Once a project within the programme is completed, the project engineer reports this back to the benefits team who in turn commence tracking of performance. This normally allows the team to determine whether a given project has been success within a matter of weeks, if not days. The entire programme is reliant

Davyhulme WwTW - BAFF Plant and implementation team (engineers and operators) - Courtesy of United Utilities


Sandon Dock WwTW part of the Asset Optimisation Programme - Courtesy of United Utilities

on the benefits that are implemented being sustained by those responsible for the day-to-day running of the sites. This requires engagement, knowledge and ongoing tracking of benefits.

The benefits team will maintain a remote watching brief on all delivered improvements. If performance starts to move back to pre-project levels, then suitable controls are in place (and acted upon) to maintain operational savings at the anticipated levels.

During embedment, it was also noted that the best way to help those responsible for maintaining our complex treatment processes, was to simplify the control philosophies given to them and to guarantee that the most appropriate training is given.

Successes

A recent example of one of the many successes of AOP has been the installation of real time control (RTC) to the fine-bubble diffused air (FBDA) system at Stockport WwTW. The installation was commissioned in June 2011, and the recent one-year review of the data has indicated a power saving of 12% (equating to a 23% saving when normalised for changes to MLSS production). The graph below shows the level of control of dissolved oxygen levels with the RTC running. Even with variable influent, the effluent levels remain relatively constant.

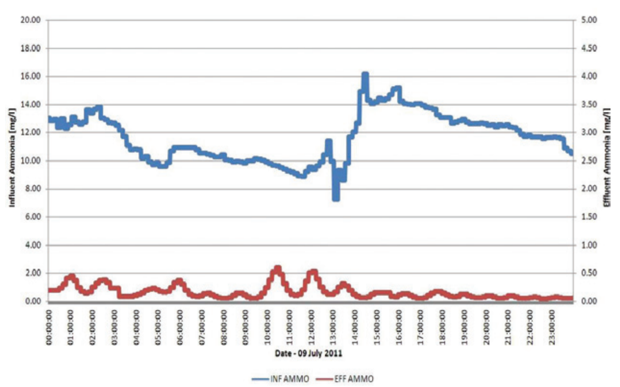

Figure 1 – Stockport WwTW FBDA Performance (One day example)

Another example of AOP in action is the improved performance and control of the BAFF treatment process at Davyhulme WwTW. A modified control philosophy associated with an alternative maintenance regime for the instrumentation has resulted in a 31% decrease in power (10,500kWh per day).

The trial of a polymer injection system at Preston WwTW (led by the AOP team) has resulted in a reduction in polymer usage down to 7.1kg/tds. This delivery system upstream of centrifuges has also improved centrate quality to 600mg/l.

The team are not only focussed on the large power savings that can be made with energy intensive aeration processes, but also the optimisation of other stages of treatment.

For example, the installation of self-adjusting brushes to the inlet screens at Warrington North WwTW, along with a lot of hard work and dedication from the site-based operatives has resulted in a 57% increase in the tonnage of screenings removed. This has had a direct and substantial effect on the amount of reactive hours spent dealing with blockages on site.

The programme has raised awareness of regional issues and as a result our maintenance department has rolled out a programme of inlet screen improvements under the title *'Inlet Screen MOT programme'* working collaboratively with our main equipment suppliers to improve screening performance.

Minor changes such as modifications to maintenance arrangements of heat exchangers and a better understanding of the science behind salt deposition within sludge systems have resulted in temperature increases at a number of sludge digestion facilities. The subsequent increase in gas production has allowed our CHP engines to run more efficiently and for longer periods.

The biggest success has been the combining of operations, engineering and capital delivery all working together with a joint goal to improve operational efficiency.

Conclusion

United Utilities Optimisation Programme has already realised a substantial sustained ongoing operational saving. This saving is forecast to increase year on year.

The programme won the Institution of Engineering & Technology (IET) Innovation award in the Asset Management category in 2011 based upon the innovative application of business improvement techniques.

This £multi-million programme has developed a model for ongoing collaborative working between operations and engineering. This has come to fruition as a business-as-usual activity by the creation of new roles within the business that are dedicated to optimisation based on the principles above.

Those within the programme have gained invaluable training and experience that will aid them in their future careers. Engineers will develop more operationally focussed designs in the future, whilst operational staff have an improved understanding of engineering theory and how to apply it to the challenges they face.

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