Beijing Etechwin Electric Co., Ltd.

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Industry: Water & Wastewater (Sewage treatment)

About Goldwind Group
Xinjiang Goldwind Science & Technology Co., Ltd. (commonly known as Goldwind) is the leading wind power company in China and in the last twenty years has built up a wealth of experience to become the global leader. Goldwind is expanding by entering the environmental protection business, providing total solutions to help create a clean, energy-efficient society.

Leveraging its advanced technology and rich experience in the investment and management of water resources, the company has been developing into an integrated service provider for the eco-business in recent years. Accordingly, the company has brought water treatment companies such as sewage treatment facilities under its umbrella to step up its environmental improvement efforts.

Beijing Etechwin Electric Co., Ltd. (Etechwin) is a wholly owned subsidiary of Goldwind. In the Goldwind Group, Etechwin provides energy management equipment and applications by integrating diverse information related to energy management via networks.

Executive Summary and the Challenges
Yokogawa has applied its control technology and Data-Driven Modeling for Optimization (DDMO) solution to boost the operational efficiency of a sewage treatment plant owned by Goldwind Environmental Protection Co., Ltd. and operated by its wholly owned subsidiary, Shuyang Lingzhi Water Affair Company Limited.

The plant is located in the northeast of Shuyang County, and its Phase I and II facilities treat a total of 79,000 tons of sewage per day. As the plant covers an industrial area, almost the entire influent to the plant is industrial wastewater.

Industrial wastewater imposes a heavy load with large daily fluctuations, making it difficult to treat as well as creating problems for operation and maintenance. In addition, the Chinese government recently stepped up its environmental improvement efforts and set strict regulations on effluent discharged from sewage treatment facilities, with severe penalties for violating the regulations.

In order to keep the effluent quality within the statutory limits, the sewage treatment process must be operated appropriately and stably.

Particularly, appropriate aeration at each reaction tank in the treatment process is crucial because it affects the quality of discharged effluent. The air-blowing rate is usually controlled with a sufficient safety margin to ensure that the statutory limits are never exceeded, but this causes a waste of power. As the aeration tanks account for at least 40% of the power consumed by the entire plant, optimizing the power consumption of these tanks will greatly help save energy for the entire plant.

To cut the excessive power consumption, Yokogawa’s solution for optimizing the rate of air-blowing to the aeration tanks was applied. Yokogawa’s CENTUM VP distributed control system (DCS) and DDMO solution were integrated with the existing supervisory control and data acquisition (SCADA) systems to automate the equipment and optimize the energy consumption while maintaining the effluent quality below the statutory limits. As a result, the electric power consumed by the blowers was successfully reduced by approximately 25%.
The Solutions

1. Overall system concept

The plant had been using SCADA systems, and equipment was operated mainly manually, adjusting the air blowing rate if necessary according to the influent conditions.

For efficient use of energy, a DCS was added to the existing systems to automatically control the blowers associated with the reaction tanks as well as the return sludge pumps, digestion liquid circulation pumps, and sludge withdrawing pumps. In addition, the DDMO solution was combined to estimate the quality of discharged effluent.

DDMO was configured to estimate the chemical oxygen demand (COD) and ammonium (NH₄⁺) concentrations in the treated effluent to save energy while maintaining the quality of the effluent in linkage with automatic control by the DCS. A system to implement the required functions while utilizing the existing systems with appropriate investment was proposed.

DDMO helps 79,000 t/d Sewage Treatment Plant Reduce Energy Cost while Meeting Stricter Environmental Regulations in China

2. Application of DDMO

Before introducing DDMO, the expected energy saving was assessed and the design was modeled based on various data such as the inflow to the plant, water quality and power consumption. DDMO performs sophisticated calculations to estimate the effluent quality based on various historical data on water quality and flow as well as the retention time in each process, and then determines the optimum air blowing rate. This optimum rate is sent to the DCS, which then sets the air flow control setpoint. By optimizing the air blowing rate, wasted energy at the aeration tank can be greatly reduced.

3. Interlink between DCS and DDMO

To maximize the energy saving effect, the tasks of DDMO and the DCS were defined as follows:

- The DCS shall automatically control each pump to stabilize the sewage treatment process and suppress fluctuations in water quality, in order to improve the accuracy of estimation by DDMO.
- The DCS and DDMO shall be linked with each other so that automatic control will change the mode and continue to work to prevent adverse effects on plant operation even in cases where the DDMO model becomes unable to track the process due to a server failure, abrupt changes in influent quality and the like.

4. Sensor application

In sewage treatment plants, water quality data is manually analyzed on a daily basis; however, the measurements obtained by automatic online analyzers, or by modeling and estimation, are used. The calculation interval of DDMO was set to 15 minutes. Namely, DDMO estimates the effluent quality and transfers the optimum blowing rate to the DCS at 15-minute intervals.

As DDMO is configured to reflect the correlations between online data in the model formula, improving the estimation accuracy depends on selecting appropriate online data items. This time, an ammonium (NH₄⁺) sensor was added to measure the ammonium concentration at the outlet of each reaction tank. This has provided very useful data because the degree of nitrogen removal by nitrification and denitrification direct influences the nitrogen concentration in effluent.

5. Values gained

A three-month evaluation conducted after introducing the optimization system confirmed that the blower power consumption (kW/d) and consumption rate (kW/m³) were reduced by 25.1% and 24.7%, respectively. It was also confirmed that this effect continued over the following year, verifying that the reduction goal of 20% had been easily exceeded.

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The graphs below show that maintaining the effluent quality below but near the statutory limits has prevented excessive aeration which occurred in the past and saved energy. It was demonstrated that DDMO has maximized the energy saving while complying with effluent quality standards.

The optimization solution applied to this project is comprised of DDMO that models process characteristics using the latest statistical analysis technology and a DCS that performs automatic control. By clarifying the characteristics of sewer process data and sewage treatment operation and fully automating the operation, the solution brings the benefits of optimized control, improved operation efficiency and reduced operation cost in addition to saved energy.

**Customer Satisfaction**

“We are grateful for Yokogawa’s control and optimization technologies which have delivered the expected benefits. As our sewage treatment facilities consume so much energy, the entire Goldwind Group needs to work harder to save energy in the future for sustainable operation. We look forward to continuing to work together for using energy efficiently through the latest technology.”

- Zhang Guangbo, Executive Director and Managing Director, Shuyang Lingzhi Water Affair Company Limited

For more information and contact

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