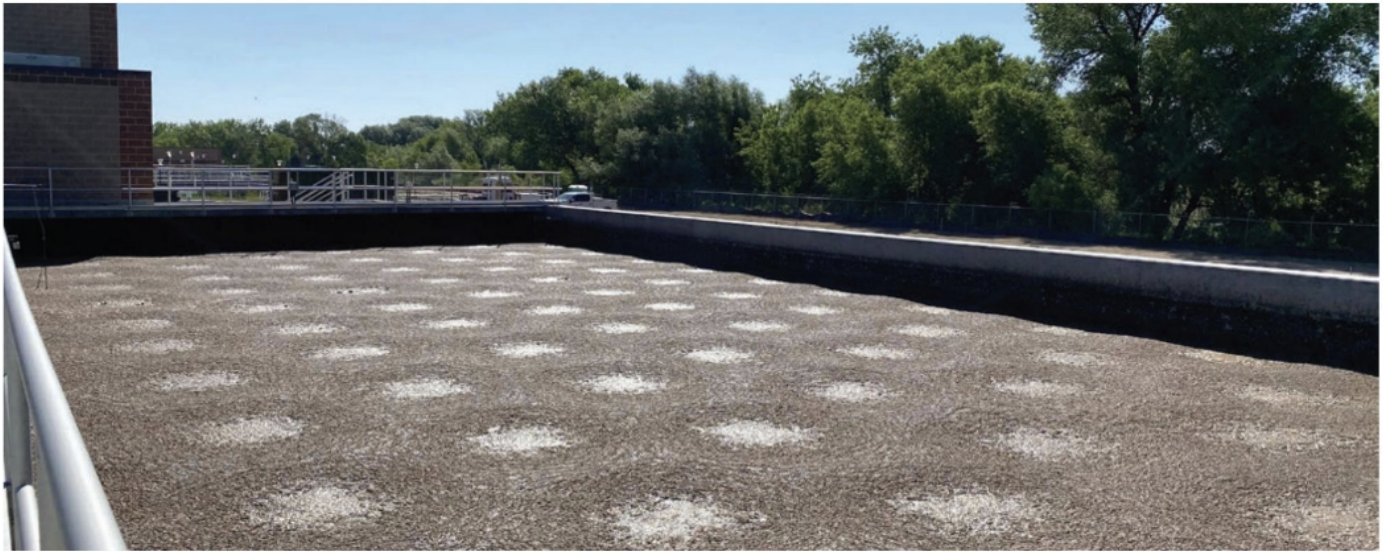


Boxelder WWTF Decouples Aeration from Mixing to Meet Stringent Effluent Discharge Limits

Taylor Jordan, Process and Innovation Engineer, EnviroMix



CGM delivers bottom-up mixing in one of Boxelder's aerobic digesters.

Organized in 1965, the Boxelder Sanitation District provides sanitary sewer services to customers near Fort Collins, Colorado. The district constructed a state-of-the-art enhanced biological phosphorus removal (EBPR) wastewater treatment facility (WWTF) in 2014 to keep pace with the rapid growth of the area.

In 2021, Boxelder expanded and upgraded the WWTF to accommodate future population growth and new stringent effluent discharge limits on nitrogen and phosphorus. Increasing capacity from 3.0 MGD to 4.6 MGD (million gallons per day), the comprehensive project encompassed many process improvements, including: UV equipment upgrades, headworks modifications, an additional oxidation ditch, two new secondary clarifiers, and two new aerobic digesters. The upgraded

facility was designed to produce effluent containing less than seven mg/L total inorganic nitrogen.

After evaluating conventional aerobic digestion alongside alternative technologies, Boxelder's design team ultimately selected EnviroMix's BioCycle-D Optimized Aerobic Digestion Process to provide volatile sludge destruction and stabilization in the new aerobic digesters.

A MORE EFFECTIVE ALTERNATIVE

In a conventional aerobic digestion process, aeration is used to both provide the oxygen needed for digestion and completely mix the tank contents. Automated process control and instrumentation feedback are rarely incorporated. This approach results in over-aerating the digester, leading to high energy consumption and excessive amounts of nitrogen recycled back to the secondary process.

BioCycle-D is designed with a diffused aeration system to satisfy process oxygen demand and a compressed gas mixing system to satisfy mixing requirements. This decoupling of aeration from mixing facilitates independent control over oxygen delivery and mixing operation.

Through online sensor feedback, the controller automatically transitions between an aerobic cycle for volatile solids destruction and nitrification to an anoxic cycle for denitrification, alkalinity recovery, and energy savings. Alternating aerobic and anoxic conditions optimize digestion and prevent over-aeration.

Prior to 2021, Boxelder utilized a sludge storage lagoon that recycled high amounts of nutrients to the secondary process, reducing efficiency and necessitating expensive sludge removal. Before the upgrade, Boxelder was spending around \$400,000 annually to dredge out its waste stabilization pond.

RESULTS: SOLIDS RETURN STREAM NITROGEN CONTENT

The EPA estimates that typical side-stream nitrogen loads are between 15 and 50% of the load on the secondary process (Bilyk, Taylor, Pitt, and Wankmuller 2011). Boxelder successfully reduces the ammonia and nitrate concentrations in the digester supernatant and pressate return streams sent back to the head of the plant.

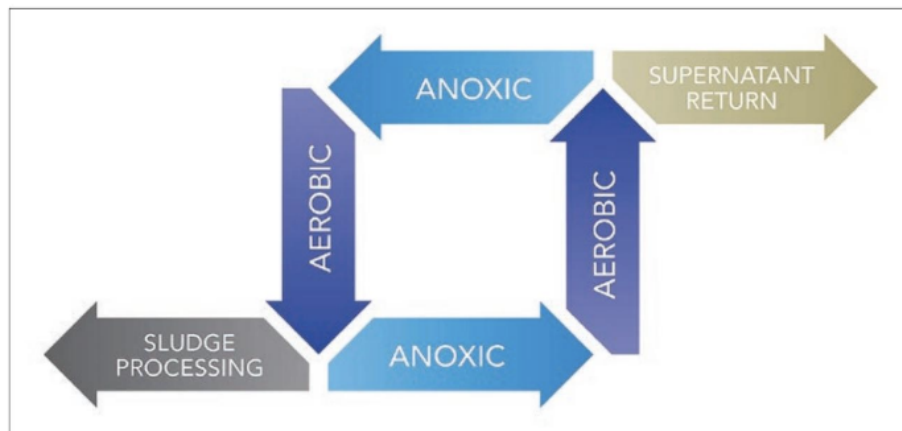
Figure 2 displays levels of ammonia and nitrate in Boxelder's pressate return. For comparison, anaerobic digestion return streams typically contain ammonia concentrations of 300-900 mg/L, while conventional aerobic digestion return streams typically contain nitrate concentrations of 50-200 mg/L.

"Very shortly after [BioCycle-D] startup, it was clear that nitrate in the return stream was really low – like less than one part – and it didn't require much effort," stated Craig Hibbard, plant manager. "Having low concentrations of both ammonia and nitrate in our return streams has helped us achieve the lowest total nitrogen discharge levels in the state of Colorado for a couple of years now."

In Figure 3, blower operation is indicated by the yellow curve in the graph – 1.00 indicates the blower is enabled; 0.00 indicates the blower is off. Controlled on a time cycle, the blower is running for one hour and then off for 30 minutes.

The DO concentration, shown in dark blue, indicates when the digester is in an aerobic or an anoxic environment. When conditions in the digester are aerobic, nitrification occurs, and ammonia is converted to nitrate. When conditions in the digester are anoxic, denitrification occurs and nitrate is converted to nitrogen gas, which leaves the system.

The cycling between aerobic and anoxic conditions not only reduces nitrogen in return streams, but it also maximizes volatile solids destruction, which is required for class B biosolids suitable for land application. Boxelder meets its class B biosolids permit year over year with a fecal coliforms geometric mean of ~35,000 CFU/g, far below the limit of two million CFU/g.



BioCycle-D is based on automatically rotating aerobic and anoxic cycles.



Compressed gas mixing nozzles integrate easily with aeration equipment.

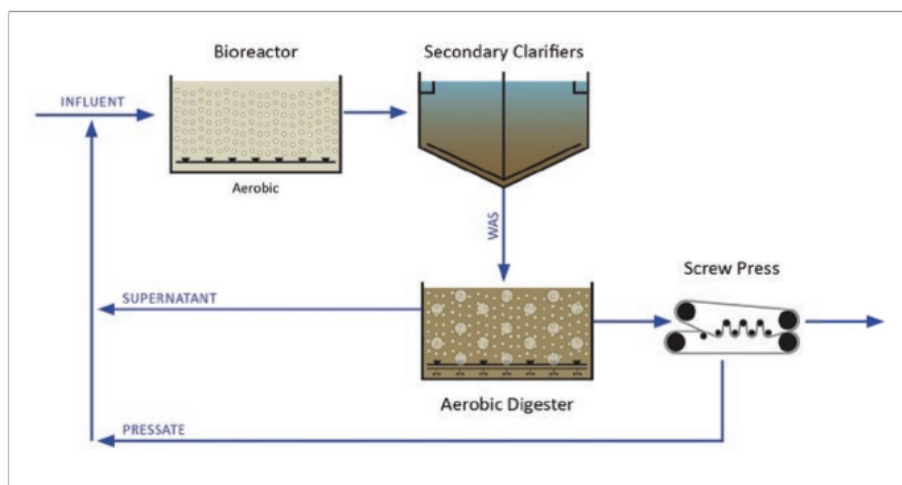


Figure 1. Boxelder's secondary process configuration.

Date	Pressate Return NH ₄ -N (mg/L)	Pressate Return NO ₃ -N (mg/L)
July 19, 2022	2.6	4.3
August 22, 2022	0.4	0.3
Sept. 9, 2022	1.4	No Test Run
Sept. 14, 2022	0.4	0.2
June 13, 2024	1.7	0.2
June 20, 2024	4.1	0.3
June 26, 2024	2.5	0.2
July 3, 2024	3.0	0.1
AVERAGES	2.0	0.8

Figure 2. Levels of ammonia and nitrate in the pressate return.

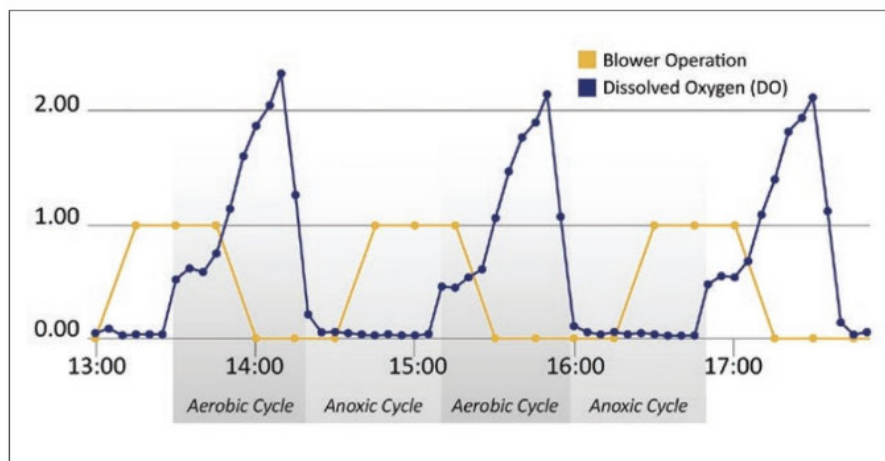


Figure 3. July 2024 data from an aerobic digester at Boxelder.

OVERALL BENEFITS

The cyclic aeration controls substantially reduces ammonia and nitrate levels in both the digester supernatant and pressate return streams, preventing nitrogen spikes in the secondary process. By utilizing the decoupled system, Boxelder reduced energy consumption by 75% versus conventional aerobic digestion.

"I'm very pleased with the energy use. The power needed for the digesters is much less than we were anticipating," Mr. Hibbard commented. Regarding maintenance, he added, "We don't have any subsurface mixers we have to haul out of there that could get fouled. 90% of the repairs are doable above ground."

By choosing this technology instead of conventional diffused aeration to mix the new aerobic digesters, it is estimated that Boxelder and the community it serves are saving \$175,000 annually.



Taylor Jordan is a process and innovation engineer at EnviroMix. Taylor focuses on biological nutrient removal and secondary treatment

biology at the design, modeling, controls, operations, and startup phases of a project. •

Loyalty at Lakeside as Dan Widdel becomes new President

Dan Widdel has become the new President of Illinois-based Lakeside Equipment Corporation, who since their formation back in 1928, have become a highly renowned provider of wastewater treatment systems, including screens, grit collectors, clarifiers, screw pumps, and biological processes.

With Lakeside for 25 years, Dan steps up to replace retiring President, Karen Wolk, who served the employee-owned company for 40 years. Karen had been in the head role for the past three years, following the sudden passing away of Lakeside's much-admired President, Steve Eckstein.

"This is a huge honour for me to follow in the footsteps of those who have led Lakeside Equipment Corporation so diligently for almost a century," said Dan Widdel.

"Despite some challenging times in our long history, including the Pandemic, and the tragic loss of our former President, we have stuck together as a very solid team, determined, no matter what, to deliver the very best solutions for our customers. I would like to sincerely thank Karen Wolk for her huge contribution in pushing Lakeside forward."

Jim Snyder (Lakeside's Production Manager), who has been with the business for 43 years, moves up to become joint Vice President, sharing the new mantle with Jim McKee (National Sales Manager), who has been at Lakeside for 25 years.

Meanwhile, Jamie Marshall has joined Lakeside as its new Controller. She recently completed her Master of Business Administration, together with achieving a human resources graduate certificate.



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