Maximising renewable energy generation from anaerobic digestion

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Process modelling to optimize and enhance energy generation from sludge treatment centres

The issue

Anglian Water wanted to improve their gas yields and energy production conversion rates from their nine anaerobic digester sites. They needed to combine proficiency in digital twin software platforms with expertise in wastewater plant operations so they could undertake extensive simulation modelling for treatment centres.

The solution

Anglian Water worked with Aqua Enviro, the SUEZ wastewater specialist company. The Aqua Enviro experts employed a process simulator, which combines biological, chemical and physical process models to accurately simulate the operation and performance of Anglian Water's sludge treatment assets. The team drew

upon a variety of techniques, including the use of BioWin based digital twins (Figure 1), to conduct an in-depth review. Using a controlled environment enhances confidence and limits implementation risk on-site. The digital twin facility enabled the team to identify improvements that otherwise might not have been identified.

love every drop

Figure 1: Building the model and asking the relevant questions at every stage



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How it worked

- 1. Developed a good working relationship with team at the utility company
- 2. Understood the specifics of each of the AD processes at all nine sites. The process flow schematics for the individual sites were developed and then the operational parameters were incorporated
- Replicated each one with a digital twin. The trained technicians use their knowledge of the Envirosim BioWin software to create the replicas (Figure 2)
- Validated the replicas in coordination with the Anglian Water team. This involved data collection and sampling over three weeks to calibrate and validate the model
- 5. Adjusted all the potential parameters. Once modelled, a range of dynamic simulations with various operational considerations and scenarios were conducted to identify key areas for improvement to enhance power output (Figure 3), bespoke for each site. Understanding of the subtleties of wastewater treatment plant operations is a distinct advantage here. The team:
 - a) Questioned and reviewed every stage of operations
 - Established the capacity of each type of sludge to generate energy
 - c) Understood the conversion rates for each type of AD process (CAMBI, Monsal, HpH)
- 6. Repeated this process multiple times to find the solutions that cost the least but gives the most benefit
- Identified the optimal list of operational improvements for each of the nine sites.



The results

As well as the improved energy production, the project successfully evaluated conversion rates for different AD processes (CAMBI, Monsal, HpH) and identified the Anglian Water HpH process as being industry-leading with conversion rates of >1 MW/tds. Much of what was achieved has been through operational optimisation (i.e., without further investment), around:

- better sludge conditioning
- better management of thickening process efficiency
- control of mixing sludges

The modelling pointed to the need for improved process control, monitoring and better mixing, all of which have contributed to enhanced performance and output.







Figure 2: The BioWin model

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Differentiating factors

EXPERIENCE:

The Aqua Enviro team have decades of wastewater treatment operational experience, gained across UK and overseas plants.

EXPERTISE:

Expertise in using digital twin BioWin software, which is used worldwide to design, upgrade, and optimize wastewater treatment plants of all types.

COLLABORATIVE APPROACH:

The Aqua Enviro team collaborated with the client, helping to mitigate risks around KPIs



costs from chemical consumption and enhancing energy output and revenue.

and business targets, reducing operational

The future

The models developed by the Aqua Enviro team can be reviewed and updated, thereby used as a metric to evaluate, and monitor the impact of improvements made on site. New enhancements and algorithms in the modelling programme now extend to include emissions from digestate (methane) and NOx from wastewater treatment processes.

A retrospective view of the project demonstrates that BioWin modelling is an invaluable enabler of innovation and optimisation at a strategic level. Given the complexity of the task of comparing efficiency on multiple integrated STCs, BioWin, along with the framework developed with the team at Aqua Enviro, is a powerful tool in providing successful efficiency gains and process insights. -David Inman, Innovation Projects Manager, Anglian Water



About Anglian Water

Anglian Water is a utility provider operating in the East of England. Their purpose is to bring environmental and social prosperity to the region. They do it by developing a responsible business standard, setting ambitious commitments that protect the environment embedding innovation in their values.

About Aqua Enviro

Aqua Enviro is a leading, specialist environmental consultancy, conference organiser and training provider. Aqua Enviro has its own laboratory, developing solutions for even the most complex issues. Water, wastewater, bio-resources and organic waste are just some of the sectors that their services cover.

About SUEZ

Since the end of the 19th century, SUEZ has built expertise aimed at helping people to constantly improve their quality of life by protecting their health and supporting economic growth. With an active presence on five continents, SUEZ and its 35,000 employees strive to preserve our environment's natural capital: water, soil, and air. SUEZ provides innovative and resilient solutions in water management, site remediation and air treatment, optimising municipalities' and industries' resource management through 'smart' cities and improving their environmental and economic performance.

