

Stadtwerke Trier

Optimization of wastewater treatment plant processes with the help of artificial intelligence

It is more important than ever for cities and municipalities to leverage wastewater treatment plant data to optimize operational efficiency and sustainability, given the increase in energy prices and the rising frequency of severe weather events due to climate change.

Challenge

Stadtwerke Trier (SWT) operates the main wastewater treatment plant (WWTP) in Trier, with a capacity of 170,000 population equivalents. This facility was one of the largest energy consumers in the utility for many years, with hundreds of thousands of kilowatt hours of valuable energy being drawn from the public grid as a result of poor control. Although investments in energy-efficient technology significantly reduced this consumption, intelligent control was still needed to make the existing technology more efficient and even make plant operations' energy self-sufficient.

Germany's oldest city was therefore looking for an innovative system that would simultaneously streamline the energy requirements in biological processes, increase operational safety and improve the control of chemical use. Optimization had to significantly reduce operating costs and close the energy cycle within the main wastewater treatment plant. This required coordinating energy consumption and production to prevent external energy purchases. The control system also had to ensure that the monitoring values of the wastewater treatment plant effluent were always reliably maintained.

Solution

Aquatune GmbH, which has since been acquired by Xylem, was entrusted with this project. As a first step, a real-time assistance system for wastewater treatment was implemented at the plant. The aim was to support the utility in complying with monitoring values and reduce the energy required for pressurized aeration at the biological treatment stage. The optimization system uses model-based forecasts to suggest the control variables to reliably comply with effluent values, with minimal energy consumption. Previously, only conventional controllers had been used.



Program Highlights

- >20 % less energy consumption for ventilation
- Optimized plant operation led to a drastic reduction in peak energy consumption
- Savings of approx. 4000 kWh per year, equivalent to about 50 four-person households
- Forecasting models helped to control gas production depending on consumption

Stadtwerke Trier used [Xylem Vue](#)'s Plant Real-Time Decision Support application. This technology is based on artificial neural networks, which are used to create data-driven models for the degradation of carbon, nitrogen and phosphorus compounds. The system receives all the parameters and data required for this in real time from the existing SCADA system at the wastewater treatment plant. The resulting digital twin allows for hundreds of scenarios to be simulated within seconds, so that the required aeration intensity for the biological degradation of carbon and nitrogen compounds, as well as the chemical requirement for phosphorus precipitation, are optimally controlled, depending on the current and expected load of the wastewater treatment plant.

After training the model and trial operations, the system was finally brought into service in November 2017. It now determines the optimal setpoints for pressure aeration of the six biological treatment tanks connected in parallel.

In the second step, a prediction model was created using the Plant Real-Time Decision Support application to predict energy consumption and production at the plant to intelligently control gas production.

Results

At the beginning of 2018, the optimization results of the first phase were compared with the data from previous WWTP operations. This led to the establishment of an important parameter for measuring success: the specific energy used to eliminate one kilogram of chemical oxygen demand (COD). This parameter highlights avoidable fluctuations in plant operations.

A significant reduction in these fluctuations, and thus in situational peak energy consumption, has been achieved thanks to optimized plant operations. Since the implementation of the Plant Real-Time Decision Support application, Trier's main plant has reduced energy consumption in the aeration system by over 20%. This corresponds to savings of 4000 kWh/year. All monitoring values of the effluent are also safely and continuously complied with.

