City of Kaufbeuren

Increasing energy and resource efficiency through AI-based process control

In the face of climate change and cost and supply uncertainties, cities and municipalities must operate their plants and processes as efficiently and sustainably as possible. In this context, the town of Kaufbeuren recognized significant potential for energy optimization at its wastewater treatment plant.

The challenge

The town of Kaufbeuren operates a sewage treatment plant designed for 80,000 population equivalents, incorporating nitrification, denitrification, and phosphorus removal.

The wastewater treatment plant combines a trickling filter system with an activated sludge process. This unique system results in the nitrification process taking place after the aeration stage in the trickling filters.

Due to this process combination, the wastewater treatment plant's specific energy consumption (kWh/PE·a) is relatively high compared to other municipal wastewater treatment plants.

Aeration is usually the largest energy consumer in wastewater treatment plants by far, with biological wastewater treatment using the activated sludge process. However, the use of trickling filters for nitrification means that no additional aeration is required at the Kaufbeuren wastewater treatment plant. This energy saving is offset by the pumping energy required to pump the water to the trickling filters' inlet level. Additionally, for denitrification, a large part of the effluent from the nitrification stage must be recirculated upstream to the denitrification stage, which precedes aeration. This results in multiple cycles of internal recirculation, each requiring pumping. The recirculation ratio is therefore a key factor to target potential energy savings in the wastewater treatment plant. A high recirculation ratio increases the energy demand for pumping to the trickling filters, as well as managing the internal recirculation flow and return sludge from the aeration stage.

The greatest potential for energy saving lies in minimizing the recirculation ratio, providing the quality of the wastewater treatment is not affected.

Program highlights:

- Artificial neural network trained with historical data to calculate real-time forecasts during operations.
- Digital twin to forecast system behavior and suggest optimization proposals.
- Improved energy efficiency through reduced recirculation ratios.
- Stable discharge values maintained despite operational changes.
- Annual electricity savings of between 160,000 to 190,000 kWh compared to the previous system.

The solution

Traditional methods for optimizing the energy efficiency of wastewater treatment plants involve replacing inefficient units or implementing more energy-efficient technologies. The city of Kaufbeuren has chosen the Xylem Vue Plant Management application for wastewater, which is based on artificial neural networks.

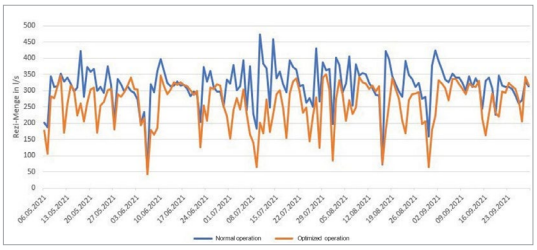
This solution is particularly resource-efficient, as the hardware does not have to be renewed or replaced. Instead, only software needs to be installed while the existing interfaces and infrastructure are retained.

The software-based control system enables automated, adaptive control of the recirculation flow without the need for additional or complex measurement technology. The artificial neural network is trained using historical data and calculates real-time forecasts during operation that adapt to changing external conditions. Although the experience and understanding of the plant operators are still important components for safe, effective plant operation, they cannot constantly monitor all the plant parameters and control them in real time, especially at night. With this system, constant monitoring is not now necessary.

The Xylem Vue Plant Management solution creates a digital twin of the process to be optimized. This can be used after being trained through the evaluation of suitable online operating data to forecast the behavior of the system and suggest optimization proposals.

Optimal operation is achieved when the system follows the setpoints generated by the neural network, which primarily aims to minimize the flow rate of the trickling filter pump by adjusting the recirculation ratio to the prevailing operating conditions.

Instead of the previous automatic control, the setpoint value of the recirculation volume flow is now specified by the artificial neural network.



Comparison between standard operations (blue) and optimized operations (orange)

The results

The implementation of the Xylem Vue wastewater treatment plant optimization system in Kaufbeuren helped the plant streamline the recirculation, return sludge and trickling filter feeding areas. As a result, annual energy consumption was reduced by between 160,000 kWh to 190,000 kWh compared to the previous non-optimized system. Importantly, these energy savings were achieved without compromising the stability of discharge values, ensuring consistent treatment quality.

Updated June 2025