

OSCAR system DINO controller reduces nutrient return and improves energy efficiency

Results from Green Lake, Wisconsin

Faced with rising operating costs due to increasing energy and chemical prices as well as stricter effluent permit limits, many operators and engineers are turning to sensors and automation as a means to enhance treatment performance and reduce operating costs while limited capital expenses.

In order to overcome these challenges, an advanced process control solution was implemented in an aerobic digester in Green Lake, Wisconsin. By controlling the process in a smarter way, the solution significantly reduced phosphorus and nitrogen in the returns to the main treatment process and reduced energy consumption and wear on the blower.

Plant data

The study was conducted at the City of Green Lake wastewater treatment plant in Wisconsin that uses a continuous feed ICEAS advanced SBR system (average flow = 0.2 MGD) with aerobic digestion. The digester includes fine bubble diffusers, positive displacement blowers, and a manual telescoping valve for decanting. Digester solids are sent to a belt filter press for dewatering and ultimately land application.

The digester has four zones operating in series, two in the east digester and two in the west digester. Waste activated sludge is automatically pumped from the ICEAS system into the east digester approximately every two hours. The supernatant from the digester is returned to the SBR through the telescoping valve and is manually initiated four days per week. A sludge pump is used to remove sludge from the west digester once per week.

During the study, YSI sensors measuring NH_4 , NO_3 , K, DO and ORP were installed in the east and west digesters. Additionally, a YSI orthophosphate (PO_4) analyzer (P700 model) was installed in the east digester.



TEST PLANT: Green Lake, Wisconsin
 PROCESS: Conventional Aerobic Digester
 LOAD: 5,380 GPD WAS @ 0.8%
 TEST: January 2016 - March 2017

AEROBIC DIGESTER CHARACTERISTICS

		US Units	Metric Units
Flow (ave)	gpd lpd	5,380	20,360
WAS feed	mg/L	8,000	8,000
TSS	lbs/d kg/d	359	163
WAS feed	C F	41-77	5-25
Temp	Gals m ³	185,000	700
Total Volume	days	34.4	34.4
SRT			

OSCAR system DINO controller

The aerobic digester was upgraded with an OSCAR process performance optimizer control system with DINO controller, which automatically adjusts the required aeration time in the digester based on potassium readings. The DINO controller alternates aerobic, anoxic and anaerobic conditions in the digester to optimize total nitrogen and phosphorus treatment while minimizing energy consumption.

Result: Improved Nutrient Removal and Energy Savings

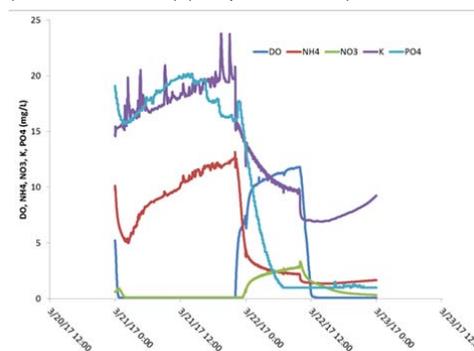
The OSCAR system with DINO controller enabled biological phosphorus removal in the digester reducing PO₄ returned to the main plant more than 90% on average. Figure 1 shows one example aerobic period where soluble PO₄ decreased more than 95%, resulting in a significant reduction in the amount of phosphorus returned to the ICEAS process via decant or solids dewatering. This reduction helped the plant reduce chemical consumption in the main treatment process by more than 50% while still meeting the effluent phosphorus permit.

The DINO controller also achieved 100% reduction in NO₃ returned to the main treatment process when compared to previous operation which was continuously aerated. Digester blower energy consumption was reduced at Green Lake by 95% compared to previous operation. Blower energy was shifted from 36% on-peak to 0% on-peak, reducing demand charges and the unit cost of energy.

Conclusions

The aerobic digester, equipped with the OSCAR system with DINO controller, enhanced digester performance by reducing nutrients (nitrogen and phosphorous) that were returned to the main treatment process by more than 90% and lowering energy consumption by more than 95%.

Figure 1. Aerobic Digester Aeration and Nutrient Removal (March 21-22, 2017) (Temperature = 7C)



DIGESTER AERATION CONTROL COMPARISON

	Fully Aerated	Using DINO controller
Blower Energy (Kwhr/wk)	3,000	160
Blower Energy (USD\$/yr)	\$11,800	\$1,500
Blower Energy (% on peak)	36%	0%
PO ₄ returned to plant (lbs/wk)	7	0.5
PO ₄ returned to plant (% influent)	15-25%	1-2%
NO ₃ returned to plant (lbs/wk)	27	0
NO ₃ returned to plant (% influent)	15-25%	0%

Fully Aerated – Blower Runs 100% of time

DINO controller – Blower is turned on at 12 AM T, W, R and the aerated time is controlled based on online measurement of Potassium