



evoqua
WATER TECHNOLOGIES



VLR[®] SYSTEM FOR BIOLOGICAL TREATMENT

ADVANCED NUTRIENT REMOVAL WITH HIGH EFFICIENCY AERATION

PROVEN COST-EFFECTIVE WASTEWATER TREATMENT

Experience & Performance

Evoqua's Vertical Loop Reactor system, an extension of the Orbal® system is an activated sludge process that was introduced in 1986. With over 100 installations across the world and flows ranging from 0.2 MGD to 42 MGD, the VLR® system has been on the leading edge of implementing simultaneous nitrification-denitrification (SND) plant designs for over 30 years. Each system is designed with the intent of meeting the most challenging nutrient removal issues at the lowest operational cost.

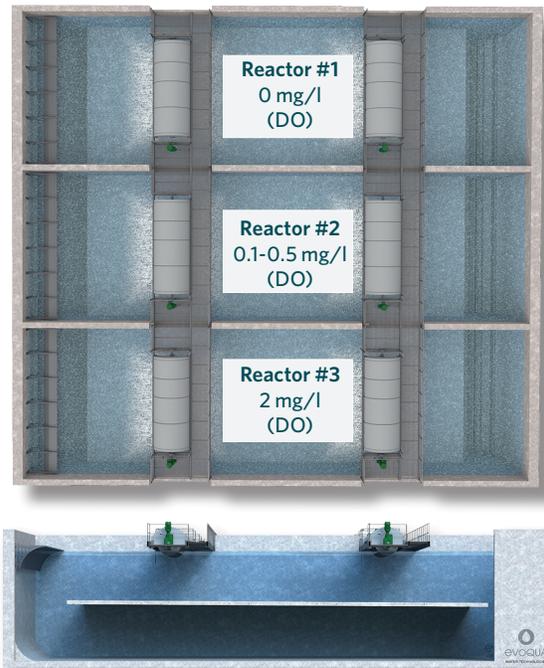
Biological Wastewater Treatment

Secondary wastewater treatment systems account for approximately 60% of the overall energy consumption of a conventional wastewater treatment plant. According to Metcalf & Eddy, electricity requirements for wastewater treatment plants in the United States in the next 20-30 years are expected to increase by an additional 30-40%. Therefore, it is paramount to not only select the most efficient aeration device and biological treatment process to meet treatment objectives.

The simultaneous nitrification-denitrification (SND) biological process is the backbone of the VLR system design, which can reduce energy consumption up 35% in comparison to other traditional conventional activated sludge (CAS) processes. A typical VLR system includes two or more tanks installed in series or side by side, creating dedicated zones for specific treatment purposes. Each treatment zone operates at different dissolved oxygen (DO) levels to create a biological environment conducive for SND and biological nutrient removal (BNR) treatment.

The VLR System & Operation

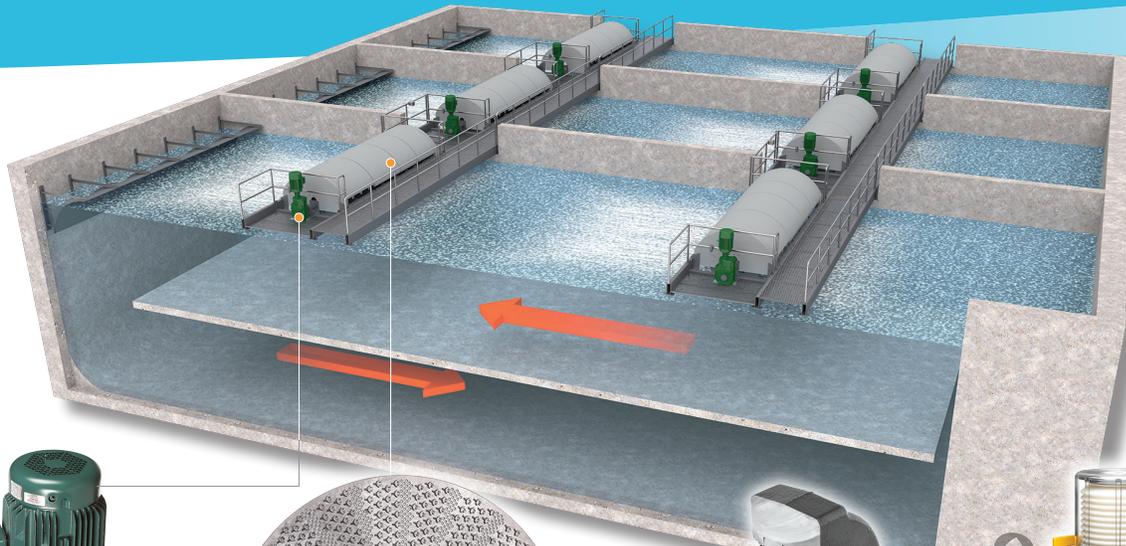
A typical VLR system utilizes a rectangular tank with a horizontal baffle running the length of the tank. Both mixing and aeration are provided from Evoqua's surface mounted Ox™ disc aerator assembly allowing for ease of maintenance without having to dewater the tank.



Typical VLR system Plan View and Cross-Section View utilizing surface mounted disc aerators providing both aeration and mixing.

In the first tank, influent and return activated sludge (RAS) enter the first reactor and operate under an oxygen deficit (aerated-anoxic) condition to promote SND. By design, aeration discs installed in the first reactor supply between 40-70% of the total oxygen requirement for the system. The design also ensures a constant oxygen deficit condition throughout the reactor with a DO set-point of 0 mg/L. The vast majority (between 50-70%) of the system's nitrification takes place in the first reactor where the anoxic condition also drives denitrification. This is the true definition of an SND biological treatment system.

During the next step of the process, mixed liquor flows hydraulically to the second reactor where DO conditions swing depending on daily flow and load variations. Finally, the mixed liquor flows to the third reactor where the DO is designed to operate around 2.0 mg/l. In the last reactor, final treatment takes place in a surplus oxygen condition.



Direct drive gearboxes for OX™ Disc Aerator reduce maintenance and increase operating efficiency by seven percent vs. belt driven gear boxes.



The Ox™ Disc Aerator, made of a durable, high-density, polystyrene delivers both oxygen and mixing to the VLR® System.



Extended bearing life due to its ability to handle greater degrees of misalignment.



Evoqua's Auto-Greasing System is a standard feature providing easy maintenance of the bearings lasting up to three months on a single grease cartridge.

SmartBNR™ Process Control System

As previously noted, the biological aeration system typically consumes the most power in a wastewater treatment plant. Evoqua's process engineers work closely with electrical engineers to optimize power consumption and process effluent quality for the VLR® system. The SmartBNR controls utilize a touch screen operator interface with ORP and DO analyzers to continuously monitor and adjust aerator speeds automatically with VFDs based upon actual wastewater conditions and characteristics of the disc aerator.

The SmartBNR control system also provides remote access to the system control screens for process analysis and adjustments.

VLR System Advantages

Energy Savings - SND biological process can save up to 35% on energy consumption compared to a typical conventional activated sludge (CAS) process due to the fact that a large volume of the treatment is done in a low DO environment.

Biological Nutrient Removal - The VLR system is a flexible, reliable solution for enhanced BNR treatment that can easily adapt to changing total nitrogen (TN) and/or total phosphorus (TP) regulations.

Stormflow Mode - During stormflow mode, influent is diverted to the second reactor, while the RAS solids are stored in the first reactor, reducing solids loading on the clarifiers and to prevent any loss of biological treatment during peak flow events.

Plant Footprint - VLR system tanks can be constructed up to 22 feet of SWD reducing the required footprint of the treatment system. Deeper tanks coupled with common wall construction reduce the initial cost of the secondary treatment system. Additionally, independent anoxic tanks and their associated equipment are not required for BNR treatment.

Flexible Design & Operation - Reactors in series meet state redundancy requirements and operational flexibility to meet the variations in influent flows and loads on a daily basis. Expanding capacity can be accomplished by adding tanks or more disc aerators with the reactors in series configuration.

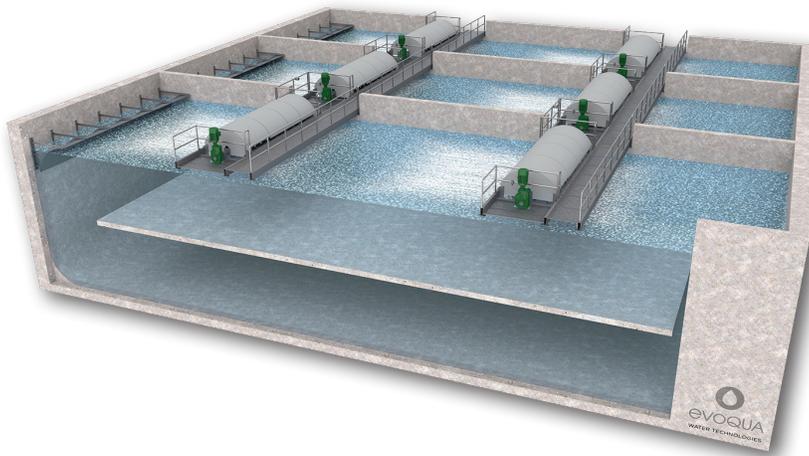


ONE OF THE LARGEST VLR® SYSTEMS IN THE UNITED STATES

The Sangamon County Water Reclamation facility located in Springfield, IL was able to increase treatment capacity from 20 MGD to 32 MGD with Evoqua's VLR System. Aeration energy was reduced from 1200-1500 HP to 500 HP resulting in a cost savings close to \$1.2 million annually along with an associated reduction in the local power utility carbon footprint.

VLR System Effluent Quality:

Assuming typical influent municipal wastewater characteristics, effluent quality of a VLR system can be further improved with the configuration of the VLR system outlined to the right.



Configuration	Effluent (mg/L)*
2 reactors in series	BOD<10 TSS<10 Ammonia<1 TN<15
3 reactors in series	BOD<10 TSS<10 Ammonia<1 TN <10 TP <1
3 reactors in series with internal recycle	BOD<10 TSS<10 Ammonia<1 TN<5
3 reactors in series with internal recycle and anaerobic selector	BOD<10 TSS<10 Ammonia<1 TN<5 TP<1
3 reactors in series with internal recycle and anaerobic selector and post-anoxic zone	BOD<10 TSS<10 Ammonia <1 TN<3 TP<1

* TP w/o chemicals

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