



LagoonGuard™ 0°C

Lead-Lag Biofilm Reactor (LLBR)

WATER TECHNOLOGIES

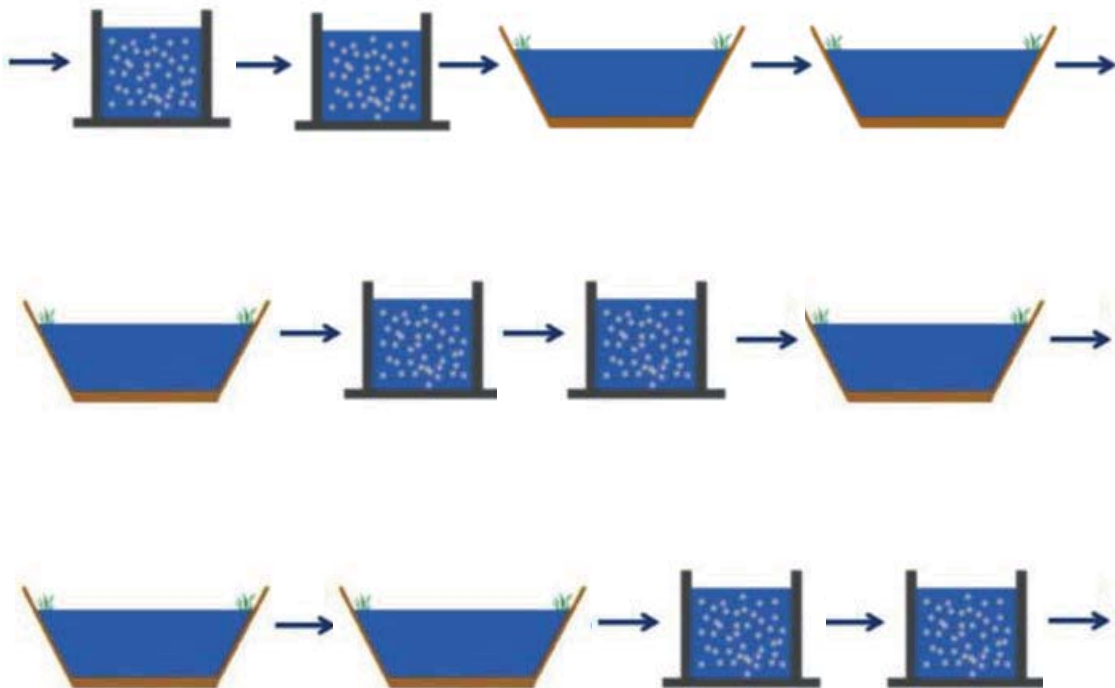
LagoonGuard™ 0°C - LLBR Benefits

AnoxKaldnes LagoonGuard™ 0°C LLBR

Today's municipalities and operators using facultative or aerobic wastewater treatment lagoons are facing the challenge of increasingly stringent effluent ammonia regulations under extremely low temperatures posing both space and financial challenges. To solve the challenges, Veolia revolutionized its LagoonGuard™ technology with an innovative lead-lag design to maximize biofilm growth and biomass inventory on media carriers to ensure efficient treatment performance under low temperatures with the smallest footprint and lowest capital costs. The lead-lag biofilm reactors (LLBR) have the following characteristics: 1. two reactors in series, each reactor periodically takes lead in receiving flows; 2. flow through system without recycle; 3. moving bed media carriers with high protected surface area; 4. stainless steel medium bubble aeration diffusers and media retaining screens. The LagoonGuard™ 0°C LLBR has the following advantages:

- Guaranteed performance at a temperature as low as 0.5°C
- Innovative and patented lead-lag reactor design
- Significantly smaller footprint than other technologies
- Lower construction and capital costs
- Easy to maintain and operate
- Lower energy costs due to use of medium bubble diffusers with increased oxygen transfer efficiency
- Single system supplier for all process equipment including media, screens, air grids, controls, instrumentation, blowers, valves and if required, headworks screens and discfilters

LagoonGuard™ 0°C LLBR Configurations



LagoonGuard™ 0°C - LLBR Components

AnoxKaldnes AnoxK™ 5 Media

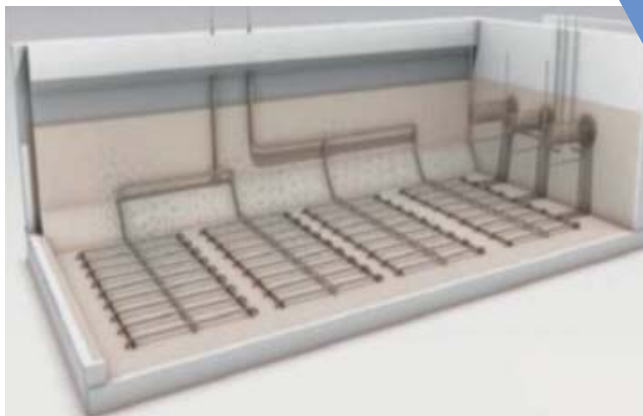
AnoxK™5 media provides the guardian structure for biofilm growth found in the LagoonGuard™. The media offers 800 m²/m³ of protected surface area for the biofilm. The incredible amount of surface area provides a large biomass inventory that remains fixed in the reactor. This eliminates the risk of biomass washout (especially nitrifiers) and significantly reduces the retention time, and therefore the footprint in the system. The hydraulic retention time in the LagoonGuard is within hours as compared to days in earthen or rock basins.

Media volume can be up to 55% the reactor volume. Typical designs allow for significant expansion of the treatment capacity simply by adding media.

The AnoxK™ series are made of virgin, high density polyethylene. This media is built to last and has proven the ability to be in long-term operation without degradation or media replacement.



LagoonGuard™ Reactor Cell



- LagoonGuard stainless steel air diffuser system is robust, non-clogging and maintenance free.
- Medium bubble air grids provide the oxygen and mixing needs for optimal biological performance. Diffusion through MBBR media results in increased oxygen transfer, saving more energy than coarse bubble systems.
- Cylindrical screens at the reactors effluent wall retain media, while allowing treated water to pass through.
- Reactors are sized to allow for media addition, increasing the treatment capacity within existing cells.

LagoonGuard™ 0°C LLBR Systems Include

- Complete process design with equipment warranty and effluent guarantee
- Equipment: media, air grid, blowers, screens, pumps, valves, meters and analyzers
- Controls: Veolia standard (A-B) or customized Control panel, PLC and HMI



LagoonGuard™ 0 °C - LLBR Complete Solution

TSS & Phosphorous Removal

Veolia is able to support the entire process train with in-house expertise and a complete line of technologies.

Hydrotech™ Discfilters

Similar to the new lower limits for ammonia, TSS and Total Phosphorus, effluent limits are becoming more stringent. Thus, a TSS and/or phosphorus removal stage may be required after the LagoonGuard™ process. Veolia's Hydrotech™ Discfilter is an operator friendly and low maintenance equipment for removal of TSS and phosphorus to low levels. For TSS polishing only, the Hydrotech Discfilter can typically achieve the regulation without chemicals. When the Hydrotech Discfilter is also used for achieving low effluent phosphorus concentrations, coagulant and polymer may be required. The Hydrotech Discfilter can achieve $TP \leq 0.1 \text{ mg/L}$ in the effluent with a Veolia chemical coagulation/flocculation process that will optimize chemical usage.

HYDROTECH™ series 2200 & 2600

Flow rates per unit	2200 series up to 9 MGD 2600 series up to 15 MGD
Process	Inside out filtration
Backwash Reject	~1-2% of treated flow
Effluent	TSS $\leq 5 \text{ mg/L}$, TP $\leq 0.1 \text{ mg/L}$



Influent Screening

If the LagoonGuard reactor is placed in front of the lagoons or to eliminate large solids and debris from entering the reactor, Veolia offers a full line of headworks equipment such as the ROTARC screen that can be installed in a channel or a tank. In typical lagoon applications, the screened solids are removed once per week from the wastewater treatment plant site and hauled off for disposal.

LagoonGuard™ - Performance Data



Neepawa, MB Commercial Demonstration

Operational Time: Dec 2016 to April 2017

Application: Post-Lagoon Nitrification

Discharge: Continuous

Effluent Ammonia Objective: < 5 mgNH₄-N and non-acutely lethal to rainbow trout

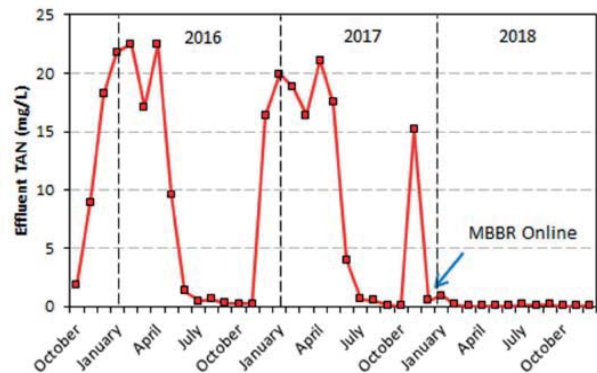
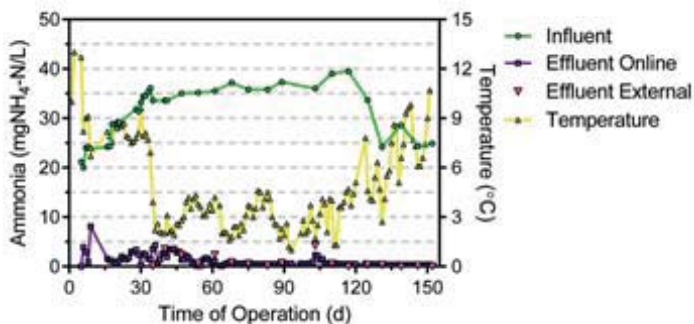
- Minimum WW temperature 0.6°C
- Effluent ammonia objective met
- Effluent passed acute lethality testing 0% mortality
- Process robust to changing conditions
- LagoonGuard™ preselected for upgrade

Wray, CO Municipal Installation

Operational: Since 2017

Design: Hybrid MBBR/Discfilter solution operating with or without lagoon with simple flow through process in a small footprint

- Doubled the wastewater treatment capacity (0.25 MGD to 0.5 MGD)
- Lowered the amount of organic and inorganic material without clarifiers
 - BOD < 10 mg/L
 - NH₃-N < 1 mg/L
 - TSS < 10 mg/L



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