Process Control System Optimizes Nutrient Removal, Saves Energy

By Manuel de los Santos

Wastewater treatment limits are getting increasingly tighter and municipalities are required to implement more advanced treatment. These requirements translate into higher cost of operation and the need for operators to become more knowledgeable on these advanced technologies.

In order to better optimize the performance of the system, plant operators have to measure and/or analyze an array of parameters including but not limited to total suspended solids (TSS), dissolved oxygen (DO), pH, oxidation-reduction potential (ORP), nitrates, ammonia and phosphate. Operators use this data to calculate the process parameters which help them make operational decisions.

As the requirements get tighter, especially with low nutrient limits, the need for more data increases exponentially and the decision making practice becomes sensitive to response time.

In-basin Instrumentation

The IntelliPro® Process Monitoring and Control System from Aqua-Aerobic Systems, Inc. was developed to help municipalities and industries meet these challenges, as well as simplifying the decision making process. The PC based process

Liquor Suspended Solids (MLSS) concentrations, Food to Mass ratio (F/M), solids retention times (SRT), aeration relational parameters, kinetic rates (nitrification, denitrification, phosphorus uptake, etc.) are calculated, as well as real-time and historical graphical representation of process parameters.

In-basin Parameters

Treatment plant optimization includes controlling chemical addition to meet low total phosphorus and low total nitrogen requirements. In this case, a process management system helps automatically calculate the actual chemical requirements, resulting in a reduction of chemical use for the plant since dosages are adjusted to real-time conditions.

Operators cannot control the influent wastewater constituents; however they can control the in-basin environment for proper treatment. The main parameters to control can be adjusted via the process monitoring and control system. The IntelliPro's Active Mode of operation can include DO control, mass control, automatic cycle and aeration system adjustment to enhance biological nutrient removal.

With in-basin DO probes, the system automatically targets a DO concentration range for nutrient removal so the blowers only operate as needed. As a result, the system can lower the plant's electrical consumption and associated carbon footprint.

The IntelliPro system is a PC based process control system that receives, interprets and proactively responds to the loading variation in the biological process.

Phosphorus, Nitrates and ORP

An important part of a plant's operation is process and mechanical troubleshooting. A significant troubleshooting feature of the process management system is the BioAlert™ notification (process alarm) program. The program automatically generates a notification when process parameters are outside typically accepted or operator-defined ranges. The operator receives a description of possible negative consequences to the process, as well as recommendations for corrective action. For non-alert type troubleshooting, an electronic Operation and Maintenance (O&M) Manual is accessible along with a wealth of supplemental online help resources such as an extensive index of micro-organisms with applicable color pictures.

Conclusion

In summary, with more reliable instrumentation and technology advancements of monitoring and control systems, treatment plant operators have more options for optimizing the biological treatment process to meet increasingly lower nutrient limits. Real-time monitoring, automatic calculation of process parameters, Active Modes of control, and process notification alerts all can contribute to a plant meeting its low level effluent requirements with the added benefits of reduced energy consumption, decreased chemical use and operator time savings. **WW**

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Reactor Conditions				
Current Status	Reactor			UOM
	1	2		
Phase:	React	Mix Fill		
Time Remaining:	30.1	30.1		Minutes
Dissolved Oxygen:	3.5	0		mg/l
pH:	7.3	6.8		
Temperature:	23.0	23.1		°C
TSS:	1,895	2,170		mg/l
ORP:	95	(253)		mv
NH₃-N:	1.47	1.35		mg/l
NO₃-N:	2.00	0.97		mg/l
PO₄-P:	0.08	1.79		mg/l
Basin Level:	11.7	10.4		feet
Current MLSS lvl:	2,262	2,302		mg/l

System Discharge Status		
WAS Flow Average:	29,120	GPD
Decant Flow Average:	0.741	MGD
Decant TSS Average:	1	mg/l

System Condition		
MLSS LWL Average Day:	2,575	mg/l
MLSS LWL Average:	2,135	mg/l
F/M Average Ratio:	0.135	days-1
SRT day:	15.1	days
SRT 30 Day Average:	8.5	days

In-basin parameters and process calculated parameters.

control system receives, interprets and proactively responds to the loading variation in the biological process. The system can help operators optimize a plant's treatment performance by calculating and storing process parameters such as nutrient removal, chemical addition and energy. It offers an Active Mode to automatically adjust the system operation to influent conditions. If process parameters are detected outside of the accepted/defined range, the system generates a notification message for operators with suggested corrective action to eliminate downtime and upsets.

Comparing real-time data with the design data is also important for decision making. The process monitoring and control system receives real-time data from the in-basin instrumentation and compares it to project specific design parameters and system set-points included in the monitoring software. Process conditions such as Mixed

The system mass (MLSS concentration) is controlled via automatic sludge waste time adjustment, targeting a specific operator adjustable set-point of MLSS, F/M or SRT. The operator simply selects the desired set-point and the system then targets that value by gradually adjusting the wasting time automatically. The mass control and cycle control saves the operators sampling time by letting the process management system automatically adjust parameters for the incoming load.

By continuously monitoring supernatant TSS concentrations, the system can detect if there are any anomalies in the process settling performance. If there is, the system notifies the operators with corrective action that can be taken manually or the parameters can be adjusted automatically in the Active Mode of operation.

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